Course Title: **Data Structure and Algorithms Lab**		Course Code: **19ECSP201**
L-T-P: **0-0-2**	Credits: **2**	Contact Hrs: **4 hrs/week**
ISA Marks: **80**	ESA Marks: **20**	Total Marks: **100**
Teaching Hrs:**56 hrs**	Exam Duration: **3 hrs**	

Tentative plan of lab Implementation

Week No	Lab Assignments
1	02 Programming Assignments on Basic Data structures
2	
3	02 Assignments on Algorithm Efficiency Analysis
4	
5	02 Assignments on Trees
6	
7	02 Assignments on Sorting and Searching
8	
9	04 Assignments on Graphs and Design Techniques
10	
11	
12	
13	Open Ended Experiment

Materials and Resources Required:

Text Books:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein. Introduction to Algorithms, Third Edition (3rd ed.). The MIT Press. 2009.
2. Anany V. Levitin. 2002. Introduction to the Design and Analysis of Algorithms. Addison-Wesley Longman Publishing Co., Inc., Boston, MA, USA.

Reference Books:

1. Hemant Jain, Problem Solving in Data structures and Algorithms Using C, TaranTechnologies Private Limited, 2016
2. Online Sites: HackerRank / CodeChef

Program: Bachelor of Engineering		
Course Title: Object Oriented Programming with C++		Course Code: 18ECSC207
L-T-P: **3-0-0**	Credits: **3**	Contact Hrs: **3 hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **40**	Exam Duration: **3hrs**	

Unit –I		
1	**Chapter No. 1: Introduction:** Introduction to object oriented programming. Characteristics of object oriented languages, Programming Basics, arrays, Functions in C++ (parameter passing techniques.)	**4 hrs**
2	**Chapter No. 2:Classes and Objects:** Introduction to Classes and Objects, encapsulation visibility modifiers, constructor and its types, nested classes, String class. UML diagrams to describe classes and relationships.	**6 hrs**
3	**Chapter No. 3:Inheritance:** Introduction, types of Inheritance, constructors, Abstract class,Aggregation: classes within classes	**6 hrs**
	Unit –II	
4	**Chapter No. 4:Virtual Functions and Polymorphism:** Virtual functions, Friend functions, static functions, The 'this' pointer	**6 hrs**
5	**Chapter No. 5:Templates and Exception Handling:** Function and class templates.Introduction to exceptions, Throwing an Exception, Try Block, Exception Handler (Catching an Exception), Multiple exceptions. Exceptions with arguments	**6hrs**
6	**Chapter No. 6:Design Patterns:** Creational, Structural and Behavioural design patterns.	**4 hrs**
Unit –III		
7	**Chapter No. 7:Streams and Files:** Stream classes, File I/O with streams.	**4 hrs**
8	**Chapter No. 8:Standard Template Library:** container classes: Sequence and Associative Containers	**4 hrs**

Textbooks

1. Robert Lafore, "Object oriented programming in C++", 4th Edition, Pearson education,

Reference Books

1. Lippman S B, Lajorie J, Moo B E, C++ Primer, 5ed, Addison Wesley, 2013.

2.	Herbert Schildt: The Complete Reference C++, 4th Edition, Tata McGraw Hill

Program: Bachelor of Engineering		
Course Title: **Object Oriented Programming with C++ Lab**		Course Code: **18ECSP203**
L-T-P: **0-0-1.5**	Credits: **1.5**	Contact Hrs: **3 hrs/week**
ISA Marks: **80**	ESA Marks: **20**	Total Marks: **100**
Teaching Hrs: **39**	Exam Duration: **3hrs**	

Experiments	**Lab assignments/experiment**
2-Demonstration	Introduction to Code Blocks IDE (Integrated Development Environment), C++ programming basics.
4–Exercise	Classes and objects, Inheritance, Polymorphism, Templates and Exceptions Handling
2-Structured Enquiry	Classes and objects, Inheritance, Polymorphism, Templates and Exceptions Handling
1-Open Ended	Data types, Classes and Objects, Inheritance polymorphism, Exception Handling. Design patterns

Text Book:

1. Robert Lafore, "Object oriented programming in C++", 4thEdition, Pearson education.

Reference Books:

1. Lippman S B, Lajorie J, Moo B E, C++ Primer, 5ed, Addison Wesley, 2013.
2. Herbert Schildt: The Complete Reference C++, 4th Edition, Tata McGraw Hill

1.

Evaluation :

Students Assessment Through CIE (80%) + SEE (20%)

Continuous Internal	Assessment	Weightage in Marks

Evaluation (80%)	Exercises	40
	Structured Enquiry	20
	Open Ended Experiment	20
Semester End Examination (20%)	Structured Enquiry	**20**
	Total	**100**

Program: **Bachelor of Engineering**		
Course Title **Scripting Languages Lab**		Course Code: **18ECSP201**
L-T-P: **0-0-2**	Credits: **2**	Contact Hrs: **4hrs/week**
ISA Marks: **80**	ESA Marks: **20**	Total Marks: **100**
Teaching Hrs: **30**	Exam Duration: **3 hrs**	

1	**Introduction to UNIX Utilities** Architecture, Commands, File Attributes, vi Editor, Process, Simple Filter, File System, Handling Files and Basic File Attributes.	**06hrs**
2	**UNIX shell Scripting** Shell Basics, Shell Environment, Shell Script Programming Concepts, Decision Structures, Looping Structures, and Command line arguments, Functions and Arrays, Regular Expression & Filters, Processes.	**06hrs**
3	**Python Scripting** Python: Types, Variables, and Simple I/O, Branching and Looping, String Manipulation,Numbers, Lists and Dictionaries, Regular Expressions, Functions, Files and Exceptions, Programming using numpy and scipy libraries.	**12hrs**
4	**System Administration** Common administrative tasks, creating and mounting file system, File system management, managing users and group accounts, monitoring system performance, accessing system information, backup and restore files, reconfiguration hardware with kudzu, installing and removing packages.	**06 hrs**

Tentative plan of lab implementation

Expt./ Job No.	Lab assignments/experiment	No. of Lab. Slots per batch (estimate)
1-2	Introduction to UNIX Utilities	02
3-4	Shell Script	03
5-10	Python programming	05
11-12	System Administration	02

Text Books
1. Sumitabha Das, UNIX Concepts and Applications", 4th Edition, McGraw-Hill, 2017. 2. Mark Lutz, "Programming Python", 4th Edition, O'Reilly, 2010.
Reference Books
1. Noah Gift, Jeremy Jones, Python for Unix and Linux System Administration, 2008. 2. RytisSileikam, Pro Python System Administration, 2nd Edition, 2014 3. Michael Dawson, Python Programing for the Absolute Beginner, Premier Press, 3rd Edition 2010.

Program: Bachelor of Engineering		
Course Title: **Operating System Principles and Programming**		Course Code: **18ECSC202**
L-T-P: **4-0-1**	Credits: **5**	Contact Hrs: 4+2**hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **74**	Exam Duration: **3 hrs**	

Unit –I		
1	**Chapter No. 1. Introduction and Systems structures** Operating system definition; Operating System operations; Modules of OS ,Overview of UNIX Operating System,UNIX APIs	04 hrs + 02 hrs (lab)
2	**Chapter No. 2. Process Management** Process concept; Process scheduling; Operations on processes; Inter-process communication (Pipes and FIFOs). Threads, Process Scheduling: Basic concepts; Scheduling criteria; Scheduling algorithms. Process management using UNIX APIs**:** Process Management Functions, User IDs and Group IDs, Creating process, parent child relationship.	10 hrs + 08 hrs (lab)
3	**Chapter No. 3. Process Synchronization**	06 hrs +

	Synchronization: The Critical section problem; Peterson's solution; Semaphores, Classical problems of synchronization, Process synchronization UNIX APIs.	02 hrs (lab)
Unit –II		
4	**Chapter No. 4. Deadlocks** Deadlocks: System model; Deadlock characterization; Methods for handling deadlocks; Deadlock prevention; Deadlock avoidance; Deadlock detection and recovery from deadlock.	06 hrs + 02 hrs (lab)
5	**Chapter 5 : File management** File concepts, Directory structure, File Types , File systems , File Attributes, Inodes in UNIX , UNIX Kernel Support for Files, Directory Files, Hard and symbolic names. General File APIs: File and record lock API, Symbolic file API	07 hrs + 04 hrs (lab)
6	**Chapter No. 6. Memory Management** Memory Management Strategies: Background; Swapping; Contiguous memory allocation; Paging; Segmentation. Virtual Memory Management: Background; Demand paging; Page replacement.	07 hrs + 02 hrs (lab)
Unit –III		
7	**Chapter No. 7. Secondary Storage Management** Mass storage structures; Disk structure; Disk attachment; Disk scheduling; Disk management.	5hrs
8	**Chapter No. 8. Case study** Architecture of Mobile OS - Introduction. .Overall Architecture, Linux Kernel, various components, Network OS, Applications.	5hrs
Text Books 1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne: Operating		

System Principles, 9th edition, Wiley-India, 2006. 2. W. Richard Stevens, Stephen A. Rago, “Advanced Programming in the UNIX Environment”, 3rd Edition, Addison Wesley Professional, 2013
References 1. William Stallings,”Operating System Internals and Design Principles”, 5th edition, Pearson Education, Asia, 2005 2. Gary Nutt,” Operating System”3rd edition, Pearson Education,2004 3. Terrence Chan, “Unix System Programming Using C++”, 1 ed., Prentice Hall India, 2007 4. Marc J. Rochkind, “Advanced Unix Programming”, 2nd Edition, Pearson Education, 2005.

Program: **Bachelor of Engineering**		
Course Title: **Product Realization**		Course Code: **17ECSP203**
L-T-P: **0-0-2**	Credits: **02**	Contact Hrs: **03 Hrs**
ISA Marks: **80**	ESA Marks: **20**	Total Marks: **100**
Teaching Hrs:	Exam Duration:	

Experiments	Lab assignments/experiment
Week 1 And Week 2	IOT workshop: Introduction to Android studio, Introduction to Arduino programming, PHP
Week 3	Selection of UI and Core Component of Android
Week 4	UI implementation using XML
Week 5	UI implementation and validation
Week 6	Android core component implementation and Unit Testing
Week 7	Android core component implementation and Unit Testing
Week 8	Android core components integration and testing
Week 9	Configuration of IoT Server
Week 10	Integratesubsystems for prototype testing, Analyze the test results, System modification, and System integration.
Week 11	System Testing

Reference:

1. Beginning Android Programming with Android Studio by J.F. DiMarzio

Program: Bachelor of Engineering		
Course Title: **Engineering Design Practice [Part B] [Part A – Central Level]**		Course Code: **17ECSP202**
L-T-P: **0-0-1.5**	Credits: **1.5**	Contact Hrs: **3 hrs/week**
ISA Marks: **40**	ESA Marks: **0**	Total Marks: **40**
Teaching Hrs: **39 hrs**	Exam Duration: **3 hrs**	

Experiments	Lab assignments/experiment
Phase 1 (Plannig)	Introduction to Eclipse –IDE Requirement modeling : • Identifying use cases and actors • Apply UML notations to draw use case diagram
Phase 2 (Conceptual Design)	Behaviour Modeling using DFD • List behavior of system/sub-system • List states, tasks and their dependencies Illustrate DFD : • Identify data flow and processes of a system • Draw data flow diagrams for system/sub-system • Draw system diagram to show interaction of all domain components (Draw state and sequence diagram for identified tasks)
Phase 3(System Design)	Software Architectures: • List components of architecture • List type of architectures Choose appropriate architecture for given system
Phase 4 (Detail Design)	UI Design using GUI wireframe: • Design function prototyping for event diagrams(DFD) • Identify user interface components • Choose appropriate property of component • Use wireframe to design a user interface
Text books: 1. Ian Somerville, Software Engineering, 9th, Pearson Ed, 2015 2. Clive L Dym and Patrick Little, "Engineering Design: A Project Based Introduction", John Wiley & Sons	
Reference books: 1. Roger S. Pressman, Software Engineering: A Practitioners Approach, 7th, McGraw, 2007 2. Shari Lawrence Pfleeger and Joanne M. Atlee, Software Engineering Theory and Practice,	

	3rd, Pearson Ed, 2006
3.	Jalote, P, An Integrated Approach to Software Engineering, 3rd, Narosa Pub, 2005

Program: Bachelor of Engineering		
Course Title: **Database Management System**		Course Code:**15ECSC208**
L-T-P: **4-0-0**	Credits: **4**	Contact Hrs: **4 hrs/week**
CIE Marks: **50**	SEE Marks: **50**	Total Marks: **100**
Teaching Hrs: **50**	Exam Duration: **3** hrs	

Unit –I		
1	**Introduction and ER Model:** Introduction to DBMS and an example ; Data models, schemas and instances; Three-schema architecture; Database languages; Using High-Level Conceptual Data Models for Database Design; An Example Database Application; Entity Types, Entity Sets, Attributes and Keys, Relationship types, Relationship Sets. Roles and Structural Constraints; Weak Entity Types; Refining the ER Design; ER Diagrams, Naming Conventions and Design Issues.	**07hrs**
2	**Relational Data Model and Relational Algebra** Relational Model Concepts; Relational Model Constraints and Relational Database Schemas; Update Operations and dealing with constraint violations; Unary Relational Operations: SELECT and PROJECT; Binary Relational Operations: CARTESIAN PRODUCT, JOIN: Additional Relational Operations; Relational Database Design Using ER- to-Relational Mapping.	**08hrs**
3	**SQL** SQL Data Definition and Data Types; Specifying basic constraints in SQL; Schema change statements in SQL; Insert, Delete and Update statements in SQL; Basic queries in SQL,JOIN operations, Complex SQL Queries.	**06hrs**
Unit –II		
4	**Database Design** Informal Design Guidelines for Relation Schemas; Functional Dependencies; Normal Forms Based on Primary Keys; Boyce-Codd Normal Form.	**06 hrs**
5	**PL/SQL** Features of PL/SQL; Advantages of PL/SQL; PL/SQL Basic syntax; PL/SQL Data types; PL/SQL variables; PL/SQL Constraints and Literals; PL/SQL Operators; PL/SQL Conditions; PL/SQL Loops; PL/SQL Strings; PL/SQL Arrays; PL/SQL Procedures; PL/SQL Functions; PL/SQL Cursors; PL/SQL Records; PL/SQL Triggers.	**07 hrs**
6	**Introduction to Transaction Processing** Introduction to Transaction Processing; Transactions and System concepts; Desirable Properties of Transactions; Characterizing schedules based on-recoverability, Serializibilty.	**06 hrs**
Unit –III		
7	**Concurrency control techniques**	

	Introduction, Two-phase locking techniques for concurrency control, dealing with dead-lock and starvation, Concurrency control based on Time stamp ordering.	**05 hrs**
8	**Database Security** Introduction to DB security issues, Discretionary access control based on granting and revoking privileges, Mandatory access control and role-based access control, Mandatory Access Control.	**05 hrs**

Text Books:

1. Elmasri R. and Navathe S., Fundamentals Database Systems, 6th edition, Pearson Education, 2011.
2. Steven Feuerstein, Bill Pribyl Oracle PL/SQL Programming, 6th Edition , O'Reilly Media,2014.

References:

1. Ramakrishnan S. and Gehrke J., Database Management Systems, 3rd edition, McGraw Hill, 2007.
2. Silberschatz A., Korth H.F. and Sudharshan S., Data base System Concepts, 5th Edition, Mc- GrawHill, 2006.
3. PL/SQL User's Guide and Reference 10g Release 1 (10.1) December 2003.

Scheme for Semester End Examination (SEE)

UNIT	**8 Questions to be set of 20 Marks Each**	**Chapter Numbers**	**Instructions**
I	Q.No.-1, Q.No.-2, Q.No.-3	1, 2,3	Solve Any **2** out of **3**
II	Q.No.-4, Q.No.-5, Q.No.-6	4,5,6	Solve Any **2** out of **3**
III	Q.No.-7	7	Solve Any **1** out of **2**
	Q.No.-8	8	

Program: Bachelor of Engineering		
Course Title: **Database application Lab**		Course Code: **15ECSP204**
L-T-P: **0-0-1.5**	Credits: **1.5**	Contact Hrs: **3 hrs/week**
CIE Marks: **80**	SEE Marks:**20**	Total Marks: **100**
Teaching Hrs: **36**	Exam Duration: **3 hrs**	

Experiments	**Lab assignments/experiment**
2-Demonstration	SQL and PL/SQL
5–Exercise	Cartesian Product, Aggregate Functions, Nested Queries, Procedures & Functions
2-Structured Enquiry	Database Design , Cursors and Triggers

References :

1. Elmasri R. and Navathe S., Fundamentals Database Systems, 6th edition, Pearson Education, 2011.
2. Steven Feuerstein, Bill Pribyl Oracle PL/SQL Programming, 6th Edition, O'Reilly Media, 2014.
3. Ramakrishnan S. and Gehrke J., Database Management Systems, 3rd edition, McGraw Hill, 2007.
4. Silberschatz A., Korth H.F. and Sudharshan S., Data base System Concepts, 5th Edition, Mc- GrawHill, 2006.
5. PL/SQL User's Guide and Reference 10g Release 1 (10.1) December 2003.

Program: Bachelor of Engineering		
Course Title: **Digital System Design**		Course Code: **15ECSC202**
L-T-P: **3-0-0**	Credits: **3**	Contact Hrs: **03 hrs/week**
CIE Marks: **50**	SEE Marks: **50**	Total Marks: **100**
Teaching Hrs: **40**	Exam Duration: **3 hrs**	

	Unit –I	
1	**Boolean Function Minimization** Canonical representation of expressions, Complete and Incomplete Boolean Functions and significance of don't Care Conditions. Minimization of logic functions using Karnaugh –map- Prime Implicants, Essential Prime Implicants and implicates.	**06hrs**
2	**Combinational Circuit Design** Design of combinational circuits using combinational ICs: Code convertors, decoders encoders, comparators, multiplexers, de-multiplexers, Adders: Ripple adders and Parallel adders and Subtractors.	**06hrs**
3	**Introduction to Sequential Circuits** The basic bistable element, latches, flip flops and Characteristic equations	**04hrs**
	Unit –II	
4	**Sequential Circuit Design** Design of shift registers and counters.	**06 hrs**
5	**Synchronous Sequential Networks** Structure and Operation of Clocked Synchronous Sequential Networks, Analysis of clocked Synchronous Sequential Networks.	**06 hrs**
6	**Asynchronous Sequential Networks** Structure and Operation of Asynchronous Sequential Networks, Analysis of Asynchronous Sequential Networks.	**04 hrs**
	Unit –III	
7	**Logic Design with PLDs** Introduction to Programmable Devices, Architecture of PLDs.	**04 hrs**
8	**The 555 Timer:**	**04 hrs**

	Monostable Multivibrator, Astable Multivibrator.	

Text Books:

1. Donald D. Givone "Digital Principles and Design" Tata McGraw Hill edition 2003.

Reference Books:

1. M. Morris Mano and C. R. Kime "Logic and Computer Design Fundamentals" 2nd Edition Updated Publishers Pearson Education 2005.
2. Ronald J. Tocci, Neal S. Widmer, Gregory L. Moss, "Digital Systems Principles and Applications" 10th Edition, PHI/Pearson Education, 2007.

Scheme for Semester End Examination (SEE)

UNIT	8 Questions to be set of 20 Marks Each	Chapter Numbers	Instructions
I	Q.No.-1, Q.No.-2, Q.No.-3	1, 2 & 3	Solve Any **2** out of **3**
II	Q.No.-4, Q.No.-5, Q.No.-6	4, 5 & 6	Solve Any **2** out of **3**
III	Q.No.-7	7	Solve Any **1** out of **2**
	Q.No.-8	8	

Program: Bachelor of Engineering		
Course Title: **Object Oriented Programming**		Course Code: **15ECSC204**
L-T-P: **3-0-0**	Credits: **3**	Contact Hrs: **3 hrs/week**
CIE Marks: **50**	SEE Marks: **50**	Total Marks: **100**
Teaching Hrs: **40**	Exam Duration: **3 hrs**	

Unit –I		
1	**Introduction to Java** Introduction to Object Oriented concepts. Features of Java, Java Development Kit, Java Source File Structures, Basic Data Types, Arrays, Strings, StringBuffer, Class diagrams-UML notations.	**4 hrs**
2	**Classes and Objects** Class Fundamentals, Declaring objects, Assigning object reference variables, Introducing methods, Constructors, this key word, Garbage collection: The finalize method. A closer Look at Methods and Classes: Overloading: Methods, Constructors. Using objects as Parameters, Returning objects, Access control. Understanding static and final keywords. Introducing nested and inner classes.	**6 hrs**
3	**Inheritance and Polymorphism** Inheritance: Basics, types of inheritance, implementing inheritance, Method overriding, Dynamic method dispatch, Abstract classes, Object class.	**6 hrs**
Unit –II		
4	**Packages, Interfaces & Exception handling** Packages and Interfaces: Packages: creating and importing, Access protection. Interfaces: creating, implementing. Exception Handling: Fundamentals,	**6 hrs**

	Exception Types, Uncaught Exceptions, Using try, catch, throw, throws and finally, Multiple catch, Nested try statements, User defined exceptions.	
5	**Java Design Patterns** Creational, Structural and Behavioral design patterns.	**4 hrs**
6	**GUI Design using AWT and Swings** Introduction: AWT Classes, Window Fundamentals, Working with Frame Windows, Using AWT Controls, Layout managers and Menus: Control Fundamentals, Labels, Buttons, CheckBoxes, List, TextField, TextArea, Layout managers, Menu Bars and Menus. Event Handling: Event Handling Mechanism, Delegation Event Model. Swings: introduction to swings, swing features, Component and containers, swing packages, Event Handling. Exploring swing: JLabel, image Icon, JTextField, JButton, Check Boxes, Radio Button, JList, and JComboBox.	**6 hrs**
Unit –III		
7	**Collection Framework** Collections Framework, Set Interface, Set Implementation Classes, List Interface, List Implementation Classes, The Map Interface, Map Implementation Classes.	**4 hrs**
8	**Generics** Introduction, Type safety, Generic class with two type parameters, general form of generic class, Bounded types, Wild card arguments, generic method.	**4 hrs**

Text Books:

1. Herbert Schildt, The Complete Reference, 7, McGraw-Hill.

Reference Books:

1. Kathy Sierra and Bert Bates, Head First JAVA, 2, O'Reilly Media, 2005.
2. Bruce Eckel, Thinking in Java, 5, Prentice Hall.

Scheme for Semester End Examination (SEE)

UNIT	8 Questions to be set of 20 Marks Each	Chapter Numbers	Instructions
I	Q.No.-1, Q.No.-2, Q.No.-3	1, 2 and 3	Solve Any **2** out of **3**
II	Q.No.-4, Q.No.-5, Q.No.-6	4, 5 and 6	Solve Any **2** out of **3**
III	Q.No.-7	7	Solve Any **1** out of **2**
	Q.No.-8	8	

Program: **Bachelor of Engineering**		
Course Title: **Digital System Design Lab**		Course Code: **15ECSP202**
L-T-P: **0-0-1.5**	Credits: **1.5**	Contact Hrs: **3 hrs/week**
CIE Marks: **80**	SEE Marks: **20**	Total Marks: **100**
Teaching Hrs: **42**	Exam Duration: **3 Hrs**	

Tentative plan of lab implementation

Week No	Lab Assignments
1.	Introduction to digital trainer kit.
2 3 4 5 6	Design of combinational circuits using SSI and MSI components/ Verilog programming. • Code converters • Arithmetic Circuits • Decoders/encoders • Mutliplexers/Demultiplers
7 8 9 10	Design of Sequential circuits using SSI and MSI components/ Verilog programming. • Shift registers • Counters
11 12 13	Structured Enquiry

Materials and Resources Required:

Reference Books:

1. Donald D. Givone "Digital Principles and Design" Tata McGraw Hill edition 2002.
2. Hamacher C., Vranesic Z., and Zaky S., "Computer Organization", 5th Edition, McGraw Hill, 2012.
3. HDL Programming (VHDL and Verilog)-NazeithM.Botros- Creamtech Press 2006 edition.
4. John P. Hayes "Computer Architecture and Organization" Tata McGraw Hill 3rd Edition, 2012.
5. M. Morris Mano and C. R. Kime "Logic and Computer Design Fundamentals" 2nd Edition Updated Publishers Pearson Education 2005.
6. Ronald J. Tocci, Neal S. Widmer, Gregory L. Moss, "Digital Systems Principles and Applications" 10th Edition, PHI/Pearson Education, 2007.

Manuals: Lab Manual available in Lab.

Program: Bachelor of Engineering		
Course Title: **Principles of Compiler Design**		Course Code: **15ECSC205**
L-T-P: **3-0-0**	Credits: **3**	Contact Hrs: **03 hrs/week**
CIE Marks: **50**	SEE Marks: **50**	Total Marks: **100**
Teaching Hrs: **40**	Exam Duration: **03 hrs**	

Unit –I		
1	**Introduction to compilers** Brief History of Compilers, Translation process, Major data structures in Compilers, Chomsky hierarchy, **Lexical analysis:** Scanning process, Regular expressions for tokens, lexical errors, applications of Regular expressions.	**06 hrs**
2	**Finite Automata** Introduction: Language, automata, From regular expressions to Deterministic Finite Automata (DFA): Є-Nondeterministic Finite Automata (Є-NFA), NFA, DFA, Equivalence of Deterministic Finite Automata, Nondeterministic Finite Automata, Finite automata as recognizer, Implementation of Finite Automata.	**06 hrs**
3	**Introduction to Syntax Analysis** Role of parser, Regular Grammars, Context-Free Grammars (CFGs), Parsers, Parsing and ambiguity in Grammars and Languages, Different errors and recovery strategies.	**04 hrs**
Unit –II		
4	**Top Down Parsing** Top Down parsing: Recursive Parsing, Left Recursion, Left factoring, LL(1) Parsing, FIRST and FOLLOW sets, error recovery in Top Down Parsing.	**08 hrs**
5	**Bottom up Parsing** Bottom Up parsing: Overview, SLR(1) parsing, General LR(1) and LALR(1) Parsing, error recovery in bottom up parsing	**08 hrs**
Unit –III		
6	**Semantic Analysis** Attributes and Attributes grammars, Algorithm for attribute computation, Symbol table, data types and Data checking	**04 hrs**
7	**Intermediate Code Generation** Intermediate Code and data structure for code generation, Code generation of data structure references, code generation of control statements and expressions.	**04 hrs**

Text Books:

1. Alfred V Aho, Monica S. Lam, Ravi Sethi, Jeffrey D Ullman, Compilers - Principles, Techniques and Tools, 2nd Edition, Pearson, 2007
2. Kenneth C Louden, Compiler Construction Principles & Practice, 1997, Cengage Learning, 1997

Reference Books:

1. Andrew W Apple, Modern Compiler Implementation in C, Cambridge University Press, 1998
2. Charles N. Fischer, Richard J. leBlanc, Jr, Crafting a Compiler with C, Pearson, 2010.
3. Peter Linz, An Introduction to formal languages and Automata, IV edition, Narosa, 2009.

4.	Basavaraj S Anami,, Karibasappa K.G, Formal Languages and Automata Theory, First, Wiley India, 2011.

Scheme for Semester End Examination (SEE)

UNIT	8 Questions to be set of 20 Marks Each	Chapter Numbers	Instructions
I	Q.No.-1, Q.No.-2, Q.No.-3	1, 2 and 3	Solve Any **2** out of **3**
II	Q.No.-4, Q.No.-5	4 and 5	Solve Any **2** out of **3**
III	Q.No.-6	6	Solve Any **1** out of **2**
	Q.No.-7	7	

Program: Bachelor of Engineering		
Course Title: **Computer Organization and Architecture**		Course Code:**15ECSC206**
L-T-P: **3-1-0**	Credits: **4**	Contact Hrs: **04 hrs/week**
CIE Marks: **50**	SEE Marks: **50**	Total Marks: **100**
Teaching Hrs: **40**	Exam Duration: **03 hrs**	

Unit –I		
1	**Basic Structure of Computers and Machine Instructions** Basic operational concepts; Bus structures; Performance; Numbers, arithmetic operations & characters; memory locations and addresses. **Basic Processing Unit** Fundamental concepts; Instruction Execution, Hardware Components Instruction Fetch and Execution Steps, Control Signals, Hardwired Control, CISC-Style Processors.	**06 hrs**
2	**Pipelining** Basic Concept, Pipeline Organization, Pipelining Issues , Data Dependencies, Memory Delays, Branch Delays, Resource Limitations, Performance Evaluation.	**05 hrs**
3	**Input /Output Organization** Accessing i/o devices; interrupts Bus Structure, Bus Operation, Arbitration, Interface Circuits, Interconnection Standards.	**05 hrs**
Unit –II		
4	**The Memory System** Basic Concepts, Semiconductor RAM Memories, Read-only Memories Direct Memory Access, Memory Hierarchy, Cache Memories, Performance Considerations, Virtual Memory, Memory Management Requirements, Secondary Storage.	**06 hrs**
5	**Arithmetic** Addition and Subtraction of Signed Numbers, Design of Fast Adders, Multiplication of Unsigned Numbers, Multiplication of Signed Numbers Fast Multiplication, Integer Division, Floating-Point Numbers and Operations.	**06 hrs**

6	**The ARM architecture** The Acorn RISC machine, Architectural inheritance, The ARM programmers model, ARM development tools, 3-stage pipeline ARM organization, ARM instruction execution, Addressing Modes, Examples.	**04 hrs**
Unit –III		
7	**The ARM Instruction Set** Data processing instructions, Data transfer instructions, Control flow instructions, Examples.	**04 hrs**
8	**ARM Assembly Programming** Exceptions, Conditional execution, Branch instructions.	**04 hrs**

Text Books:

1. Hamacher C., Vranesic Z., and Zaky S., Computer Organization, 6 ed., McGraw Hill, 2012.
2. Steve Furber, ARM System-on-chip Architecture, 2, Pearson, 2000

Reference Books:

1. William Stallings, “Computer Organization & Architecture”, 8th Edition, Pearson Education, 2010.
2. Miles Murdocca and Vincent Heuring, "Computer Architecture and Organization an Integrated Approach", 2nd Edition, WSE, 2010.

Scheme for Semester End Examination (SEE)

UNIT	8 Questions to be set of 20 Marks Each	Chapter Numbers	Instructions
I	Q.No.-1, Q.No.-2, Q.No.-3	1,2 & 3	Solve Any **2** out of **3**
II	Q.No.-4, Q.No.-5, Q.No.-6	4, 5 & 6	Solve Any **2** out of **3**
III	Q.No.-7	7	Solve Any **1** out of **2**
	Q.No.-8	8	

Tentative plan of Tutorial implementation

Sl. No	Assignments
1.	Introduction to ARM architecture
2.	Programming on Data transfer instructions
3.	Programming on Data processing instructions: arithmetic and logical instructions
4.	Programming on Control flow instructions
5.	Interfacing techniques

Materials and Resources Required:

Text Books:

1. Steve Furber, “ARM System-on-chip Architecture” LPE, 2nd Edition, 2000.

Reference Books:

1. David E. Simon, “An Embedded Software Primer”, Addison-Wesley Professional, 1st

Edition, 1999.
2. William Hohl, "ARM Assembly Language Fundamentals and techniques" CRC Press, 2009.

Program: Bachelor of Engineering		
Course Title: **Principles of Compiler Design**		Course Code:**17ECSC202**
L-T-P: **3-0-0**	Credits: **3**	Contact Hrs: **03 hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **40**	Exam Duration: **03 hrs**	

Unit –I		
1	**Introduction to compilers** Brief History of Compilers, Translation process, Major data structures in Compilers, Chomsky hierarchy, Lexical analysis: Scanning process, Regular expressions for tokens, lexical errors, applications of Regular expressions	**08 hrs**
2	**Top Down Parsing** Top Down parsing: Recursive Parsing, Left Recursion, Left factoring, LL (1) Parsing, FIRST and FOLLOW sets, error recovery in Top Down Parsing..	**08 hrs**
Unit –II		
3	**Bottom up Parsing** Bottom Up parsing: Overview, SLR (1) parsing, General LR (1) and LALR (1) Parsing, error recovery in bottom up parsing	**08 hrs**
4	**Semantic Analysis** Attributes and Attributes grammars, Algorithm for attribute computation, Symbol table, data types and Data checking.	**08 hrs**
Unit –III		
5	Intermediate Code and data structure for code generation, Code generation of data structure references, code generation of control statements and expressions.	**04 hrs**
6	**Machine Independent Code optimizer** Principal sources of optimization, Data flow analysis, Redundancy elimination, Loops in flow graphs.	**04 hrs**

Text Book: 1. Alfred V Aho, Monica S. Lam, Ravi Sethi, Jeffrey D Ullman: Compilers - Principles, Techniques and Tools, 2nd Edition, Pearson, 2008. 2. Kenneth C Louden: Compiler Construction Principles & Practice, Cengage Learning, 1997.
References: 1. Andrew W Apple: Modern Compiler Implementation in C, Cambridge University Press, 1997. ***2.*** Charles N. Fischer, Richard J. leBlanc, Jr.: Crafting a Compiler with C, Pearson, 1991.

Program: Bachelor of Engineering		
Course Title: **Computer Organization and Architecture**		Course Code:**17ECSC205**
L-T-P: **3-0-0**	Credits: **3**	Contact Hrs: **03 hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **40**	Exam Duration: **03 hrs**	

Unit –I		
1	**Basic GPU Structure** Basic operational concepts. Bus structures. Performance. Numbers, arithmetic operations. Memory locations and addresses. Fundamental concepts: Instruction Execution, Hardware Components. Instruction Fetch and Execution Steps, Control Signals. CISC-Style Processors.	**06 hrs**
2	**Pipelining** Basic Concepts. Pipeline Organization. Pipelining Issues: Data DependenISAs, Memory Delays, Branch Delays, and Resource Limitations. Performance Evaluation.	**05 hrs**
3	**Input /Output Organization** Accessing i/o devices. Interrupts. Bus Structure/Operation, Arbitration. Interface Circuits. Interconnection Standards.	**05 hrs**
Unit –II		
4	**The Memory System** Basic Concepts. Semiconductor RAM Memories. Read-only Memories. Direct Memory Access. Memory Hierarchy. Cache Memories. Performance Considerations. Virtual Memory. Memory Management Requirements. Secondary Storage	**06 hrs**
5	**Arithmetic** Addition and Subtraction of Signed Numbers. Design of Fast Adders. Multiplication of Signed and Unsigned Numbers. Fast Multiplication. Integer Division. Floating-Point Numbers and Operations	**06 hrs**

6	**The ARM architecture** The Acorn RISC machine. Architectural inheritance. The ARM programmer's model. ARM development tools. 3-stage pipeline ARM organization. ARM instruction execution. Addressing Modes.	**04 hrs**
Unit –III		
7	**The ARM Instruction Set** Data processing instructions. Data transfer instructions. Control flow instructions.	**04 hrs**
8	**ARM Assembly Programming** Exceptions. Conditional execution. Branch instructions. Programming Examples.	**04 hrs**
Text Books: 1. 1Hamacher C., Vranesic Z., andZaky S., Computer Organization, Sixth, McGraw Hill, 2012. 2. Steve Furber, ARM System-on- chip Architecture, Second, Pearson Education, 2000		
Reference Books: 1. William Stallings., Computer Organization & Architecture, Eighth, Pearson Education, 2010. 2. Miles Murdocca and Vincent Heuring, Computer Architecture and Organization an Integrated Approach, Second, WSE, 2010.		

Scheme for Semester End Examination (ESA)

UNIT	8 Questions to be set of 20 Marks Each	Chapter Numbers	Instructions
I	Q.No.-1, Q.No.-2, Q.No.-3	1,2,3	Solve Any **2** out of **3**
II	Q.No.-4, Q.No.-5, Q.No.-6	4,5,6	Solve Any **2** out of **3**
III	Q.No.-7	7	Solve Any **1** out of **2**
	Q.No.-8	8	

Tentative plan of Tutorial implementation

Sl. No	Assignments
6.	Introduction to ARM architecture
7.	Programming on Data transfer instructions
8.	Programming on Data processing instructions: arithmetic and logical instructions
9.	Programming on Control flow instructions
10.	Interfacing techniques

Materials and Resources Required:

Text Books:

2. Steve Furber, "ARM System-on-chip Architecture" LPE, 2nd Edition, 2000.

Reference Books:

3. David E. Simon, "An Embedded Software Primer", Addison-Wesley Professional, 1st

Edition, 1999. 4. William Hohl, "ARM Assembly Language Fundamentals and techniques" CRC Press, 2009.

Program: **Bachelor of Engineering**		
Course Title: **Computer Organization and Architecture Lab**		Course Code: **18ECSP202**
L-T-P: **0-0-1.5**	Credits: **1.5**	Contact Hrs: **3 hrs/week**
ISA Marks: **80**	ESA Marks: **20**	Total Marks: **100**
Teaching Hrs: **42**	Exam Duration: **3 Hrs**	

Tentative plan of lab implementation

Experiments	Lab assignments/experiment	Hrs
1-	**Exercises on Combinational Logic**	**03 hrs**
2-	**Exercises on Sequential Circuit Design**	**08 hrs**
3-	**Structured Enquiry** **Applications of Computer Organization concepts**	**03 hrs**

Materials and Resources Required:

Text Books:

1. Donald D. Givone "Digital Principles and Design" Tata McGraw Hill edition 2003.
2. Hamacher C., Vranesic Z., and Zaky S., Computer Organization, 5ed., McGraw Hill,2002.

Reference Books:

3. John P. Hayes. Computer Architecture and Organization,3rd Edition, McGraw Hill
4. M. Morris Mano and C. R. Kime "Logic and Computer Design Fundamentals" 2nd Edition, Updated Publishers Pearson Education 2005.
5. Ronald J. Tocci, Neal S. Widmer, Gregory L. Moss, "Digital Systems Principles and Applications" 10th Edition, PHI/Pearson Education, 2007.

Course Code: 18ECSC206	**Course Title: Microcontroller Programming& Interfacing**	
L-T-P-SS: 3-0-1	**Credits: 4**	**Contact Hrs: 3+2 hrs**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hrs: 40		**Exam Duration: 3 hrs**

Content	Hrs
Unit – I	
Chapter No. 1.The 8051 Architecture Introduction, 8051 Microcontroller hardware, input/output pins, ports & circuits, External memory,	04 hrs
Chapter No. 2. Assembly Programming Introduction, addressing modes, External Data Moves, Code Memory Read Only Data Moves / Indexed Addressing mode, PUSH and POP opcodes, Data exchanges, assembler directives, example programs. Byte level logical Operations, Bit level Logical Operations, Rotate and Swap Operations, Example Programs. Arithmetic Operations: Flags, Incrementing and Decrementing, Addition, Subtraction, Multiplication and Division, Decimal Arithmetic, Example Programs. The JUMP and CALL Program range, Jumps, Call and Subroutines, Example programs	12hrs +08 hrs (Lab)
Unit – II	
Chapter No. 3. Timer/Counter & Serial Port Programming. C Data Types and Time delay computation in 8051 Counters and Timers, Programming 8051 Timers/counters in different modes, Basics of Serial Communication, RS232 standards, 8051 connection to RS232, 8051 serial port Programming.	12 hrs
Chapter No. 4. Interrupts Programming 8051 Interrupts, Programming Timer Interrupts, Programming external hardware interrupts, Programming the Serial Communication Interrupts, Interrupt Priority in the 8051, Interrupt programming.	04 hrs
	4 hrs
Unit – III	
Chapter No. 5. Interfacing to Peripheral Devices Interfacing 8051 to LEDs, DIP switches, BCD Decoder display, 7 Segment Display, LCD, Keypad, DAC, ADC, Stepper Motor and DC Motor	08hrs +12 Hrs (Lab)

Text Books (List of books as mentioned in the approved syllabus)

2. Ayala.K.J, “The 8051 Microcontroller”, 3rd.,CENGAGELearning, 2007.
3. Mazidi.M.A, Mazidi.J.G and McKinlay.R.D, “The 8051 Microcontroller and Embedded Systems-using Assembly and C”, 2ed, PHI 2006/Pearson, 2006.

References

1. Ayala.K.J., Gadre D.V., “The 8051 Microcontroller & Embedded Systems using Assembly and C”, 1ed., CENGAGE Learning, 2010
2. V. Udayashankara, M.S. Mallikarajunaswamy, ”8051 Microcontroller Hardware, Software and Applications”, 1ed., Tata McGraw Hill, 2009.

Scheme for End Semester Assessment (ESA)

UNIT	8 Questions to be set of 20 Marks Each	Chapter Numbers	Instructions
I	Q.No.-1, Q.No.-2, Q.No.-3	1 & 2	Solve Any **2** out of **3**
II	Q.No.-4, Q.No.-5, Q.No.-6	3 &4	Solve Any **2** out of **3**
III	Q.No.-7	5	Solve Any **1** out of **2**
	Q.No.-8	5	

Program: **Bachelor of Engineering**		
Course Title: **Software Engineering**		Course Code: **15ECSC301**
L-T-P: **3-0-0**	Credits: **3**	Contact Hrs: **3 hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **40**	Exam Duration: **3 hrs**	

Unit –I		
1	**Chapter No. 1. Software Engineering process** Professional software development Software engineering ethics, Case studies, Software processes: Software process models, Process activities, Coping with change, The rational unified process, Continuous Integration and Continuous Deployment and Tools.	**06 hrs**
2	**Chapter No. 2. Agile Software Development** Agile methods, Plan-driven and agile development, Extreme programming, Agile project management.	**04 hrs**
3	**Chapter No. 3. Requirement Engineering** Functional and Non-functional requirements; The software requirements Document, Requirement specification, Requirements Engineering Processes, Requirements elicitation and analysis; Requirements validation; Requirements management	**06 hrs**
Unit –II		
4	**Chapter No. 4. System Modeling** Context models, Interaction Models, Structural models, Behavioral models.	**06 hrs**
5	**Chapter No. 5. Architectural Design** Architectural Design Decision, Architectural views, Architectural patterns,	**05 hrs**

	Application Architectures	
6	**Chapter No. 6. Object-Oriented design and implementation** Object oriented design using UML, design patterns, Implementation Issues, Open source development.	**05 hrs**
Unit –III		
7	**Chapter No. 7. Software Testing** Development Testing, Test Driven Development, Release Testing, User Testing	**04 hrs**
8	**Chapter No. 8. Configuration management** Change management, Version management, System building, Release management	**04 hrs**

Text Books

1. Ian Somerville, Software Engineering, 9th, Pearson Ed, 2015

Reference Books:

1. Roger S. Pressman, Software Engineering: A Practitioners Approach, 7th, McGraw- , 2007
2. Shari Lawrence Pfleeger, Joanne M. Atlee, Software Engineering Theory and Practice, 3rd, Pearson Ed, 2006
3. Jalote, P, An Integrated Approach to Software Engineering, 3rd, Narosa Pub, 2005

Scheme for End Semester Assessment (ESA)

UNIT	**8 Questions to be set of 20 Marks Each**	**Chapter Numbers**	**Instructions**
I	Q.No.-1, Q.No.-2, Q.No.-3	1, 2,3	Solve Any **2** out of **3**
II	Q.No.-4, Q.No.-5, Q.No.-6	4,5,6	Solve Any **2** out of **3**
III	Q.No.-7	7	Solve Any **1** out of **2**
	Q.No.-8	8	

Program: Bachelor of Engineering		
Course Title: **Computer Networks - I**		Course Code: **17ECSC301**
L-T-P: **3-0-0**	Credits: **3**	Contact Hrs: **3 hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **40**	Exam Duration: **3 hrs**	

Unit –I		
1	**Introduction** Internet, The Network Edge and Core, Protocol layer and service models: OSI and TCP/IP, Networks attacks, History of computer network and Internet	**08 hrs**
2	**Application Layer** Principles of Network Applications , HTTP , SMTP, DNS	**08 hrs**
Unit –II		
3	**Transport-Layer Services** Introduction, connectionless transport, principles of reliable data transfer	**10 hrs**

	protocol, connection-oriented and connectionless transport, principle of congestion control, TCP congestion control	
4	**Network Layer: Data plane** Introduction to data and control plane and, virtual circuit and datagram networks, Internet protocol: datagram format, fragmentation, IP addressing	**06 hrs**
Unit –III		
5	**Network Layer: Data plane** NAT, IPv6, generalized forward and SDN	**04hrs**
6	**Network tools** HTTP, DNS, SMTP tools, packet analysis	**04 hrs**

Text Books:

1. J. F. Kurose, K. W. Ross, "Computer Networking, A Top-Down Approach", 7th Edition, Pearson Education, 2017.

Reference Books:

1. Peterson, Larry L, "Computer networks : a systems approach", 5th Edition, The Morgan Kaufmann series in networking, 2012
2. Behrouz Forouzan, Data Communications and Networking, McGraw Hill 4ed., 2007

Scheme for End Semester Assessment (ESA)

UNIT	**8 Questions to be set of 20 Marks Each**	**Chapter Numbers**	**Instructions**
I	Q.No.-1, Q.No.-2, Q.No.-3	1,2	Solve Any **2** out of **3**
II	Q.No.-4, Q.No.-5, Q.No.-6	3,4	Solve Any **2** out of **3**
III	Q.No.-7	5	Solve Any **1** out of **2**
	Q.No.-8	6	

Program: Bachelor of Engineering		
Course Title: **System Software**		Course Code: **17ECSC302**
L-T-P: **3-0-0**	Credits: **3**	Contact Hrs: **3 hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **40**	Exam Duration: **3 hrs**	

	Unit –I	
1	**Introduction to a Machine Architecture** Introduction, System Software and Machine Architecture, Simplified Instructional Computer (SIC) - SIC Machine Architecture, SIC/XE Machine Architecture, SIC and SIC/XE Programming Examples.	**06hrs**
2	**Assembler** Basic Assembler Function - A Simple SIC Assembler, Assembler Algorithm and Data Structures, Machine Dependent Assembler Features - Instruction Formats & Addressing Modes, Program Relocation.	**09hrs**

Unit –II		
3	**Assembler M/c Independent Features and Design options** Machine Independent Assembler Features: Literals, Symbol Defined Statements, Expression, Program Blocks, Control Sections and Programming Linking, Assembler Design Options: One Pass Assembler, Multi Pass Assembler, Implementation Examples: Assembler(8086): MASM	**07 hrs**
4	**Loaders and Linkers** Basic Loader Functions: Design of an Absolute Loader, A Simple Bootstrap Loader, Machine Dependent Loader Features: Relocation, Program Linking, Algorithm and Data Structures for a Linking. **Loader M/c Independent Features:** Automatic Library Search, Loader Options, Loader Design Options - Linkage Editor, Dynamic Linkage, Bootstrap Loaders, Implementation Examples: 8086 Linker.	**08 hrs**
Unit –III		
5	**Macro Processor** Basic Macro Processor Functions: Macro Definitions and Expansion, Macro Processor Algorithm and Data Structures, **Machine Independent Macro Processor Features:** Concatenation of Macro Parameters, Generation of Unique Labels, Conditional Macro Expansion, Keyword Macro Parameters Implementation Examples: 8086 Macro Processor.	**05 hrs**
6	**Back end of Compiler: Code generation and Machine dependent features.** Review of phases of compilers, code generation routines, machine dependent features.	**05 hrs**

Text Books:

4. Leland.L.Beck and D. Manjula: System Software, 3 ed, Pearson Education, 2007
2. Ayala: The 8051 Microcontroller , 3rd ed, Cenagage Learning- 2009

Reference Books:

1. Alfred V Aho, Monica S. Lam, Ravi Sethi, Jeffrey D Ullman, "Compilers- Principles, Techniques and Tools", 2nd Edition, Addison-Wesley, 2007.
2. Muhammad Ali Mazidi et al: The 8051 Microcontroller and Embedded systems, 2nd Edition, Pearson education, 2009.

Scheme for End Semester Assessment (ESA)

UNIT	8 Questions to be set of 20 Marks Each	Chapter Numbers	Instructions
I	Q.No.-1, Q.No.-2, Q.No.-3	1, 2	Solve Any **2** out of **3**
II	Q.No.-4, Q.No.-5, Q.No.-6	3,4	Solve Any **2** out of **3**
III	Q.No.-7	5	Solve Any **1** out of **2**
	Q.No.-8	6	

Program: Bachelor of Engineering		
Course Title: **Data Mining & Analysis**		Course Code: **18ECSC301**
L-T-P: **3-0-1**	Credits: **4**	Contact Hrs: **5 hrs/week**
ISA Marks: **80**	ESA Marks: **20**	Total Marks: **100**
Teaching Hrs: **40**	Exam Duration: **3hrs**	

Unit –I		
1	**Data Pre-Preprocessing** Introduction to data mining, Data Warehouse and OLAP Technology for Data mining: Data Warehouse, Multidimensional Data Model, Data Warehouse Architecture, Major tasks in data preprocessing- data reduction, data transformation and data Discretization, data cleaning and data integration.	**08 hrs**
2	**Frequent Pattern Mining** Frequent item sets and association rules; Item set mining algorithms; Generating association rules; Summarizing item sets: maximal and closed frequent item sets; Interesting patterns: pattern evaluation methods;	**08 hrs**
Unit –II		
3	**Classification Techniques** Probabilistic classification: naïve Bayes classifier, K-nearest neighbours; Decision tree classifier: decision tree induction, tree pruning; Model evaluation and selection: metrics, cross validation, random sampling, ROC curves;	**08 hrs**
4	**Cluster Analysis** Cluster Analysis- Partitioning methods, Hierarchical Methods, Density based methods, Outlier Detection.	**08 hrs**
Unit –III		
5	**Advanced Mining Techniques** Popular data pre-processing techniques: One hot encoding, stacking; Techniques to improve classification accuracy: ensemble methods, random forests, XGBoosting; Bias-variance trade-off; Post processing: Visualization and Interpretation;	**08 hrs**

Text Books:

2. Jiawei Han, Micheline Kamber and Jian Pei, Data Mining: Concepts and Techniques, 3rd edition, Morgan Kaufmann, 2012.

Reference Books:

7. Ian H. Witten, Eibe Frank, Mark A. Hall and Christopher J. Pal, Data Mining:

Practical Machine Learning Tools and Techniques, Morgan Kaufmann; 4th edition, 2016.
8. Pang-Ning, Michael Steinbach and Vipin Kumar, Introduction to Data Mining, Pearson, International edition, 2013.
9. Mohammed J. Zaki and Wagner Meira, Jr., Data Mining and Analysis: Fundamental Concepts and Algorithms, Cambridge University Press, 2014.
10. M. H. Dunham, Data Mining: Introductory and Advanced Topics, Pearson Education, 1st edition, 2006.

Scheme for End Semester Assessment (ESA)

UNIT	**8 Questions to be set of 20 Marks Each**	**Chapter Numbers**	**Instructions**
I	Q.No.-1, Q.No.-2, Q.No.-3	1, 2	Solve Any **3** out of **4**
II	Q.No.-4, Q.No.-5, Q.No.-6	3, 4,5	Solve Any **3** out of **4**
III	Lab exam	6	Lab exam evaluation

Program: Bachelor of Engineering		
Course Title: **Machine Learning**	Course Code: **17ECSC306**	
L-T-P: **2-0-1**	Credits: **3**	Contact Hrs: **30**
ISA Marks: **50**	ESA Marks: 50	Total Marks: **100**
Teaching Hrs: **30**	Exam Duration: **3 hrs**	

Content	**Hrs**
Unit – 1	
Chapter No 1. Introduction to machine learning Introduction to Machine Learning, Applications of Machine Learning, Types of Machine Learning: Supervised, Unsupervised and Reinforcement learning, Dataset formats, Features and observations.	5 hrs
Chapter No 2. Supervised Learning: Linear Regression, Logistic Regression Linear Regression: Single and Multiple variables, Sum of squares error function, The Gradient descent algorithm, Application, Logistic Regression, The cost function, Classification using logistic regression, one-vs.-all classification using logistic regression, Regularization.	7 hrs

Unit – 2	
Chapter No 3. Supervised Learning: Neural Network Introduction to perceptron learning, Model representation, Gradient checking, Back propagation algorithm, Multi-class classification, and Application- classifying digits. Support vector machines,	6 hrs
Chapter No 4. Unsupervised Learning : Dimensionality reduction and Learning Theory Expectation Maximization (EM), Factor Analysis, The dimensionality reduction,PCA : PCA for compression, Incremental PCA, Randomized PCA, Kernel PCA , ICA (Independent Component Analysis). Bias/variance tradeoff, Union and Chernoff / Hoeffding bounds VC dimension.	6 hrs
Unit – 3	
Chapter No 5. Reinforcement Learning Reinforcement Learning: Introduction, Applications, Model of the environment, Policy search, Learning to optimize rewards and value functions, Evaluating actions: The credit assignment problem, Policy gradients, Markov decision processes, Q-learning.	6 hrs

Text Book

1. Tom Mitchell., Machine Learning, Mc Graw Hill, McGraw-Hill Science, 3rd edition.
2. Christopher Bishop., Pattern Recognition and Machine Learning, Springer, 2006.

References:

1. Hands-On Machine Learning with Scikit-Learn and TensorFlow, Concepts, Tools, and Techniques to Build Intelligent Systems, AurelianGerona, Publisher: O'Reilly Media , July 2016.
2. Advanced Machine Learning with Python Paperback, 28 Jul 2016 by John Hearty.

Program: Bachelor of Engineering		
Course Title: **System Software Lab**		Course Code: **15ECSP301**
L-T-P: **0-0-1.5**	Credits: **1.5**	Contact Hrs: **3 hrs/week**
ISA Marks: **80**	ESA Marks: **20**	Total Marks: **100**
Teaching Hrs: **36**	Exam Duration: **3 hrs**	

Sl No	***Experiments***	***Slots/Hrs***
1.	Practice programs on user defined functions , structures and programs on file handling	3 hrs

2.	Introduction to basics of given assembly language Programs	3 hrs
3.	Evaluation on given assembly language Program	3 hrs
4.	Implementation of Pass 1 Assembler	3 hrs
5.	Implementation of Pass 2 Assembler	6 hrs
6.	Implementation of Pass 1 Linking loader	3 hrs
7.	Implementation of Pass 2 linking loader	6 hrs
8.	Course Project on Identifying machine to implement assembler , learning its architectural features and design Pass 1 Assembler or Pass2 Assembler	6 hrs

Reference Books:

1. Leland.L.Beck and D. Manjula: System Software, 3 ed, Pearson Education, 2007
2. Alfred V Aho, Monica S. Lam, Ravi Sethi, Jeffrey D Ullman, “Compilers- Principles, Techniques and Tools”, 2nd Edition, Addison-Wesley, 2007.

Program: **Bachelor of Engineering**		
Course Title: **Mini Project**		Course Code: **15ECSW301**
L-T-P: **0-0-3**	Credits: **3**	Contact Hrs: **3 hrs/week**
CIE Marks: **50**	SEE Marks: **50**	Total Marks: **100**
Teaching Hrs: **39**	Exam Duration: **3 Hrs**	

Student Evaluation Matrix

Sl. No	**Continuous Internal Evaluation**	**Assessment**	**Weightage in Marks**
1	Review 1 :	Problem identification & Defining a problem statement, test plan and Construction of software system	15
2.	Review 2 :	Software Requirement Specification (SRS)	10
3.	Review 3 :	Software Design	05
4.	Review 4 :	Construction (as per design) & testing	10
5.	Review 5 & peer review:	Final Demo & exhibition Peer review will be done after review 1 & review 4)	10
		Total	**50**

Program: Bachelor of Engineering		
Course Title: **Computer Networks-II**		Course Code: **17ECSC304**
L-T-P: **3-0-0**	Credits: **3**	Contact Hrs: **3 hrs/week**
CIE Marks: **50**	SEE Marks: **50**	Total Marks: **100**
Teaching Hrs: **40**	Exam Duration: **3 hrs**	

Unit –I		
1	**Introduction:** Overview of IP addressing, Network layer control plane: routing algorithms, routing in internet, broadcast and multicast routing, SDN control plane, Network management and SNMP	**08 hrs**
2	**Data Link Layer** Error-Detection and -Correction Techniques, Parity Checks, Check summing Methods, Cyclic Redundancy Check (CRC), multiple access links and protocols	**08 hrs**
Unit –II		
3	**Switched Local Area Networks** Link-Layer Addressing and ARP, Ethernet, Link-Layer Switches, Virtual Local Area Networks (VLANs), Multiprotocol Label Switching (MPLS), Data Center Networking.	**08 hrs**
4	**Wireless Networks** Wireless Links and Network Characteristics, 802.11 Wireless LANs, Architecture, MAC Protocol, Frame, Mobility, Advanced Features, Personal Area Networks: Bluetooth and Zigbee, Cellular networks and internet access	**08 hrs**
Unit –III		
6	**Mobility Management** Mobility, mobile IP, managing mobility in cellular network, wireless and mobile: impact on higher layer protocols	**04 hrs**
7	**Multimedia Networking:** Applications, Voice-over-IP, Protocols for real-time applications.	**04 hrs**

Text Books:

1. J. F. Kurose, K. W. Ross, "Computer Networking, A Top-Down Approach", 7th Edition, Pearson Education, 2017.

Reference Books:

1. Peterson, Larry L, "Computer networks : a systems approach", 5th Edition, The Morgan Kaufmann series in networking, 2012
2. Behrouz Forouzan, Data Communications and Networking, McGraw Hill 4ed., 2007

Scheme for End Semester Assessment (ESA)

UNIT	8 Questions to be set of 20 Marks Each	Chapter Numbers	Instructions
I	Q.No.-1, Q.No.-2, Q.No.-3	1, 2	Solve Any **2** out of **3**
II	Q.No.-4, Q.No.-5, Q.No.-6	3,4	Solve Any **2** out of **3**
III	Q.No.-7	5	Solve Any **1** out of **2**
	Q.No.-8	6	

Program: Bachelor of Engineering		
Course Title: **Distributed and Cloud Computing**		Course Code:**17ECSC305**
L-T-P: **2-0-1**	Credits: **3**	Contact Hrs: **04 hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **30**	Exam Duration: **03 hrs**	

Unit –I		
1	**Distributed System Models and Enabling Technologies** Scalable Computing over the Internet, Technologies for Network-Based Systems, System Models for Distributed and Cloud Computing.	**04 hrs**
2	**Virtual Machines and Virtualization of Clusters and Data Centers** Implementation Levels of Virtualization, Virtualization Structures/Tools and Mechanisms, Virtualization of CPU, Memory, and I/O Devices, Virtual Clusters and Resources Management.	**04 hrs**
3	**Cloud Platform Architecture over Virtualized Data Centers** Cloud Computing and Service Models, Architectural Design of Compute and Storage Clouds, Public Cloud Platforms.	**04 hrs**
Unit –II		
4	**Cloud Programming and Software Environments** Features of Cloud and Grid Platforms, Parallel and Distributed Programming Paradigms, Programming Support of Google App Engine.	**04 hrs**
5	**Cloud Resource Management** Policies and mechanisms for resource management, Applications of control theory to task scheduling on a cloud, Stability of a two-level resource allocation architecture, Feedback control based on dynamic thresholds, Coordination of specialized autonomic performance managers.	**04 hrs**
6	**Cloud Resource Scheduling** Resource bundling; combinatorial auctions for cloud resources, Scheduling algorithms for computing clouds. Fair queuing, Start-time fair queuing, Borrowed virtual time, Cloud scheduling subject to deadlines, Scheduling MapReduce applications subject to deadlines.	**04 hrs**
Unit –III		

6	**Cloud Security** Cloud security risks, Security; the top concern for cloud users, Privacy; privacy impact assessment, Trust, Operating system security, Security of virtualization.	**03 hrs**
7	**Hypervisor & Operating System security** Security risks posed by shared images, Security risks posed by a management OS, Xoar - breaking the monolithic design of the TCB, A trusted virtual machine monitor.	**03 hrs**

Text Books:

3. Kai Hwang, Geoffrey C. Fox, Jack J. Dongarra, "Distributed and Cloud Computing from Parallel Processing to the Internet of Things", Morgan Kaufman, Elsevier- 2012.
4. Dan C. Marinescu "Cloud Computing Theory and Practice", Morgan Kaufman, Elsevier- 2013.

Reference Books:

5. Rajkumar Buyya, Christian Vecchiola, S.Thamarai Selvi "Mastering Cloud Computing", McGraw Hill Education (India) Pvt. Limited, 2013.
6. Anthony T. Velte, Toby J. Velte, Robert Elsenpeter: Cloud Computing, A Practical Approach, McGraw Hill, 2010.

Scheme for End Semester Assessment (ESA)

UNIT	8 Questions to be set of 20 Marks Each	Chapter Numbers	Instructions
I	Q.No.-1, Q.No.-2, Q.No.-3	1, 2, 3	Solve Any **2** out of **3**
II	Q.No.-4, Q.No.-5, Q.No.-6	4,5,6	Solve Any **2** out of **3**
III	Q.No.-7	7	Solve Any **1** out of **2**
	Q.No.-8	8	

Expt./Job No.	Brief description about the experiments	No. of Lab slots per batch (estimate)
1.	Hypervisors (Type-I and Type-II)	01
2.	Instance building using Infrastructure as a Service	01
3.	Application hosting using Platform as a Service	01
4.	Private cloud setup	01
5.	Developing Task Model Applications using Aneka Management Studio	02
6.	Developing Thread Model Applications using Aneka Management Studio	02
7.	VMware Online Hands on Lab (HOL)	01

Program: Bachelor of Engineering		
Course Title: **Professional Aptitude and Logical Reasoning**		Course Code:15EHSC301
L-T-P:3-0-0	Credits: **3**	Contact Hrs: **03 hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**

Unit –I		
1	Arithmetical Reasoning	10hrs
2	Analytical Thinking	4hrs
3	Syllogistic Logic	3hrs
Unit –II		
4	Verbal Logic	
5	Non-Verbal Logic	
Unit –III		
6	Lateral Thinking	

Text Books:

1. A Modern Approach to Verbal and Non – Verbal Reasoning – R. S. Aggarwal, Sultan Chand and Sons, New Delhi
2. Quantitative Aptitude – R. S. Aggarwal, Sultan Chand and Sons, New Delhi

Evaluation Scheme

Reference Books:

1. Verbal and Non – Verbal Reasoning – Dr. Ravi Chopra, MacMillan India
2. Lateral Thinking – Dr. Edward De Bono, Penguin Books, New Delhi

Scheme for End Semester Assessment (ESA)

ISA Scheme

Assessment	**Weight age in Marks**
Minor Exam 1	15
Minor Exam 2	15
Assignments	

Written Class Tests	10 10
Total	**50**

Program: Bachelor of Engineering		
Course Title: **Computer Networks Lab**		Course Code: **15ECSP302**
L-T-P: **0-0-1.5**	Credits: **1.5**	Contact Hrs: **3 hrs/week**
CIE Marks: **80**	SEE Marks: **20**	Total Marks: **100**
Teaching Hrs: **36**	Exam Duration: **3hrs**	

Expt. /Job No.	**Brief description about the experiment/job**
1.	Introduction to Hardware components and Ethernet LAN set up.
2.	Introduction to socket programming
3.	Implementation of FTP
4.	Implementation of error control techniques.
5.	Implementation of flow control ARQs
6.	Introduction to NOS.
7.	Subnet design
8.	VLAN setup
9.	OSPF and RIP configuration and performance analysis
10.	eBGP and iBGP configuration and performance analysis
11.	Wireless network performance analysis
12.	Wireless network performance analysis

Program: Bachelor of Engineering		
Course Title: **Web Technologies Lab**		Course Code:**15ECSP303**
L-T-P: **0-0-1.5**	Credits: **1.5**	Contact Hrs: **3 hrs/week**
CIE Marks: **80**	SEE Marks: **20**	Total Marks: **100**
Teaching Hrs: **42**	Exam Duration: **3** hrs	

	Tutorial	
1	**Javascript Frameworks** **Angular2:** Introduction, Navigation: Angular router, Dependency injection, Bindings, observables, and pipes, component communications, forms, Interacting with servers using HTTP and WebSockets, Bundling and deploying applications. **Node.js** Introduction to Node.js Building servers using the http and net modules, Node modules and events, Express, Accessing Data.	**12 hrs**

2	**Python Frameworks** Introduction to Python Frameworks, components of frameworks,-building RESTful web services.	**06 hrs**
3	**Using Python full stack frameworks** Django**:** Introduction to Django, Django's take on MVC: Model, View and Template, Django Forms: Form classes, Validation, Authentication, Advanced Forms processing techniques, working with databases, Integrate with RESTful web services.	**06 hrs**
4	**Building Enterprise Web Applications.** Ruby on Rails: An Overview Of Ruby on Rails, Rails and HTML Forms, Form Helpers and Validation, Databases and Rails, Adding Style to an Application, Sessions.	**06 hrs**

Tentative Lab Plan

Expt./ Job No.	Lab assignments/experiment	No. of Lab. Slots per batch (estimate)
1	Demonstration on Angular.js	01
2	Exercise on Angular.js	01
3	Demonstration on Node.js	01
4	Exercise on Node.js	01
5	Demonstration on Django	01
6	Exercise on Django	01
7	Demonstration on Ruby on Rails	01
8	Exercise on Ruby on Rails	01
9	Structured enquiry 1 – JavaScript	02
10	Structured enquiry 2 – Django	02
11	Structured enquiry 3 – Ruby on Rails	02

Reference Books:

1. Yakov Fain, Anton Moiseev, "Angular 2 Development with TypeScript", Manning Publications Company, 2016.
2. Azat Mardan, "Practical Node.js: Building Real-World Scalable Web Apps", Apress, 2014.
3. Jeff_Forcier, "Python Web Development with Django", 1st edition, Pearson Education, 2008.
4. Michael Hartl, "Ruby on Rails Tutorial: Learn Web Development with Rails (2nd Edition) (Addison-Wesley Professional Ruby)".

Program: **Bachelor of Engineering**		
Course Title: **Minor Project**		Course Code: **15ECSW302**
L-T-P: **0-0-6**	Credits: **6**	Contact Hrs: **3 hrs/week**
CIE Marks: **50**	SEE Marks: **50**	Total Marks: **100**
Teaching Hrs: **39**	Exam Duration: **3 hrs**	

Student Evaluation Matrix

	Assessment	**Weightage in Marks**
Continuous Internal Evaluation Review -1	Problem Definition & Literature survey	05
	Requirement analysis and System design	05
	Synopsis and SRS report	07
	Presentation skills and team work	03
	Total	**20**
Continuous Internal Evaluation Review -2	Implementation and testing	15
	Presentation skills and team work	05
	Total	**20**
Continuous Internal Evaluation Review -3	Result Analysis	03
	Project Report	05
	Presentation skills and Viva-voce	02
	Total	**10**

Program: **Bachelor of Engineering**		
Course Title: **Computer Vision**		Course Code:**17ECSE308**
L-T-P: 3-0-0	Credits: 3	Contact Hrs: **3hrs/week**
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 30		Exam Duration: 3 hrs

.

Unit – 1		
1	**Introduction** Computer Vision Overview, Pixels and image representation, Filters: Linear systems, Convolutions and cross-correlations; Lab: Basics, Filters	**4hrs**

2	**Features and filtering** Edge detection: Gaussian, Sobel filters, Canny edge detector, Features and fitting: RANSAC Local features, Harris corner detection, Feature descriptors: Difference of gaussians, Scale invariant feature transform; Lab: Filters, Edges, Features	**8hrs**
Unit – 2		
3	**Semantic segmentation** Perceptual grouping, Agglomerative clustering, Super pixels and over segmentation; Clustering: K-means, Mean shift; Visual Bag of Words: Texture features, Visual bag of words; Lab: Resizing, clustering, recognition	**6 hrs**
4	**Motion** Optical Flow, Lucas-Kanade method, Horn-Schunk Method, Pyramids for large motion, Tracking: Feature Tracking, Lucas KanadeTomasi (KLT) tracker; Lab: Object detection, optical flow	**6hrs**
Unit – 3		
5	**Advanced Techniques** Image stitching, Image pyramids, Object recognition, Dimensionality reduction, Face identification, Detecting objects by parts	**6hrs**

Reference Books:

1. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer, 2011.
2. D. Forsyth and J. Ponce, Computer Vision: A Modern Approach, Pearson Education India, 2ndEd, 2015.
3. R. I. Hartley and A. Zisserman, Multiple View Geometry in Computer Vision, Cambridge University Press, 2nd Edition, 2004.

Scheme for End Semester Assessment (ESA)

UNIT	8 Questions to be set of 20 Marks Each	Chapter Numbers	Instructions
I	Q.No.-1, Q.No.-2, Q.No.-3	1, 2	Solve Any 3 out of 4
II	Q.No.-4, Q.No.-5, Q.No.-6	3, 4	Solve Any 3 out of 4
III	Q.No-7,Q.No-8	5	Solve Any 1 out of 2

Program: **Bachelor of Engineering**		
Course Title: **Algorithmic Problem Solving**		Course Code: **17ECSE309**
L-T-P: **0-0-6**	Credits: **6**	Contact Hrs: 74
ISA Marks: **70**	ESA Marks: 30	Total Marks: **100**
Teaching Hrs: 74	Exam Duration: 2 to 3 days	

Course Content

Unit – 1	
Chapter 0: Building Blocks Understanding coding platforms and tools, Data Structures and Algorithms revisited	**06 hrs**
Chapter 1: Strategies and Performance Warm up problems, Parsing and Formatting text, Code performance analysis and tools	**06 hrs**
Chapter 2: Advanced Data Structures Matrix, Grids, Trees and variants, Lists, Skip lists, Hash, Trie and variants	**10 hrs**
Chapter 3: Dynamic Programming Memory functions, Optimization problems	**08 hrs**
Unit – 2	
Chapter 4: Graph algorithms Traversal Algorithms, Shortest Path Algorithms, Spanning Tree Algorithms and variants	**25 hrs**
Chapter 5: Introduction to Computational Geometry Points, Line Segments, Polygons and Basics of Geometric Problems	**05 hrs**
Unit – 3	
Chapter 6: Problem Solving Assortment of problems and techniques.	**14 hrs**

Text Book

1. Levitin A., “Introduction to the Design and Analysis of Algorithms”, Third Edition, Pearson Education, 2017.
2. Levitin A, Levitin M, “Algorithmic Puzzles”, First Edition, Oxford University Press, 2011.
3. Online Coding Platforms

References

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, “Introduction to Algorithms”, Third Edition, MIT Press, 2010.

Program: Bachelor of Engineering		
Course Title: **Internet of Things**		Course Code: **17ECSE303**
L-T-P: **2-0-1**	Credits: 3	Contact Hrs: **4 hrs/week**
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 30 **hrs**	Exam Duration: 3 **hrs**	

	Unit –I	
1	**Introduction to Internet of Things (IoT)** Definition & Characteristics of IoT, Things in IoT, IoT protocols, IoT functional blocks, communication models and APIs.	**04 hrs**
2	**IoT Architecture** Enabling technologies: Sensors, Zigbee, Bluetooth, IoT ecosystem, Data Link protocols: IEEE 802.15.4e, IEEE 802.11.ah, DASH7, Low Power Wide Area Network (LoRaWAN).	**04 hrs**
3	**Network protocols** Routing Protocol for Low-Power and Lossy Networks (RPL), cognitive RPL (CORPL), Channel-Aware Routing Protocol (CARP), Low power Wireless Personal Area Networks (LoWPAN).	**04 hrs**
	Unit –II	
4	**Application and Security protocols** Message Queue Telemetry Transport (MQTT), MQTT for Sensor Networks, Secure MQTT, Advanced Message Queuing Protocol (AMQP), Constrained Application Protocol (CoAP), OPC UA, 6LoWPAN), Routing Protocol for Low-Power and Lossy Networks (RPL).	**04 hrs**
5	**IoT Platforms Design Methodology** IoT Design Methodology, Case Study on IoT System for Weather Monitoring etc., Basic building blocks of an IoT device, Raspberry Pi, interface (serial, SPI, I2C), IoT Operating Systems: Contiki, RIOT.	**04 hrs**
6	**Programming with Raspberry Pi** XML, JSON, SOAP and REST-based approach, WebSocket protocol.	**04 hrs**
	Unit –III	
7	**IoT prototyping** Business models, example applications: Case studies on Home automation, Cities, Environment, Energy, Agriculture, Health with emphasis on data analytics and security.	**06 hrs**

Text Books: 2. Arshdeep Bahga, Vijay Madisetti "Internet of Things (A Hands-on-Approach)" Universities Press- 2014. 3. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things: Key Applications and Protocols" John Wiley & Sons – 2012. **Reference Books:** 1. Subhas Chandra Mukhopadhyay "Internet of Things Challenges and Opportunities" Springer- 2014.

Scheme for Semester End Examination (SEE)

UNIT	8 Questions to be set of 20 Marks Each	Chapter Numbers	Instructions
I	Q.No.-1, Q.No.-2, Q.No.-3	1, 2,3	Solve Any **2** out of **3**
II	Q.No.-4, Q.No.-5, Q.No.-6	4,5,6	Solve Any **2** out of **3**
III	Q.No.-7	7	Solve Any **1** out of **2**

Expt./Job No.	Brief description about the experiments	No. of Lab slots per batch (estimate)
1.	Programming with Raspberry Pi	3
2.	Cloud service interface for data storage and retrieval	2
3.	Performance analysis of Data link protocols, routing and application protocols	3
4.	Open Ended Experiment with focus on data analytics and security	2

Program: Bachelor of Engineering		
Course Title: **Active Directory Domain Services**		Course Code:**17ECSE304**
L-T-P: **3-0-0**	Credits: **3**	Contact Hrs: **03 hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **40**	Exam Duration: **03 hrs**	

Unit –I		
1	**Introduction to Microsoft Active Directory** Introduction to Microsoft Active Directory, Roles of Active directory services, Features in ADDS.	**06 hrs**
2	**Domains and Forests** Active Directory Structure Storage and Technologies, Data Store Components,	**05 hrs**

	Active Directory Domains and Forests, The Logical Structure of Active Directory.	
3	**Physical Structure** The Physical Structure of Active Directory, Network Ports used by Domains and Forests.	**04 hrs**
Unit –II		
4	**Installation of R2 server** Requirements for installing ADDS, Understanding of Active Directory Domain Services Functional levels.	**06 hrs**
5	**Administration** Guidelines for raising domain and forests functional levels, Introduction to various AD Snap-ins and their functions	**04 hrs**
6	**Domain Services** Active Directory Users and Computers, Active Directory Domains and Trusts, Active Directory Sites and Services.	**05 hrs**
Unit –III		
7	**Backup/Restore** Backing Up Directory Domain Services Active, Recovering Active Directory Domain Services. Authoritative restore, Methods of authoritative restore	**10 hrs**
Text Books: 1. Introduction to MICROSOFT Active Directory Domain Services (ADDS), Microsoft reference materials.		

Scheme for End Semester Assessment (ESA)

UNIT	**8 Questions to be set of 20 Marks Each**	**Chapter Numbers**	**Instructions**
I	Q.No.-1, Q.No.-2, Q.No.-3	1,2,3	Solve Any **2** out of **3**
II	Q.No.-4, Q.No.-5, Q.No.-6	4,5,6	Solve Any **2** out of **3**
III	Q.No.-7, 8	7	Solve Any **1** out of **2**

Program: Bachelor of Engineering		
Course Title: **Parallel Computing**		Course Code: **17ECSE307**
L-T-P: **3-0-0**	Credits: **3**	Contact Hrs: **03 hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **43**	Exam Duration: **03 hrs**	

Unit –I		
1	**Introduction to Parallel Computing & Parallel Programming Platforms:** Motivating Parallelism, Scope of Parallel Computing, Implicit Parallelism: Trends in Microprocessor Architectures, Limitations of Memory System Performance, Dichotomy of Parallel Computing Platforms, Physical Organization of Parallel Platforms, Communication Costs in Parallel Machines, Routing Mechanisms for Interconnection Networks, Impact of Process-Processor Mapping and Mapping Techniques	**07 hrs**
2	**Principles of Parallel Algorithm Design:** Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing, Methods for Containing Interaction Overheads, Parallel Algorithm Models	**09 hrs**
Unit –II		
3	**Analytical Modeling of Parallel Programs:** Sources of Overhead in Parallel Programs, Performance metrics for parallel systems, The effect of Granularity on performance, Scalability of Parallel Systems, Minimum execution time and minimum cost optimal execution time, Asymptotic analysis of Parallel programs, Other Scalability Metrics	**09 hrs**
4	**Programming Using the Message Passing Paradigm:** Principles of Message – Passing Programming, The Building Blocks, MPI: The Message passing Interface, Overlapping Communication with Computation, Collective Communication and Computation Operations, Groups & Communicators	**07 hrs**
Unit –III		
5	**Programming Shared Address Space Platforms:** Thread Basics, POSIX Thread API, Synchronization Primitives in Pthreads, Controlling Thread and Synchronization Attributes, Thread Cancellation, Composite Synchronization Constructs, OpenMP: A standard for Directive Based Parallel Programming.	**06 hrs**
6	**Case Study/ Projects and Recent Trends:** Case Study/ Projects and Recent Trends	**05 hrs**

Text Books: 1. Ananth Grama, George Karypis, Vipin Kumar and Anshul Gupta, Introduction to Parallel Computing, Second Edition, Pearson India, 2013 **References:** 1. Michael Quinn, Parallel Computing Theory and Practice, Tata McGraw Hill, 2003

Scheme for End Semester Assessment (ESA)

UNIT	**8 Questions to be set of 20 Marks Each**	**Chapter Numbers**	**Instructions**
I	Q.No.-1, Q.No.-2, Q.No.-3	1,2	Solve Any **2** out of **3**
II	Q.No.-4, Q.No.-5, Q.No.-6	3,4	Solve Any **2** out of **3**
III	Q.No.-7, 8	5,6	Solve Any **1** out of **2**

Program: **Bachelor of Engineering**		
Course Title: **Quantum Computing**		Course Code:17ECSE306
L-T-P: **3-0-0**	Credits: **3**	Contact Hrs: **3 hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **50**	Exam Duration: **3hrs**	

Unit –I		
1	**Introduction and Background:** Overview, Computers and the Strong Church–Turing Thesis, The Circuit Model of Computation, A Linear Algebra Formulation of the Circuit Model, Reversible Computation, A Preview of Quantum Physics, Quantum Physics and Computation.	**07hrs**
2	**Linear Algebra and the Dirac Notation:** The Dirac Notation and Hilbert Spaces, Dual Vectors, Operators, The Spectral Theorem, Functions of Operators, Tensor Products, The Schmidt Decomposition Theorem, Some Comments on the Dirac Notation.	**05hrs**
3	**Introduction to Quantum Toolbox in Python:** Installation, Basics and Quantum mechanics	**04 hrs**
Unit –II		
4	**Qubits and the Framework of Quantum Mechanics:** The State of a Quantum System, Time-Evolution of a Closed System, Composite Systems, Measurement, Mixed States and General Quantum Operations, Mixed	

	States, Partial Trace, General Quantum Operations.	**08hrs**
5	**A Quantum Model of Computation:** The Quantum Circuit Model, Quantum Gates, 1-Qubit Gates, Controlled-U Gates, Universal Sets of Quantum Gates, Efficiency of Approximating Unitary Transformations, Implementing Measurements with Quantum Circuits.	**05hrs**
6	Exploring Python for Solving Problems / Projects using Quantum Computing	**03 hrs**
Unit –III		
7	**Introductory Quantum Algortihms:** Probabilistic Versus Quantum Algorithms, Phase Kick-back, The Deutsch Algorithm, The Deutsch–Jozsa Algorithm, Simon's Algorithm.	**04hrs**
8	**Case Studies and Projects done during the course:** Image processing, Data Sciences, Machine Learning, Networking	**04 hrs**

Text Books

2. Phillip Kaye, Raymond Laflamme and Michele Mosca "An Introduction to Quantum Computing ", Oxford University, Press, 2007
3. User Guide - Quantum Toolbox in Python, Release 4.2.0 – Qutip.org

References:

1. Internet References, toolbox and other relevant software's.

Scheme for Semester End Examination (ESA)

UNIT	8 Questions to be set of 20 Marks Each	Chapter numbers	Instructions
I	Q.No.-1, Q.No.-2, Q.No.-3	1, 2,3	Solve Any **2**
II	Q.No.-4, Q.No.-5, Q.No.-6	4, 5, 6	Solve Any **2**
III	Q.No.-7	7	Solve Any **1**
	Q.No.-8	8	

Program: **Bachelor of Engineering**		
Course Title: **Embedded Intelligent Systems**		Course Code: **18ECSE302**
L-T-P: 0-0-3	Credits: 3	Contact Hrs: **6hrs/week**
ISA Marks: 80	ESA Marks: 20	Total Marks: 100
Teaching Hrs: 60	Exam Duration: 3 hrs	

1	**Basics of embedded systems** Linux Application Programming, System V IPC, . Linux Kernel Internals and Architecture , Kernel Core , Linux Device Driver Programming, Interrupts &	**10 hrs**

	Timers , Sample shell script, application program, driver source build and execute	
2	**Heterogeneous computing** Basics of heterogeneous computing with various hardware architectures designed for specific type of tasks, Advanced heterogeneous computing with a. Introduction to Parallel programming b.GPU programming (OpenCL) c. Open standards for heterogeneous computing (Openvx) , Basic OpenCL examples - Coding, compilation and execution	**12 hrs**
3	**ML Frameworks lab with the target device** Caffe, tensorflow, TF Lite machine learning frameworks & architecture ,Model parsing, feature support and flexibility ,Supported layers , advantages and disadvantages with each of these frameworks, Android NN architecture overview , Full stack compilation and execution on embedded device	**16 hrs**
4	**Model Development and Optimization** Significance of on device AI ,Quantization , pruning, weight sharing, Distillation ,Various pre-trained networks and design considerations to choose a particular pre-trained model ,Federated Learning , Flexible Inferencing	**8 hrs**
6	**Android Anatomy** Android Architecture ,Linux Kernel , Binder , HAL Native Libraries , Android Runtime, Dalvik Application framework , Applications, IPC	**8 hrs**

Program: Bachelor of Engineering		
Course Title: **JAVA Programming**		Course Code: 19ECSP301
L-T-P:**1-0-1.5**	Credits: **2.5**	Contact Hrs: 4 Hrs/week
ISA Marks: **80**	ESA Marks: **20**	Total Marks: **100**
Teaching Hrs: **52**	Exam Duration: **3hrs**	

Unit –I		
1	**JAVA Language Fundamentals:** Java Features, Programming basics, Arrays and Strings, classes and objects	**4 Hrs**
2	**Inheritance**: Introduction, types of inheritance, static and dynamic polymorphism.	**2 Hrs**
Unit –II		
3	**Interfaces and Exception Handling:** Introduction,Create and implement interfaces, Exception handling,	**2 Hrs**
4	**Generics and Collections Frame work:** Introduction to generic programming, Collections: Interfaces: List, Set, Queue Classes: ArrayList, LinkedList and HashSet, Map	**2 Hrs**
Unit –III		
5	**Lambda Expressions:** Functional programming, Functional interface, Bulk operations on collections	**2hrs**

6	**Java Database Connectivity (JDBC):** Introduction, Drivers, Interfaces and classes to develop data base applications, case study	**2 Hrs**

Text Books:

1. JAVA The Complete Reference, Herbert Schildt, 10th Ed, 2017, McGraw-Hill

Reference Book

1. Kathy Sierra and Bert Bates, Head First Java: A Brain-Friendly Guide, 2nd Edition, O'Reilly Media
2. Introduction to Java Programming, Liang Y D, Pearson, 11th Edition

Program: **Bachelor of Engineering**		
Course Title: **Semantic Web**		Course Code:**19ECSE303**
L-T-P: **3-0-0**	Credits: **3**	Contact Hrs: **3hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **40**	Exam Duration: **03 hrs**	

Unit –I		
1	**Introduction to Semantics** History of the Web, Limitations, Vision of Semantic Web, Principles, Data Integration Across Web, Data Modeling Methods, Semantic Relationships, Metadata, Perpetual Data	**4 hrs**
2	**Expressing Meaning** Triple Store, Merging Graphs, Querying: Case Study	**4 hrs**
3	**Using Semantic Data** Query Language, Feed Forward Inference, Searching for Connections, Linked Data, Freebase	**8 hrs**
Unit –II		
4	**Working with Semantics** RDF—The Basis of the Semantic Web, OWL, Metadata with RDF, Metadata Taxonomies, Ontology	**8 hrs**
5	**Reasoning and Social Web** Reasoning types: Approximate Reasoning and Bounded Reasoning, Social Semantic Web, Semantic Crawlers	**8 hrs**
Unit –III		
6	**Semantic Modeling** Semantic Modeling, Semantic Web Applications, Logic for Semantic Web, Case Studies: Dr. Watson, Yahoo! SearchMonkey	**8 hrs**

Text Books

1. Grigoris Antoniou, Paul Groth, Frank van Harmelen and Rinke Hoekstra, A Semantic Web Primer, MIT Press; 3rd edition, 2012.
2. Toby Segaran, Colin Evans, and Jamie Taylor, Programming the Semantic Web: Build Flexible Applications with Graph Data, O'Reilly Media; 2 edition, July 2009.

Reference Books:

1. Pascal Hitzler, Markus Krötzsch, Sebastian Rudolph, Foundations of Semantic Web Technologies, Chapman and Hall; 1st edition, 2009.
2. Dean Allemang, and James Hendler, Semantic Web for the Working Ontologist, Effective Modeling in RDFS and OWL, Morgan Kaufmann; 2nd edition, 2011.
3. John Hebeler, Matthew Fisher, Ryan Blace, Andrew Perez-Lopez, and Mike Dean (Foreword), Semantic Web Programming, Wiley Publishers, 1 edition 2009.

Scheme for End Semester Assessment (ESA)

UNIT	8 Questions to be set of 20 Marks Each	Chapter Numbers	Instructions
I	Q.No.-1, Q.No.-2, Q.No.-3	1, 2,3	Solve Any **2**
II	Q.No.-4, Q.No.-5, Q.No.-6	4,5	Solve Any **2**
III	Q.No.-7	6	Solve Any **1**
	Q.No.-8	6	

Course Title: Block Chain Technology		Course ode:19ECSE301
L-T-P: **2-0-1**	Credits: **3**	Contact Hrs: **3hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **40**	Exam Duration: **3 hrs**	

	Unit –I	
1	**Introduction** Overview of Blockchain, History: Digital Money to Distributed Ledgers, Design Primitives: Protocols, Security, Consensus, Permissions, Privacy	**08 hrs**
2	**Blockchain Architecture and Design** Crypto primitives- Hash, Signature, Hashchain to Blockchain, basic consensus mechanisms, Requirements for the consensus protocols, Proof of Work, Proof of State, Scalability issues of consensus protocols	**08 hrs**
	Unit –II	
3	**Blockchain Contracts** Financial Services, Crowdfunding, Bitcoin Prediction Markets, Smart Property, Smart Contracts, Blockchain Development Platforms and APIs, Blockchain Ecosystem: Decentralized Storage, Communication, and Computation	**08 hrs**
4	**Etherium** Etherium transactions, accounts, smart contracts, smart contract development, Solidity basics, basic contracts, distributed storage, Etherium scaling	**08 hrs**
	Unit –III	
5	**Blockchain Applications** Blockchain in Financial Software and Systems: Settlements, KYC, InsuranceBlockchain for Government: Digital identity, land records and other kinds of record keeping between government entities, public distribution system social welfare systems	**08hrs**

Text Books:
1. Melanie Swan, “Blockchain: Blueprint for New Economy", 1st Edition, O'Reilly Media, 2014.
Reference Books:
1**.** ArshdeepBhaga, Vijay Madisetti, "Blockchain Applications: A Hands-On Approach", Paperback– January 31, 2017

Scheme for End Semester Assessment (ESA)

UNIT	**8 Questions to be set of 20 Marks Each**	**Chapter Numbers**	**Instructions**
I	Q.No.-1, Q.No.-2, Q.No.-3	1,2	Solve Any **2**
II	Q.No.-4, Q.No.-5, Q.No.-6	3,4	Solve Any **2**
III	Q.No.-7, 8	5	Solve Any **1**

Course Title: The ARM Architecture		**Coursecode:19ECSE302**
L-T-P: 2-1-0	**Credits: 3**	**Contact Hrs: 3hrs/week**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hrs: 30	**Exam Duration: 3 hrs**	

	Unit –I	
1	**ARM Embedded Systems and Processor Fundamentals** The RISC Design Philosophy , The ARM Design Philosophy, Embedded System Hardware, Embedded System Software, Registers, Current Program Status Register, Pipeline, Exceptions, Interrupts, and the Vector Table, Core Extensions, Architecture Revisions, ARM Processor Families	06 hrs
2	**Introduction to the ARM Instruction Set & Assembly Programming** Data Processing Instructions, Branch Instructions, Load-Store Instructions, Software Interrupt Instruction, Program Status Register Instructions, Loading Constants, ARMv5E Extensions, Conditional Execution, Thumb instruction set.	06 hrs
	Unit –II	
3	**Efficient C Programming** Overview of C Compilers and Optimization, Basic C Data Types, C Looping Structures, Register Allocation, Function Calls, Pointer Aliasing, Structure Arrangement, Bit-fields, Unaligned Data and Endianness, Division.	06 hrs
4	**Writing and Optimizing ARM Assembly Code** Writing Assembly Code, Profiling and Cycle Counting, Instruction Scheduling, Register Allocation, Conditional Execution, Looping Constructs, Bit Manipulation, Efficient Switches, Handling Unaligned Data.	06 hrs
	Unit –III	
5	**Introduction to LPC-2148 controller**	03 hrs

	Input output Ports, Pin select registers, Input output select registers, direction control and control registers, Introduction to interfacing standards	
6	**ARM Interfacing** ARM interfacing to peripherals like LED, LCD, Seven segments, Motors, Converters, Keypad.	03 hrs

Text Books

1. Andrew N.Sloss et al, ARM System Developer's Guide- Designing and Optimizing System Software

Reference Books:

1.Marilyn Wolf, Computers as Components: Principles of embedded computing system design, Morgan Ka, 2012

2.Steve Furber, ARM System-on-chip Architecture, 2, Pearson, 2000

Tutorial Plan

Expt./ Job No.	assignments/experiment	No. of Lab. Slots per batch (estimate)
1	ALP on arithmetic instructions set	*01*
2	ALP on logical instructions set	01
3	ALP on loop and branch instructions	01
4	Interface LED and Seven segments to ARM for displaying message.	01
5	Interface LCD to ARM for displaying message.	01
6	Interface Keypad to read the characters	01
7	Rotate DC and stepper motor for variable speed and direction	01
8	Interface DAC to ARM controller	01

Scheme for End Semester Assessment (ESA)

UNIT	**8 Questions to be set of 20 Marks Each**	**Chapter Numbers**	**Instructions**
I	Q.No.-1, Q.No.-2, Q.No.-3	1,2	Solve Any **2** out of **3**
II	Q.No.-4, Q.No.-5, Q.No.-6	3,4	Solve Any **2** out of **3**
III	Q.No.-7, 8	5	Solve Any **1** out of **2**

Program: **Bachelor of Engineering**		
Course Title: **Big Data and Analytics**		Course Code: **17ECSC401**
L-T-P: **2-0-1**	Credits: **03**	Contact Hrs: **04 hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **54**	Exam Duration**: 03 hrs**	

Unit –I		
1	**Understanding Big Data -** What is Big Data?, Data Analytics, Data Analytics Life Cycle, Big Data Characteristics , Different Types of Data.	**04hrs**
2	**Big Data Storage Concepts -** Clusters , File Systems and Distributed File Systems , NoSQL , Sharding, Replication , Combining Sharding and Replication.	**06 hrs**
3	**Big Data Processing Concepts -** Parallel Data Processing, Distributed Data Processing, Hadoop.	**03 hrs**
Unit –II		
4	**Big Data Processing Concepts - Map Reduce -** Processing Workloads, Cluster, Processing in Batch Mode, Processing in Real-time Mode.	**06hrs**
5	**Introduction to MongoDB-** What is MongoDB?, WhyMongoDB?, Terms Used in RDBMS and MongoDB, Data Types in MongoDB, MongoDB Query Language.	**06hrs**
Unit –III		
6	**Introduction to Hive -** What is Hive?, Hive Architecture, Hive Data Types, Hive File Format, Hive Query Language (HQL), RCFile Implementation, User-Defined Function (UDF).	**05hrs**

Text Books

1. Thomas Erl, WajidKhattak,and Paul Buhler,"Big Data Fundamentals Concepts, Drivers & Techniques", Prentice Hall, 2015.
2. SeemaAcharya, SubhashiniChellappan,"Big Data and Analytics", Wiley India Pvt Ltd, 2014.

Reference Books

1. Frank J Ohlhorst, "Big Data Analytics: Turning Big Data into Big Money", Wiley and SAS Business Series, 2012.
2. Colleen Mccue, "Data Mining and Predictive Analysis: Intelligence Gathering and Crime Analysis", Elsevier, 2007.

Scheme for End Semester Assessment(ESA)

UNIT	8 Questions to be set of 20 Marks Each	Chapter Numbers	Instructions
I	Q.No.-1, Q.No.-2, Q.No.-3	1, 2,3	Solve Any **2** out of **3**
II	Q.No.-4, Q.No.-5, Q.No.-6	4,5	Solve Any **2** out of **3**
III	Q.No.-7, Q.No.-8	6	Solve Any **1** out of **2**

Program: **Bachelor of Engineering**		
Course Title: **Capstone Project**		Course Code: **18ECSW401**
L-T-P: **0-0-14**	Credits: **6**	Contact Hrs: **3 hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
	Exam Duration: **3hrs**	

Project themes:

Networking	Data Engineering	System Engineering
• Internet of Things • Cloud Computing • Software Defined Network • Social Network Analysis	• Data Analytics • Image and video processing • Computer Vision and Graphics • Natural Language Processing	• Parallel Computing • High Performance Computing • Parallel system design

***Evaluation*:**

Students Assessment through ISA (50%) + ESA (50%)

	Assessment	Weightage in Marks
Internal Semester Assessment* (50%)	Periodic reviews by Project Guide	25
	Periodic reviews by Committee	25
End Semester Assessment (50%)	Final Review	50
	Total	**100**

Program: **Bachelor of Engineering**		
Course Title: **Industry Training**		Course Code: 18ECSI493
Credits: 6	ISA Marks: 50	ESA Marks: 50
Total Marks: 100	Exam Duration: 3 hrs	L-T-P: 0-0-6

Overview of the Course

Industry Training is a supervised, practical training periods for which Undergraduate, final year students earn academic credits. Industry Training provide excellent opportunities for students to put into practice much of the knowledge and skills acquired during their studies and to gain firsthand knowledge of the software industry. It is also an opportunity for employers to observe the student in the work environment and evaluate their potential for possible future employment.

The companies selected for the Industry Training can range from start-ups to large scale industries.The students who got placed in campus interviews may be offered Industry Training depending upon the need of the company. Other students who wish to do internship are responsible to find a company on their own for the Training.

Course Learning Outcomes.

CO 1. Apply the knowledge and skills acquired on campus in a real-life work situation.

CO 2. Provide students with opportunities for practical, hands-on learning from practitioners.

CO 3. Enhance the employability skills of the students.

CO 4. Practice ethical standards appropriate to Internship site.

CO 5. Ability to write technical documents and give oral presentations of the work completed.

Scheme for In Semester Assessment(ISA) and End Semester Assessment (ESA)

Course	Course Code	Max ISA marks	Max ESA marks	Minimum Passing Marks
Industry Training	18ECSI493	50	50	Students must secure minimum of 40% marks in both ISA and ESA.

Program: **Bachelor of Engineering**		
Course Title: **Industry Project**		Course Code: 18ECSW494
Credits: 14	ISA Marks: 50	ESA Marks: 50
Total Marks: 100	Exam Duration: 3 hrs	L-T-P: 0-0-14

Overview of the Course

The purpose of providing the Industry Project is to give you the opportunity for students, to apply the knowledge, skills and competencies they have acquired, in real life practice. An Industry Project involves a stay in a relevant company or organization.

The students who got placed in campus interviews may be offered Industry Project depending upon the need of the company. Other students who wish to do Industry Project are responsible to find a company on their own.

Course Learning Outcomes.

CO 1. Identify the problem and perform requirement analysis

CO 2. Design potential solutions and evaluate to select optimal solution

CO 3. Apply professional norms of project implementation to meet specified requirements

CO 4. Apply fundamental activities of module, integration and system testing to validate the system

CO 5. Analyze results and present technical/scientific findings effectively through written and oral mode

Scheme for In Semester Assessment(ISA) and End Semester Assessment (ESA)

Course	Course Code	Max ISA marks	Max ESA marks	Minimum Passing Marks
Industry Project	18ECSW494	50	50	Students must secure minimum of 40% marks in both ISA and ESA.

Program: Bachelor of Engineering		
Course Title: Cyber Security		Course Code: **18ECSE401**
L-T-P: **2-0-1**	Credits: **3**	Contact Hours: **04 hrs/week**
CIE Marks: **50**	SEE Marks: **50**	Total Marks: **100**
Teaching Hours: **40**	Examination Duration: **03 Hrs**	

Unit I	
Chapter No. 1. Introduction to Cybercrime, Cyber offenses & Cybercrime: Cybercrime definition and origins of the world, Cybercrime and information security, Classifications of cybercrime, A global Perspective on cybercrimes. Cyber attack plans, Social Engineering, Cyber stalking, Cyber cafe and Cybercrimes, Botnets, Proliferation of Mobile and Wireless Devices, Credit Card Frauds in Mobile and Wireless Computing Era.	**06 hrs**
Chapter No. 2. Cybercrimes and Cyber security: The Legal Perspectives: Why do we need Cyber law: The Indian Context, The Indian IT Act, Digital Signature and the Indian IT Act, Amendments to the Indian IT Act, Cybercrime and Punishment.	**06 hrs**
Unit II	
Chapter No. 3. Understanding computer forensic: Historical background of cyber forensic, Forensic analysis of email, Digital forensic life cycle, Network forensic, Setting up a computer forensic Laboratory, Forensic analysis of digital media.	**06 hrs**
Chapter No. 4. Cyber security: Organizational Implications: Cost of Cybercrimes and IPR Issues, Protecting People's Privacy in the Organization, Organizational Guidelines for Internet Usage, Intellectual Property in the Cyberspace of Cyber security.	**06 hrs**
Unit III	
Chapter No. 5. Cybercrime: Illustrations, Examples and Case studies: Introduction, Real-Life Examples, Case Studies: Illustrations of Financial Frauds in Cyber Domain, Digital Signature-Related Crime Scenarios, Online Scams.	**06 hrs**

Text Books:

1. Nina Godbole&SunitBelapure, "Cyber Security", Wiley India, 2012.

Reference Books:

1. Harish Chander, "Cyber laws & IT protection", PHI learning pvt.ltd, 2012.
2. Dhiren R Patel, "Information security theory & practice", PHI learning pvt.ltd, 2010.
3. Ms.M.K.Geetha&Ms.Swapne Raman, "Cyber Crimes and Fraud Management", Mc. MILLAN, 2012.
4. Bill Nelson, "Guide to Computer Forensics and Investigations", 4th Edition, CENGAGE Publication. 2009.

Tentative list of lab experiments:

1. Crime Scene / Field Response Evidence Preservation -1 Hr

2. System Image Restoration and Target drive preparation -1Hr
3. Removable/External Media Imaging -1 Hr
4. Evidence Search -1 Hr
5. Forensic analysis on Image documents -2 Hr
6. Forensic analysis on Audio files -2 Hr
7. Forensic analysis on Video files -2 Hr
8. Forensic analysis on Text Document -2 Hr

Scheme for End Semester Assessment(ESA)

UNIT	8 Questions to be set of 20 Marks Each	Chapter Numbers	Instructions
I	Q.No.-1, Q.No.-2, Q.No.-3	1, 2	Solve Any **2** out of **3**
II	Q.No.-4, Q.No.-5, Q.No.-6	3, 4	Solve Any **2** out of **3**
III	Q.No.-7, Q.No.-8	5	Solve Any **1** out of **2**

Program: **Bachelor of Engineering**		
Course Title: **Social Network Analysis**		Course Code: **18ECSE402**
L-T-P: **3-0-0**	Credits: **3**	Contact Hrs: **03 hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **40**	Exam Duration: **03 hrs**	

	Unit –I	
1	**Introduction** Introduction : Motivation, different sources of network data, types of networks, tools for visualizing network data.	**06 hrs**
2	**Structural properties of networks** Structural properties of networks : Notions of centrality, cohesiveness of subgroups, roles and positions, structural equivalence, equitable partitions, stochastic block models.	**10 hrs**
	Unit –II	
3	**Cascading properties of networks** Cascading properties of networks : Information/influence diffusion on networks, maximizing influence spread, power law and heavy tail distributions, preferential attachment models.	**10 hrs**
4	**Small world phenomenon** Small world phenomenon : Six Degrees of Separation, Structure and Randomness, Decentralized Search, Empirical Analysis and Generalized Models, Core-Periphery Structures and Difficulties in Decentralized Search, Advanced Material: Analysis of Decentralized Search.	**06 hrs**

Unit –III		
5	**Mining Graphs- I** Mining Graphs- I : Community and cluster detection: random walks.	**04 hrs**
6	**Mining Graphs- II** Mining Graphs- II : Spectral methods; link analysis for web mining.	**04 hrs**

Text Books

1. Stanley Wasserman, Katherine Faust, Social network analysis: methods and applications, Cambridge University Press, 1994.
2. David Easley and Jon Kleinberg, Networks, Crowds, and Markets: Reasoning About a Highly Connected World., Cambridge University Press, 2010.

Reference Books:

1. Peter R. Monge, Noshir S, Contractor, Theories of communication networks, Oxford University Press, 2003.
2. Duncan Watts, Six degrees: the science of a connected age. Norton, 2004.

Scheme for Semester End Examination (ESA)

UNIT	8 Questions to be set of 20 Marks Each	Chapter numbers	Instructions
I	Q.No.-1, Q.No.-2, Q.No.-3	1, 2	Solve Any **2** out of **3**
II	Q.No.-4, Q.No.-5, Q.No.-6	3, 4	Solve Any **2** out of **3**
III	Q.No.-7	5	Solve Any **1** out of **2**
	Q.No.-8	6	

Program: **Bachelor of Engineering**		
Course Title: **Unix Network Programming**		Course Code: **18ECSE404**
L-T-P: **3-0-0**	Credits: **3**	Contact Hrs: **03 hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **40**	Exam Duration: **3 hrs**	

Unit –I		
1	**Communication Protocols** Introduction TCP/IP – Internet Protocols XNS SNA NetBIOS UUCP Protocol comparisons.	5 hrs
2	**Elementary Socket Programming** Introduction Overview UNIX Domain Protocols Socket Addresses Elementary Socket system calls A simple example.	5 hrs

3	**Advanced Socket Programming** Advanced Socket System calls Reserved Ports Stream Pipes Passing file descriptors Socket options Asynchronous I/O Input/output Multiplexing Out-of-Band Data Sockets and Signals Internet Super server Socket implementation.	6 hrs
Unit –II		
4	**Time and Date Routines** Introduction Internet Time and Date Client Network Time Synchronization.	5 hrs
5	**Ping Routines** Introduction Internet Ping Client XNS Echo Client.	5 hrs
6	**Trivial File Transfer Protocol** Introduction Protocol Data Formats Connections Client user interface UDP implementation TCP implementation.	6 hrs
Unit –III		
7	**Remote Command Execution** Introduction Security Issues rcmd function and rshd Server rexec function and rexecd Server.	4 hrs
8	**Remote Login** Introduction Terminal Line disciplines A simple Example.	4 hrs

Text Books

1. W.R. Stevens, Unix Network Programming, PHI 2003.
2. M. J. Rochkind, Advanced Unix Programming, 2nd Edition, Pearson Education 2004.

Reference Books

1. Sumitabha Das, Unix Concepts and Applications, 3rd Edition, Tata McGraw-Hill 2006.

Scheme for End Semester Assessment(ESA)

UNIT	8 Questions to be set of 20 Marks Each	Chapter Numbers	Instructions
I	Q.No.-1, Q.No.-2, Q.No.-3	1, 2,3	Solve Any **2** out of **3**
II	Q.No.-4, Q.No.-5, Q.No.-6	4,5,6	Solve Any **2** out of **3**
III	Q.No.-7	7	Solve Any **1** out of **2**
	Q.No.-8	8	

Program: **Bachelor of Engineering**		
Course Title: **Software Testing**		Course Code:**18ECSE407**
L-T-P:**3-0-0**	Credits: **3**	Contact Hrs: **03 hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **40**	Exam Duration**: 3 hrs**	

Content	Hrs
Unit - 1	
Chapter No. 1.Software Testing Principles: Need for testing ,The Psychology and Economics of Program Testing Program ,Inspections, Walkthroughs, and Reviews.	04hrs
Chapter No. 2. Test-Case Design: Overview, White box testing, Error Guessing, strategies , Module (Unit) Testing-Incremental Testing, Top-down versus Bottom-up Testing, Performing the Test.	06hrs
Chapter No. 3. Higher-Order Testing: Function testing, System testing, Acceptance testing, Installation testing, Test planning and Control, Test completion criteria, Extreme testing.	06hrs
Unit - 2	
Chapter No. 4. Testing Tools and Standards: Automated Tools for Testing - Static code analyzers - Test case generators - GUI Capture/Playback – Stress Testing - Testing Client – server applications – Testing compilers and language processors - Testing web-enabled applications.	10hrs
Chapter No 5 :CMM Model and its stages – Introduction to PCMM, CMMI and Six Sigma concept – ISO 9000.	06hrs
Unit - 3	
Chapter No. 6. Software Quality and Testing: Introduction to software quality and quality control – Benefits of quality control - Quality assurance - quality circles and quality improvement.	04hrs
Chapter No. 7. Introduction to quality cost – Measuring quality cost – Total Quality Management (TQM).Architecture, Process, memory and file management in Mobile OS, Network OS.	04hrs

Text Books

1. Glenford J. Myers, Tom Badgett, Corey Sandler, and Todd M. Thomas, “The Art of Software Testing”, John Wiley & Sons, Second edition, 2004.
2. Roger S. Pressman, “Software Engineering. A Practitioners Approach”, McGraw-Hill International Edition, Seventh edition, 2009.

References

1. William E. Perry, “Effective Methods for Software Testing”, John Wiley & Sons, Secondedition, 2000.
2. Boris Beizer, “Techniques for Functional Testing of Software and Systems”, John Wiley & Sons, 1995.
3. P.C. Jorgensen, “Software Testing - A Craftman's Approach”, CRC Press, 1995.

4. Boris Beizer, "Software Testing Techniques", Van Nostrand Reinhold, Second edition, 1990.

Scheme for End Semester Assessment(ESA)

UNIT	8 Questions to be set of 20 Marks Each	Chapter Numbers	Instructions
I	Q.No.-1, Q.No.-2, Q.No.-3	1, 2, 3	Solve Any **2** out of **3**
II	Q.No.-4, Q.No.-5, Q.No.-6	4, 5	Solve Any **2** out of **3**
III	Q.No.-7, Q.No.-8	6, 7	Solve Any **1** out of **2**

Program: **Bachelor of Engineering**		
Course Title: **C# Programming and .NET**		Course Code: **18ECSE409**
L-T-P: 3-0-0	Credits: 3	Contact Hrs: **3hrs/week**
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 40	Exam Duration: 3 hrs	

Unit –I		
1	**The Philosophy of .NET** Understand the motivation behind the .NET platform, Common Language Infrastructure (CLI). Know the role of the Common Type System (CTS), the Common Language Specification (CLS) and the Common Language Runtime (CLR), Understand the assembly, metadata, namespace, type distinction, Contrast single-file and multi-file assemblies, Know the role of the Common Intermediate Language (CIL), Platform independent .NET(Mono / Portable .NET distributions).	**5hrs**
2	**C# Language Fundamentals** Language Fundamentals, Reference and value Types, primitive types the Nullable and enum types, Classes and objects, Defining classes Creating objects, Using static members, Overloading Methods, Various Constructors. Encapsulating data, access modifiers, properties, indexers arrays and readonly fields. Structures. String and DateTime classes, three pillars of OOPs	**7 hrs**
3	**Exceptions and Object Life Time** Ode to Errors, Bugs and Exceptions, The Role of .NET Exception handling, the System. Exception base class, Throwing a generic Exception, Catching Exceptions, CLR System-Level Exceptions (System.SystemException), Custom Application-Level Exceptions (System.ApplicationException). Handling	**4 hrs**

	Multiple Exception, The Finally Block, The Last Chance Exception, Understanding Object Life time. The CIL of "new", The Basics of Garbage Collection	
	Unit –II	
4	**Event handling paradigm Interfaces and Collections** Understanding the .NET Delegate type, Multicast Delegate and events. Interfaces, overriding interface implementation. Explicit interface implementation, Collection, IEnumerable, IEnumerator, IList, IComparer and their Generic equivalent. Working with generic List, Stack, Dictionary and Queue	**6 hrs**
5	**Programming Window Forms Applications** Anatomy of a Form, Component Class, Control Class, Control Events, Responding to Keyboard Events, Form Class, Building Menus with Windows Forms, Building your Menu System, Creating Pop-Up Menu, Adding Controls to Forms (IDE-Free), Adding Controls to Forms (via VS.NET), Working with Basic Controls like Buttons, Configuring Tab Order.	**5 hrs**
6	**Working with Database** Introduction to ADO.NET , Connecting to a database, Understanding DataTables, Creating a DataAdapter, Referencing fields in a DataRow, Navigating records ,Adding, editing, and deleting records, Building an ADO.NET example.	**5 hrs**
	Unit –III	
7	**Understanding the .NET Assemblies** Problems with Classic.COM Binaries, An overview of .NET Assembly, Building a single file test assembly, A C# Client Application, A Visual Basic .NET Client Application, Cross-Language Inheritance, Exploring the Car Library's Manifest, Exploring the Car Library's Types.	**4 hrs**
8	**Using .NET Assemblies** Building a multi file assembly, Using the Multifile Assembly , Understanding the private Assemblies, Probing for private Assemblies (The Basics), Private Assemblies and XML Configuration Files, Probing for Private Assemblies(The details), Understanding Shared Assemblies, Understanding Shared Names, Building a Shared Assembly, Understanding Delay Signing, Installing/Removing Shared Assembly, Using a Shared Assembly.	**4 hrs**

Text Books:

1. Herbert Schildt, "The Complete Reference C# 4.0", Tata McGraw –Hill, 2010
2. Andrew Troelsen, "Pro C# with .NET 3.0", Special Edition, Dream tech Press, India, 2007.

Reference Books:

1. Stephen C. Perry, AtulKahate, Stephen Walther, Joseph Mayo, "Essential of .net and

Related Technologies with a focus on C#, XML, ASP.net and ADO.net", 2nd Edition, Pearson, 2009.
2. Paul J. Deitel, Harvey Deitel, "Visual C# 2010 for Programmers", 4th Edition, Pearson, 2010.
3. Joseph Albahari and Ben Albhari, "C# 3.0/4.0 in Nutshell", 3rd Edition, O'Rilley, 2007.

Scheme for End Semester Assessment (ESA)

UNIT	8 Questions to be set of 20 Marks Each	Chapter Numbers	Instructions
I	Q.No.-1, Q.No.-2, Q.No.-3	1, 2,3	Solve Any **2** out of **3**
II	Q.No.-4, Q.No.-5, Q.No.-6	4,5,6	Solve Any **2** out of **3**
III	Q.No.-7	7	Solve Any **1** out of **2**
	Q.No.-8	8	

Program: Bachelor of Engineering		
Course Title: Database Management System		Course Code: 15ECSO402
L-T-P: 3-0-0	Credits: 3	Contact Hrs: 3hrs/week
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 40	Exam Duration: 3 hrs	

	Unit –I	
1	**Introduction to Database:** Introduction to DBMS and an example, Characteristics of Database approach, Actors On and Behind the Scene, Advantages and Disadvantages of using DBMS, Data models, schemas and instances, Three-schema architecture and data independence, Database languages and interfaces, The database system environment.	**6 Hrs**
2	**Data Modeling Using ER Model:** Using High-Level Conceptual Data Models for Database Design, An Example Database Application, Entity Types, Entity Sets, Attributes and Keys, Relationship types, Relationship Sets. Roles and Structural Constraints, Weak Entity Types, Refining the ER Design, Degree of Relationship type, ER Diagrams, Naming Conventions and Design Issues.	**6 hrs**
3	**Relational Data Model :** Relational Model Concepts, Relational Model Constraints and Relational Database Schemas, Update Operations, Transactions and dealing with constraint violations.	**4 hrs**
	Unit –II	
4	**Structured Query Language(SQL):** SQL Data Definition and Data Types, Specifying basic constraints in SQL, Schema change statements in SQL, Views in SQL, Basic queries in SQL.	**6 hrs**

5	**Basics of Functional Dependencies and Normalization for Relational Databases**: Informal Design Guidelines for Relation Schemas, Functional Dependencies, Normal Forms Based on Primary Keys, General Definitions of Second and Third Normal Forms, Boyce-Codd Normal Form.	**6 hrs**
6	**Introduction to Transaction Processing:** Introduction to Transaction Processing, Transactions and System concepts, Desirable Properties of Transaction, Transaction support in SQL.	**4 hrs**
	Unit –III	
7	**Emerging Database Technologies:** Introduction, cloud computing and data management, Mobile databases, Multimedia Databases.	**4 hrs**
8	**Emerging Database Technologies:** GIS Database, Biological Database, Dealing with massive datasets-MapReduce and Hadoop.	**4 hrs**

Text Books:

1. Elmasri R. and Navathe S., Fundamentals of Database Systems, 6th Edition, Pearson Education, 2011.

Reference Books:

1. Ramakrishnan S. and Gehrke J., Database Management Systems, 3rd Edition, McGraw Hill, 2007.
2. Silberschatz A., Korth H.F. and Sudharshan S., Database System Concepts, 6th Edition, Mc- GrawHill, 2010

Scheme for End Semester Assessment (ESA)

UNIT	**8 Questions to be set of 20 Marks Each**	**Chapter Numbers**	**Instructions**
I	Q.No.-1, Q.No.-2, Q.No.-3	1, 2,3	Solve Any **2** out of **3**
II	Q.No.-4, Q.No.-5, Q.No.-6	4,5,6	Solve Any **2** out of **3**
III	Q.No.-7	7	Solve Any **1** out of **2**
	Q.No.-8	8	

Program: **Bachelor of Engineering**		
Course Title: **High Performance Computing for Engineering Applications**		Course Code:15ECSO404
L-T-P: **3-0-0**	Credits: **3**	Contact Hrs: **3 hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **40**	Exam Duration: **3hrs**	

Unit –I

1	**Introduction to High Performance Computing:** Computational Science and Engineering Applications; characteristics and requirements, Review of Computational Complexity, Performance: metrics and measurements, Granularity and Partitioning, Locality: temporal/spatial/stream/kernel, Basic methods for parallel programming, Real-world case studies like CFD, Bioinformatics, Flow analysis etc.	**08hrs**
2	**High Performance Computing Systems:** Memory Hierarchies, Multi-core Processors: Homogeneous and Heterogeneous, Shared-memory Symmetric Multiprocessors, Vector Computers, Distributed Memory Computers, Supercomputers and Petascale Systems, Application Accelerators / Reconfigurable Computing, Novel computers: Stream, multithreaded, and purpose-built	**08hrs**
Unit –II		
3	**Parallel Algorithms:** Parallel models: ideal and real frameworks, Basic Techniques: Balanced Trees, Pointer Jumping, Divide and Conquer, Partitioning, Regular Algorithms: Matrix operations and Linear Algebra, Irregular Algorithms: Lists, Trees, Graphs, Randomization: Parallel Pseudo-Random Number Generators, Sorting, Monte Carlo techniques	**08hrs**
5	**Parallel Programming:** Revealing concurrency in applications, Task and Functional Parallelism, Task Scheduling, Synchronization Methods, Parallel Primitives (collective operations), SPMD Programming (threads, OpenMP, MPI)	**08hrs**
Unit –III		
5	**Achieving Performance:** Measuring performance, Identifying performance bottlenecks, Restructuring applications for deep memory hierarchies, Partitioning applications for heterogeneous resources, using existing libraries, tools, and frameworks	**04hrs**
6	**Case Studies and Projects done during the course:** Various case studies from various engineering discipline	**04 hrs**

Text Books

4. Introduction to Parallel Computing, AnanthGrama, Anshul Gupta, George Karypis, and Vipin Kumar, 2nd edition, Addison-Welsey, 2003.
5. Petascale Computing: Algorithms and Applications, David A. Bader (Ed.), Chapman & Hall/CRC Computational Science Series, 2007

Reference Books:

2. G.E. Karniadakis, R.M. Kirby II, Parallel Scientific Computing in C++ and MPI: A Seamless Approach to Parallel Algorithms and their Implementation, Cambridge University Press,2003.
3. M.J. Quinn, Parallel Programming in C with MPI and OpenMP, McGraw-Hill, 2004.

Scheme for Semester End Examination (ESA)

UNIT	8 Questions to be set of 20 Marks Each	Chapter numbers	Instructions
I	Q.No.-1, Q.No.-2, Q.No.-3	1, 2	Solve Any **2**
II	Q.No.-4, Q.No.-5, Q.No.-6	3 ,4	Solve Any **2**
III	Q.No.-7	5	Solve Any **1**
	Q.No.-8	6	

Program: **Bachelor of Engineering**		
Course Title: **Essential of Information Technology**		Course Code: 15ECSO405
L-T-P: 0-0-3	Credits: 3	Contact Hrs: **6hrs/week**
ISA Marks: 80	ESA Marks: 20	Total Marks: 100
Teaching Hrs: 60	Exam Duration: 3 hrs	

	Unit - I	
1	**Introduction to computer systems:** Components of computer systems, program execution cycle, computer networks, software and its classification, Operating System: introduction, memory management, process management, file management.	**06 hrs**
2	**Programming basics:** Introduction to problem solving, SDLC overview and need for object oriented approach, object oriented concepts, introduction to java, control structures, arrays, strings.	**06 hrs**
3	**Classes and Objects:** Class fundamentals, access specifiers, constructors and its types, method overloading, static members.	**04 hrs**
	Unit - II	
4	**Data structures:** Introduction, Linear data structures: stack, queue, linked lists, Non-Linear data structures: trees, binary search tree, illustration using java collection framework.	**05 hrs**
5	**Inheritance and Polymorphism:** Inheritance: basics, types of inheritance, method overloading and overriding, dynamic method dispatch.	**05 hrs**

6	**Packages, Interfaces and Exceptions:** Introduction to packages, access protection, interfaces, exception handling mechanism, and user defined exceptions.	**06 hrs**
	Unit - III	
7	**Database Design Process:** Characteristics of DBMS, ER model, mapping ER model to relational schema, normalization.	**04 hrs**
8	**Structured Query Language:** SQL data types, database languages, operators, aggregate functions, order by and group by clause, joins and sub queries.	**04 hrs**

Text Books

1. Infosys Campus Connect Foundation Program Volume:1–3, Education and Research Department, Infosys Technologies Ltd, 2013.
2. Herbert Schildt, “Java The Complete Reference”, 8th Edition, McGraw-Hill, 2012.

Reference Books:

1. Elmasri. and Navathe, “Fundamentals of Database Systems”, 6th Edition, Pearson Education, 2011.
2. Silberschatz, Galvin, and Gagne, "Operating System Concepts", 8th Edition, Wiley, 2009.

Scheme for End Semester Assessment (ESA)

UNIT	**Experiments to be set of 10 Marks Each**	**Chapter Numbers**	**Instructions**
I	Project Examination	4 - 8	Project implementation and demonstration 20 marks

Program: **Bachelor of Engineering**		
Course Title: **Natural Language Processing**		Course Code: **18ECSE403**
L-T-P: **2-0-1**	Credits: **3**	Contact Hrs: **04 hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **30**	Exam Duration: **3 hrs**	

	Unit –I	
1	**Introduction to NLP and Deep Learning** Introduction to Natural Language Processing, Applications of Natural Language Processing, Word2vec introduction, Word2vec objective function gradients	**05 hrs**
2	**Dependency Parsing, Recurrent Neural Networks** Dependency Grammar , Neural dependency parsing, Recurrent Neural Networks and Language Models, Vanishing Gradients, Fancy RNNs	**07 hrs**

Unit –II		
3	**Machine Translation, Seq2Seq and Attention** Machine Translation, Seq2Seq and Attention, Advanced Attention	**06 hrs**
4	**Transformer Networks , Coreference Resolution, Memory Networks** Transformer Networks and CNNs, Tree Recursive Neural Networks and Constituency Parsing , Advanced Architectures and Memory Networks	**06 hrs**
Unit –III		
5	**Reinforcement Learning** Reinforcement Learning for NLP, Semi-supervised Learning for NLP, Future of NLP Models, Multi-task Learning and QA Systems	**06 hrs**

Text Books:

1. Yoav Goldberg. A Primer on Neural Network Models for Natural Language Processing , 2016.

Reference Books:

Dan Jurafsky and James H. Martin. Speech and Language Processing (3rd ed. draft).

Ian Goodfellow, YoshuaBengio, and Aaron Courville. *Deep Learning*. MIT Press.

Scheme for End Semester Assessment(ESA)

UNIT	**8 Questions to be set of 20 Marks Each**	**Chapter Numbers**	**Instructions**
I	Q.No.-1, Q.No.-2, Q.No.-3	1, 2	Solve Any **2** out of **3**
II	Q.No.-4, Q.No.-5, Q.No.-6	4,5	Solve Any **2** out of **3**
III	Q.No.-7	6	Solve Any **1** out of **2**
	Q.No.-8		

Program: Bachelor of Engineering		
Course Title: **Wireless Ad Hoc and Sensor Networks**		Course Code: **18ECSE406**
L-T-P: **3-0-0**	Credits: **3**	Contact Hrs: **3hrs/week**
CIE Marks: **50**	SEE Marks: **50**	Total Marks: **100**
Teaching Hrs: **40 hrs**	Exam Duration: **3 hrs**	

Unit –I		
1	**Introduction:** Fundamentals of wireless communication technology, Characteristics of wireless channel, Multiple Access Techniques, IEEE802.11 Standards, Bluetooth, Cellular Concept, Cellular Architecture.	**07 hrs**
2	**Ad hoc Networks:** Introduction, Issues in Ad hoc wireless networks, Ad hoc wireless internet.	**04 hrs**

3	**MAC Protocols:** Introduction, Issues in Designing MAC protocol, Design goals, Classification, Contention Based Protocols with Reservation Mechanisms. Contention-Based MAC Protocols with Scheduling Mechanism.	**05 hrs**
Unit –II		
4	**Routing Protocols:** Introduction, Issues in designing a routing protocol, classification, Table drive routing protocol, On-demand routing protocol, Hybrid routing protocol, Hierarchical routing protocols, Power aware routing protocols.	**06 hrs**
5	**Energy Management:** Introduction, Need for Energy Management, Classification, Battery Management Scheme, Transmission Power Management Schemes, System Management Scheme.	**05 hrs**
6	**Sensor Networks:** Introduction, Architecture, Data Dissemination, Data Gathering, MAC Protocols (schedule based protocols).	**05 hrs**
Unit –III		
7	**Routing Protocols for Sensor Networks:** Routing Characteristics, Routing Strategies, LEACH, SPIN.	**04 hrs**
8	**Sensor Network Applications:** Case Study: Traffic Control, Health Care, Green House Monitoring.	**04 hrs**

Text Books:

1. C. Siva Ram Murthy and B. S. Manoj, “Ad hoc Wireless Networks”,2nd Edition, Pearson Education, 2006.
2. KazemSohraby, Daniel Minoli, TaiebZnati, “Wireless Sensor Networks: Technology, Protocols, and Applications”, John Wiley and Sons, 2007.

Reference Books:

1. Ozan K. Tonguz and Gianguigi Ferrari, “Ad hoc Wireless Networks”,John Wiley, 2006.
2. C.K. Toh, “Adhoc Mobile Wireless Networks”,Protocols and Systems, Prentice-Hall PTR, 2002.

UNIT	8 Questions to be set of 20 Marks Each	Chapter Numbers	Instructions
I	Q.No.-1, Q.No.-2, Q.No.-3	1, 2,3	Solve Any **2** out of **3**
II	Q.No.-4, Q.No.-5, Q.No.-6	4,5,6	Solve Any **2** out of **3**
III	Q.No.-7	7	Solve Any **1** out of **2**
	Q.No.-8	8	

Program: **Bachelor of Engineering**		
Course Title: **Advanced Parallel Computing**		Course Code:**18ECSE408**
L-T-P:**3-0-0**	Credits: **3**	Contact Hrs: **03 hrs/week**
CIE Marks**: 50**	SEE Marks: **50**	Total Marks: **100**
Teaching Hrs: **40**	Exam Duration: **3 hrs**	

Unit –I		
1	**Introduction and History** GPUs as Parallel Computers; Architecture of a Modem GPU; Parallel Programming Languages and Models; Overarching Goals; Evolution of Graphics Pipelines; The Era of Fixed- Function ; Graphics Pipelines; Evolution of Programmable Real-Time Graphics; Unified Graphics and Computing Processors; GPGPU; An Intermediate Step; GPU Computing; Scalable GPUs Recent Developments; Future Trends.	**07 hrs**
2	**Introduction to CUDA** Data Parallelism; CUDA Program Structure; A Matrix-Matrix Multiplication Example; Device Memories and Data Transfer; Kernel Functions and Threading; Function declarations; Kernel launch; Predefined variables; Runtime API.CUDA Thread Organization; Using b1ock Id x and thread Id x ; Synchronization and Transparent Scalability; Thread Assignment ; Thread Scheduling and Latency Tolerance.	**09 hrs**
Unit –II		
3	**CUDA Memories** Importance of Memory Access Efficiency; CUDA Device Memory Types; A Strategy for Reducing Global Memory Traffic; Memory as a Limiting Factor to Parallelism; Global Memory Bandwidth; Dynamic Partitioning of SM Resources; Data Perfetching; Instruction Mix; Thread Granularity; Measured Performance.	**07 hrs**
4	**Introduction to OPENCL** Introduction to OPENCL; Background; Data Parallelism Model; Device Architecture; Kernel Functions; Device Management and Kernel Launch; Electrostatic Potential Map in OpenCL.	**09 hrs**
Unit –III		
5.	**Case Study** Concepts of Game Design, Applications like Matrix multiplication, MRI reconstruction Molecular Visualization and Gaming.	**04 hrs**
6.	**Parallel Programming and Computational Thinking** Goals of Parallel Programming, Problem Decomposition, Algorithm Selection, Computational Thinking.	**04 hrs**

Text Books:
3. David B. Kirk, Wen-mei W. Hwu, "Programming Massively Parallel Processors: A Hands on Approach", Morgan Kaufmann/Elsevier India reprint, 2010.
Reference Books:
1. Benedict R Gaster, Lee Howes, David Kaeli, Perhaad Mistry and Dana Schaa, "Heterogeneous Computing with OpenCl", Morgan Kaufmann/Elsevier reprint, 2012.

Scheme for End Semester Assessment(ESA)

UNIT	8 Questions to be set of 20 Marks Each	Chapter Numbers	Instructions
I	Q.No.-1, Q.No.-2, Q.No.-3	1, 2	Solve Any **2** out of **3**
II	Q.No.-4, Q.No.-5, Q.No.-6	3,4	Solve Any **2** out of **3**
III	Q.No.-7	5	Solve Any **1** out of **2**
	Q.No.-8	6	

Program: **Bachelor of Engineering**		
Course Title: **Software Architecture and Design Thinking**		Course Code:**18ECSE410**
L-T-P:**3-0-0**	Credits: **3**	Contact Hrs: 3**hrs/week**
CIE Marks**: 50**	SEE Marks: **50**	Total Marks: **100**
Teaching Hrs: **40**	Exam Duration: **3 hrs**	

Unit –I		
1	**Chapter No. 1 What Is Software Architecture?** What Software Architecture Is and What It Isn't ,Architectural Structures and Views, Architectural Patterns, What Makes a "Good" Architecture?	**5 hrs**
2	**Chapter No. 2 Why Is Software Architecture Important?** Inhibiting or Enabling a System's Quality Attributes, Reasoning About and Managing Change, Predicting System Qualities, Enhancing Communication among Stakeholders, Carrying Early Design Decisions, Defining Constraints on an Implementation, Influencing the Organizational Structure, Enabling Evolutionary Prototyping, Improving Cost and Schedule Estimates, Supplying a Transferable, Reusable Model, Allowing Incorporation of Independently Developed Components, Restricting the Vocabulary of Design Alternatives, Providing a Basis for Training	**6hrs**
3	**Chapter No. 3 The Many Contexts of Software Architecture** Architecture in a Technical Context, Architecture in a Project Life-Cycle Context, Architecture in a Business Context, Architecture in a Professional Context, Stakeholders, How Is Architecture Influenced?,What Do Architectures Influence?	**5 hrs**
Unit –II		

4	**Chapter No. 4. Understanding Quality Attributes** Architecture and Requirements, Functionality, Quality Attribute Considerations, Specifying Quality Attribute Requirements, Achieving Quality Attributes through Tactics, Guiding Quality Design Decisions	**5 hrs**
5	**Chapter No. 5. Quality Attributes** Tactics for Availability, Tactics for Interoperability, Tactics for Modifiability, Tactics for Performance, Tactics for Security, Tactics for Testability, Tactics for Usability,	**6hrs**
6	**Chapter No. 6. Architectural Tactics and Patterns** Architectural Patterns, Overview of the Patterns Catalog, Relationships between Tactics and Patterns, Using Tactics Together	**5 hrs**
Unit –III		
5.	**Chapter No. 7 Architecture and Requirements** Gathering ASRs from Requirements Documents, Gathering ASRs by Interviewing Stakeholders, Gathering ASRs by Understanding the Business Goals, Capturing ASRs in a Utility Tree, Tying the Methods Together	**4 hrs**
6.	**Chapter No. 8 Designing an Architecture, Implementation, Testing and EvaluationDesigning:** Design Strategy, The Attribute-Driven Design Method, The Steps of ADD, Implementation, and Testing:Architecture and Implementation, Architecture and Testing, Evaluation:Evaluation Factors, The Architecture Tradeoff Analysis Method, Lightweight Architecture Evaluation	**4 hrs**
Text Books: 1. Len Bass, Paul Clements, Rick Kazman, Software Architecture in Practice (3rd Edition), Addison-Wesley Professional; 3 edition		
Reference Books:		

Scheme for End Semester Assessment(ESA)

UNIT	**8 Questions to be set of 20 Marks Each**	**Chapter Numbers**	**Instructions**
I	Q.No.-1, Q.No.-2, Q.No.-3	1, 2	Solve Any **2** out of **3**
II	Q.No.-4, Q.No.-5, Q.No.-6	3,4	Solve Any **2** out of **3**
III	Q.No.-7	5	Solve Any **1** out of **2**
	Q.No.-8	6	

Course Title: **Model Thinking**	Course Code: **18ECSE411**	
L-T-P: **3-0-0**	Credits: **3**	Contact Hrs: **30**
CIA Marks: **50**	SEE Marks: 50	Total Marks: **100**
Teaching Hrs: **40**		Exam Duration: **3 hrs**

Content	40 Hrs

Unit – 1	
1. **Why Model** Model Thinking - The need, Advantages and disadvantages, Segregation/Peer Effects, Case study	4 hrs
2.**Modeling People, Tipping Points & Economic Growth** Rational models, Behavioral models, Rule based models, Percolation Models, Growth and its kinds	6 hrs
3. **Special Topics** Standing ovation model, Game of Life, Lyapunov Functions: Equilibrium, A cycle, Randomness or complexity, Coordination and culture. Urn models, Polya process, paths and networks, Prisoners' Dilemma, Collective Action & Mechanism Design	6 hrs
Unit – 2	
4. **Randomness and Learning Models** Luck as randomness, Random Walks & Colonel Blotto, Replicator Dynamics, Fisher's fundamental theorem, Prediction and the Many Model Thinker	8 hrs
5. **Model Checking and Modelling Concurrent Systems** Model Checking, Characteristics of Model Checking, Transition Systems, Parallelism and Communication, The State Space Explosion	8 hrs
Unit – 3	
6. **Linear-Time Properties** Linear-Time behavior, Safety Properties and Invariants, Liveness Properties, Fairness	4 hrs
7. **Regular Properties** Automata on Finite Words, Model-Checking Regular Safety Properties, Automata on Infinite Words, Model Checking with omega-regular properties	4 hrs

Text Books

1. Scott E Page, The Model Thinker, Basic Books Publication, 2018
2. ChristelBaier and Joost-Pieter Katoen, Principles of Model Checking (Representation and Mind Series), The MIT Press, 2008

References

1. Model Thinking Coursera online course from Michigan University.

Program: **Bachelor of Engineering**		
Course Title: **Cyber Security**		Course Code: 19ECSE401
L-T-P: **2-0-1**	Credits: 3	Contact Hrs: **04 hrs/week**
ISA Marks: 50	ESA Marks: 50	Total Marks:100
Teaching Hrs: 40	Exam Duration: 03hrs	

Unit –I

1	**Introduction to Cybercrime** Cybercrime definition and origins of the world, Cybercrime and information security, Classifications of cybercrime, A global Perspective on cybercrimes. Cyber attack plans, Social Engineering, Cyber stalking, Cyber cafe and Cybercrimes, Botnets, Proliferation of Mobile and Wireless Devices, Credit Card Frauds in Mobile and Wireless Computing Era.	**08hrs**
2	**Methods used in Cybercrime** Phishing, password Cracking, Keyloggers and Spyware, Virus and Worms, Trojan and backdoors, Steganography, DOS and DDOS attack, SQLinjection, Buffer Overflow, Attack on wireless networks, Identity theft	**08hrs**
Unit II		
3	**Cybercrimes and Cyber security: The Legal Perspectives** Why do we need Cyber law: The Indian Context, The Indian IT Act, Digital Signature and the Indian IT Act, Amendments to the Indian IT Act, Cybercrime and Punishment.	**08hrs**
4	**Cybercrime: Illustrations, Examples and Case studies** Introduction, Real-Life Examples, Case Studies: Illustrations of Financial Frauds in Cyber Domain, Digital Signature-Related Crime Scenarios, Online Scams.	**08hrs**
Unit III		
5	**Digital Forensics** Historical background of cyber forensic, Forensic analysis of email, Digital forensic life cycle, Network forensic, Setting up a computer forensic Laboratory, Forensic analysis of digital media.	
Text Books: 1. Nina Godbole&SunitBelapure, "Cyber Security", Wiley India, 2012.		
Reference Books: 5. Dhiren R Patel, "Information security theory & practice", PHI learning pvt.ltd, 2010. 6. Bill Nelson, "Guide to Computer Forensics and Investigations", 4th Edition, CENGAGE Publication. 2009.		

List of Experiments

Expt./Job No.	**Experiment**	***No. of Lab. Slots (2hrs)***
1.	Password cracking and recovery	1
2.	DDOS attack detection	1
3.	Firewall and IPS	1
4.	SQL Injection	1
5.	Forensic analysis of email	1
6.	Forensic analysis on digital media	1

7.	Removable/External Media Imaging	1
8.	Course Project	3

Scheme for End Semester Assessment(ESA)

UNIT	8 Questions to be set of 20 Marks Each	Chapter Numbers	Instructions
I	Q.No.-1, Q.No.-2, Q.No.-3	1, 2	Solve Any **2** out of **3**
II	Q.No.-4, Q.No.-5, Q.No.-6	3, 4	Solve Any **2** out of **3**
III	Q.No.-7, Q.No.-8	5	Solve Any **1** out of **2**

Program: **Bachelor of Engineering**		
Course Title: **Capstone Project**		Course Code: **18ECSW401**
L-T-P: **0-0-14**	Credits: **6**	Contact Hrs: **3 hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
	Exam Duration: **3hrs**	

Project themes:

Networking	Data Engineering	System Engineering
• Internet of Things • Cloud Computing • Software Defined Network • Social Network Analysis	• Data Analytics • Image and video processing • Computer Vision and Graphics • Natural Language Processing	• Parallel Computing • High Performance Computing • Parallel system design

***Evaluation*:**

Students Assessment through ISA (50%) + ESA (50%)

	Assessment	Weightage in Marks
Internal Semester Assessment* (50%)	Periodic reviews by Project Guide	25
	Periodic reviews by Committee	25
End Semester Assessment (50%)	Final Review	50

	Total	100

Program: **Bachelor of Engineering**		
Course Title: **Fuzzy Set Theory**		Course Code: **19ECSE402**
L-T-P: **3-0-0**	Credits: 3	Contact Hrs: 3**hrs/week**
ISA Marks: 50	ESA Marks: 50	Total Marks:100
Teaching Hrs: 40	Exam Duration: 3hrs	

Unit –I		
1	**Introduction** : Introduction to Fuzzy Logic, Fuzzy Membership Functions, Operations on Fuzzy Sets	8hrs
2	**Fuzzy Measures:** Fuzzy Relations,Fuzzy Proposition,Fuzzy Implications,Fuzzy Inferences	8hrs
Unit –II		
3	**Fuzzy Relations and Fuzzy Graphs**: Fuzzy Relations, Compositions of Fuzzy Relations, Properties of the Min-Max Composition, DefuzzificatinTechniques,Lambda-cut method, Weighted average method, Maxima methods, Centroid methods, Output of a Fuzzy System	8 hrs
4	**Uncertainty Modeling:** Application-oriented Modeling of Uncertainty, Causes of Uncertainty, Uncertainty Methods, Possibility Theory	8hrs
Unit –III		
5	**Fuzzy Data Bases and Queries:** Introduction, Fuzzy Relational Databases, Fuzzy Queries in Crisp Databases	4 hrs
6	**Fuzzy Sets and Expert Systems:** Introduction to Expert Systems, Uncertainty Modeling in Expert Systems, Applications	4 hrs

Text Books:

1. H. J. Zimmermann ., Fuzzy Set Theory-and Its Applications, Fourth Edition, 4th Ed., Springer Science Business Media, LLC , 2001
2. Chander Mohan, An Introduction to Fuzzy Set Theory and Fuzzy Logic,2nd ed. Vivo Books pvt ltd , 2015

Reference Books:

1. Timothy J. Ross, Fuzzy Logic With Engineering Applications, 3ed., 2010, A John Wiley and Sons, Ltd., Publication
2. Kumar S. Ray,Soft Computing and Its Applications: Fuzzy Reasoning and Fuzzy Control, 1st Edition, Apple Academic Press 2014
3. Ahmed M. Ibrahim, Fuzzy Logic for Embedded Systems Applications, Elesvier Press, 2004.

Scheme for End Semester Assessment (ESA)

UNIT	8 Questions to be set of 20 Marks Each	Chapter Numbers	Instructions
I	Q.No.-1, Q.No.-2, Q.No.-3	1, 2	Solve Any **2**
II	Q.No.-4, Q.No.-5, Q.No.-6	3,4	Solve Any **2**
III	Q.No.-7	5	Solve Any **1**
	Q.No.-8	6	

Course Code: **15ECSC702**	Course Title: **Software Engineering**	
L-T-P: **4-0-0**	Credits: 4	Contact Hrs:**4 hrs/week**
CIE Marks: **50**	SEE Marks: **50**	Total Marks: **100**
Teaching Hrs: **55 hrs**		Exam Duration: **3 hrs**

1	Introduction : Introduction to Software Engineering and A Generic view of process	**04 hrs**
2	Process models: Prescriptive Models, The waterfall model, Incremental process models, Evolutionary process models, Specialized process models, The Unified process. Agile view of process.	**09 hrs**
3	Requirements engineering: Requirements Engineering tasks, Initiating Requirements Engineering Process Eliciting Requirements, Elicitation Work Products ,Developing Use-Cases ,Analysis Model, Negotiating Requirements and Validating Requirements.	**09 hrs**
4	Design Engineering : Design within the context of SE, Design process and design quality, Design concepts, The design Model, Pattern based software design, Architectural design: Software Architecture, Data design, Architectural styles and patterns, Architectural design,	**07 hrs**
5	Testing Strategies: A strategic approach to software testing, Test strategies for conventional software, validation testing, system testing.	**07 hrs**
6	Testing tactics: White box testing, basis path testing, control structure testing, black box testing, testing for specialized environments, architectures and applications.	**08 hrs**
7	Project Management and Metrics : Management spectrum, The people, product, process , metrics in the process and project domains, soft ware measurements, metrics for software quality.	**05 hrs**
8	Project Estimation: Observations on estimation, the project planning process , software scope and feasibility , resources, software project estimation, Decomposition techniques, empirical estimation models	**06 hrs**

Text book:

1. Software Engineering :A practitioner's Approach, Roger S Pressman, seventh edition. McGrawHill International Edition, 2009.

Reference books:

1. Software Engineering, Ian Sommerville, seventh edition, Pearson education,2004.
2. Software Project Management, Bob Hughes & Mike Cotterell, fourth edition,Tata McGraw Hill,2006
3. Software Engineering – Architecture Driven Software Development, RICHARD F. SCHMIDT, Elsevier Publications

Course Code: **15ECSC703**	Course Title: **Database Management System**	
L-T-P: **4-0-0**	Credits: 4	Contact Hrs:**4 hrs/week**
CIE Marks: **50**	SEE Marks: **50**	Total Marks: **100**
Teaching Hrs: **55 hrs**		Exam Duration: **3 hrs**

1	**Introduction to DBMS and Data Modeling Using the ER Model:** Introduction: Data models, schemas and instances, Three-schema architecture and data independence. Data Modeling: An Example Database Application, Entity Types, Entity Sets, Attributes and Keys, Relationship types, Relationship Sets, Roles and Structural Constraints, Weak Entity Types, Refining the ER Design, ER Diagrams, Naming Conventions and Design Issues.	**09 Hrs**
2	**Relational Data Model and Relational Database Constraints:** Relational model constraints and relational database schema; Update operations, transactions and dealing with constraint violations.	**06 Hrs**
3	**Database Design:** Database Design Using ER- to-Relational Mapping**,** Informal Design Guidelines for Relation Schemas; Functional Dependencies; Normal Forms Based on Primary Keys; General Definitions of Second and Third Normal Forms; Boyce-Codd Normal Form.	**06 Hrs**
4	**Query Processing** Translating SQL queries to Relational Algebra, Algorithms for External sorting, Algorithms for SELECT, JOIN, PROJECT and SET operations. Implementing Aggregate and OUTER JOINS, Overview of Query optimization	**08 Hrs**
5	**Transaction Management:** The ACID Properties; Transactions and Schedules; Concurrent Execution of Transactions; Lock-Based Concurrency Control; Performance of locking; Transaction support in SQL; Introduction to crash recovery; 2PL, Serializability and Recoverability; Lock Management; Introduction to ARIES; The log; Other recovery-related structures; The write-ahead log protocol; Check pointing; Recovering from System Crash; Media Recovery; Other approaches and interaction with concurrency control	**10 Hrs**
6	**Database Security** Introduction to Database security, Discretionary Access control based on granting and revoking privileges, Mandatory access control and role based access control for multilevel security, Introduction to statistical database security, Introduction to flow control, Encryption and public key infrastructures, Challenges in database security	**08 Hrs**
7	**Object and Object-Relational Databases:** Overview of Object-Oriented Concepts, Object Identity, Object Structure and Type Constructors, Encapsulation of operations, Methods and persistence, Type and class hierarchies	**08 Hrs**

	and inheritance, Object model of ODMG, Object definition Language ODL, Object Query Language OQL, Conceptual design of Object database.	

Text Book

1. Elmasri and Navathe: Fundamentals of Database Systems, 5th Edition, Pearson Education,2008.

References

1. Raghu Ramakrishnan and Johannes Gehrke: Database Management Systems, 3rd Edition, McGraw-Hill, 2003.
2. Abraham Silberschatz, Henry F. Korth, S. Sudarshan: Database System Concepts, 4th Edition, McGraw Hill, 2002.

School of Computer Science and Engineering

_Course Code: 15ECSC704	Course Title: **Operating Systems**	
L-T-P: **4-0-0**	Credits: **4**	Contact Hrs:**4 hrs/week**
CIE Marks: **50**	SEE Marks: **50**	Total Marks: **100**
Teaching Hrs: **55 hrs**		Exam Duration: **3 hrs**

1	Operating System Overview Operating System objectives and functions, Evolution of OS, Major achievements, Developments leading to modern OS, Overview of Microsoft Windows and Linux	**06 Hrs**
2	Processes and Threads Processes- Definition, States, Description, Control, Security issues, Threads, Symmetric multiprocessing, Microkernel, Process and thread management in Windows & Linux	**08 Hrs**
3	Concurrency Principles of concurrency, Mutual exclusion, Semaphores, Monitors, Message passing, Readers problem, Deadlock- Prevention, Avoidance and Detection; Integrated deadlock strategy, Dining philosophers problem, Concurrency mechanism in Windows & Linux	**08 Hrs**
4	Memory Management and Virtual Memory Memory management- Requirements, Partitioning, Paging, Segmentation, Security issues Virtual memory - Hardware and control structures, Operating System software Memory management in Windows & Linux	**08 Hrs**
5	Scheduling Uniprocessor scheduling- Types of processor scheduling, Scheduling algorithms, Multiprocessor scheduling, Real time scheduling, Scheduling in Windows & Linux	**06 Hrs**
6	Design Techniques with Examples Design considerations, Monolithic kernels, Modular organization, Extensible nucleus, Layered Organizations, Operating Systems for distributed systems	**08 Hrs**
7	File Management Overview, Organization, Directories, Sharing, Record blocking, File system security	**06 Hrs**
8	RTOS Characteristics, Case study- TinyOS, eCOS	**05 Hrs**

Text Book

1. Text Book: William Stallings: Operating Systems- Internals and Design Principles, 6th Edition, Prentice Hall, 2008.
2. Gary Nutt, Nabendu Chaki, Sarmistha Neogy: Operating Systems, 3rd Edition, Pearson Education, 2004

References:

1. Abraham Silberschatz, Galvin, Gagne: Operating System Concepts, 8th Edition, Wiley, 2008.
2. Andrew S. Tanenbaum, Albert S. Woodhull: Operating Systems, Design and Implementation, 3rd Edition, Prentice Hall, 2006.
3. Charles Crowley: Operating System, design oriented approach, 2004.

Course Code: **15ECSE707**	Course Title: **Web Technology**	
L-T-P: **3-1-0**	Credits: **4**	Contact Hrs:**5 hrs/week**
CIE Marks: **50**	SEE Marks: **50**	Total Marks: **100**
Teaching Hrs: **42 hrs**		Exam Duration: **3 hrs**

1	Introduction to Web Technology: Introduction to the Internet, The World Wide Web, Web Browsers, Uniform Resource Locator, The Hypertext Transfer Protocol, Security, Web programmers Toolbox.	**04 Hrs**
2	HTML 5: Canvas, video, local storage, web workers, offline applications, geolocation, placeholders, input types. What does it all mean – doctype, root, headers, articles, dates and times, navigation and footers. Let's call it a drawing surface – Simple shapes, canvas, Paths, texts, gradients and images. The past, present and future of local storage for web applications, A Form of madness – place holders, autofocus fields, email, web addresses, numbers as spinboxes and sliders, date and color pickers, search boxes.	**08 Hrs**
3	CSS3: What is CSS3? Animation with CSS3, Borders with CSS3, Backgrounds with CSS3, Fonts with CSS3, Text effect, transition effects, User Interface and 2D transform.	**04 Hrs**
4	JQuery: Jquerysyntax,jquery selectors ,JQuery events, Basic functions using Jquery	**06 Hrs**
5	Python: Basics syntax, using variables, decision and looping, function used to manipulate data using database.	**05 Hrs**
6	PHP: PHP Basics, Functions, Form Handling, Files, Cookies, Session Tracking, Database Access with PHP and MySQL	**05 Hrs**
7	XML: Introduction, Basic XML, DOM,, Syntax, Elements, Attributes, CDATA, DTD, Namespaces ,Schema, XSLT, HTTP Request, DOM, Querying XML , SAX, Xlink, PHP and XML, RSS Basics	**05 Hrs**
8	JSON:JSON – Array, object, mixing literals, syntax, encoding/decoding, JSON versus XML, server-side JSON tools	**05 Hrs**

Text Books:

1. Robert W. Sebestra, “Programming the World Wide Web”, 4th Edition, Addison Wesley, 2008.
2. Albert Lukaszewski, “MySQL for Python” , Packt Publishing, 2010
3. Rob Crowther, “Hello! HTML5 & CSS3”, Manning Publications 2012.

References:

1. P. J. Deitel and H.M. Deitel, Internet & World Wide Web How to Program”, 4th Edition, Pearson 2009.
2. Mark Summerfield, “Programming in python 3”, 2nd Edition, Addison-Wesley, 2009.
3. Mark Lutz, “Python Packet Reference”, O'Reilly Media, 4th Edition, 2009

Course Code: **15ECSP708**	Course Title: **Data Structures and Algorithms Lab**		
L-T-P: **0-0-1.5**	Credits: **1.5**	Contact Hrs:**3hrs/week**	
CIE Marks: **80**	SEE Marks: **20**	Total Marks: **100**	
Teaching Hrs: **36 hrs**		Exam Duration: **3hours**	

Course Learning Outcomes-CLO

At the end of the course students will be able to:

Implement standard data structures like stack, queues, lists and trees in C language.

Choose appropriate data structures to effectively model the information in a problem.

Demonstrate testing and debugging skills for given application.

Implement the data structure as a component.

Use the data structure component to build the applications

2 Course Content

Sl No.	Topic	No. of Lab Slots
1	Over view : Implementation of data structures	1
Basic data structures :		
2	Stack, Queues (Array implementation)	1
3	Linked lists	1
4	Trees	1
Advanced Data Structures :		
5	Skip lists, Red Black and B-Trees	1
6	B-Trees, Splay trees and hash functions	1
7	Heaps and Leftist heaps.	1
Algorithmic Techniques :		
8	Greedy Technique	1
9	Divide and Conquer	1
10	Dynamic Programming	1
11	Back Tracking	1
12	CIE Test	1

Course Code: **15ECSP709**	Course Title: **DBMS Lab**	
L-T-P: **0-0-1.5**	Credits:1.5	Contact Hrs: 3 hrs/week
CIE Marks: 80	SEE Marks: 20	Total Marks: 100
Teaching Hrs: 36		Exam Duration: 3 hrs

No	Content
1	This course explores database programming using standard Structured Query Language (SQL). Topics include database management systems, database middleware, data definition language, data manipulation language, data control language; database queries reporting, query optimization, and database views. assignments include database creation, query design and programming, and database manipulation via embedded SQL calls from programming language..

Books/References:

i) Elmasri and Navathe: Fundamentals of Database Systems, 5th Edition, Pearson Education,2008.

ii) Introduction to Relational Databases and SQL Programming, Christopher Allen, Simon Chatwin, Catherine A. Vreary Tata McGraw-Hill

iii) Oracle SQL and PL/SQL Hand book, John Adolph Palinski, Pearson Education

iv) Oracle 9i PL/SQL Programming, Scott Urman, Tata McGraw-Hill

v) MySQL: The Complete Reference, Vikram Vaswani, Tata Mcgraw-Hill

vi) MySQL Bible, Steve Suehring, Wiley

Course Code: **15ECSC712**	Course Title: **Computer Communication and Networks**		
L-T-P: **4-0-0**	Credits: **4**	Contact Hrs:**4 hrs/week**	
CIE Marks: **50**	SEE Marks: **50**	Total Marks: **100**	
Teaching Hrs: **55 hrs**		Exam Duration: **3 hrs**	

1	Review of Basic Concepts Building a Network; Applications; Requirements; Network Architecture; Implementing Network software; Performance.	**06 Hrs**
2	The Application Layer Principles of Application-Layer Protocols, The World Wide Web: HTTP, File Transfer: FTP, Electronic Mail in the Internet, The Internet's Directory Service: DNS, P2P file sharing.	**08 Hrs**
3	The Transport Layer Introduction and Transport-Layer Services, Multiplexing and De-multiplexing , Connectionless Transport: UDP, Principles of Reliable Data Transfer, Connection oriented Transport: TCP, Principles of Congestion Control, and TCP Congestion Control	**08 Hrs**
4	The Network Layer Introduction and Network Service Models, Virtual Circuit and data gram Networks, inside a router, IP: the Internet Protocol, Routing algorithms, Routing in the Internet, Broad cast and multicast routing.	**10 Hrs**
5	Data Link Layer Error Detection and Correction: Introduction, Block coding, Linear block codes, Cyclic Codes: Cyclic Redundancy Check, Hardware Implementation, Polynomials; checksum; Multiple access: Random Access, Controlled Access, Channelization; PPP. Ethernet and Connecting Devices Standard Ethernet, Passive Hubs, Repeaters, Active Hubs, Bridges, Two layer switches, Routers, Three layer switches and Gateways.	**10 Hrs**
6	Wireless Networks Introduction, WiFi: 802.11 Wireless LANs, Cellular Internet Access.	**06 Hrs**
7	Mobile Networks Mobility Management: Principles, Mobile IP, Managing Mobility in Cellular Networks, Wireless and Mobility: Impact on Higher layer protocols.	**07 Hrs**

Text Book

1. J. F. Kurose, K. W. Ross, *Computer Networking, A Top-Down Approach Featuring the Internet*, 3rd Ed, Addison-Wesley 2005.
2. Behrouz Forouzan, *Data Communications and Networking*, McGraw Hill, 4th ed. 2007
3. Larray L Peterson & Bruce S Davien *Computer Networks* ,Morgan Kaufmann (Elsevier), fifth edition, 2011.

References:

1. W. Stallings, Data and Computer Communications, Prentice Hall, Sixth Edition, 2000.
2. Alberto Leon-Garcia & Indra Widjaja Communication Networks-Fundamental concepts and Key Architectures, 2nd edition, Tata McGraw-Hill. 2006
3. Michael A. Gallo & William M Han cock ,Computer Communication and Networking Technologies, Cengage Learning 2008

Course Code: **15ECRC701**	Course Title: **Philosophy and Practice of Engineering Education**	
L-T-P: **2-0-1**	Credits: **3**	Contact Hrs:**4 hrs/week**
CIE Marks: **50**	SEE Marks: **50**	Total Marks: **100**
Teaching Hrs: **28 hrs**		Exam Duration: **3 hrs**

Course Information

Course Overview

This course intends to provide an overview of the Principles and Practices of Engineering Education. Specifically, the focus of this course revolves around how engineering is best taught and learnt. The overarching goal of this course is to equip prospective engineering faculty members with the tools and techniques that can enhance the effectiveness and efficiency of their teaching practice.

Learning objectives

After successful completion of this course, participants will be able to:

1. Understand fundamental principles of teaching and learning
2. Apply instructional design principles in engineering learning environments
3. Integrate technological tools to enhance learning
4. Analyse learning styles and theories relevant to engineering education
5. Evaluate different types of assessment and evaluation techniques
6. Create engineering learning modules

Reference Materials

Articles from the Engineering Education literature and other Internet resources will be explored in order to meet the course learning objectives.

Schedule of Activities

1st Workshop: Fundamental Principles of Teaching and Learning		
DATE:	**TIME**	**TOPICS**
Session-1	9.30 – 11.00	Introductions, Expectations, Pre-Work, Team Formations
	11.00 - 11.10	Break
Session-2	11.10 - 12.40	Fundamental Principles of Teaching and Learning
	12.40-13.20	Lunch Break
Session-3	13.20-14:50	Teaching Philosophy Statements – Individual
	14.50-15.00	Break
Session-4	15.00-16.30	Course Goals and Objectives: Taxonomies

Assignments due before 2nd Workshop:

1. Revise Teaching Philosophy Statements – Individual work
2. Review Learning Objectives of at least 1 existing course - Teamwork
3. Explain Learning Styles - Team Presentations
4. Explain Learning Theories - Team Presentations

2nd Workshop: Learning Styles and Theories		
DATE:	**TIME**	**TOPICS**
Session-1	9.30 – 11.00	Teaching Philosophy Statements Revisited – Peer Review
	11.00 - 11.10	Break
Session-2	11.10 - 12.40	Learning Styles – Team Presentations
	12.40-13.20	Lunch Break
Session-3	13.20-14:50	Learning Theories – Team Presentations
	14.50-15.00	Break

Session-4	15.00-16.30	Learning Theories – Team Presentations

Assignments due before 3rd Workshop:

1. Discuss Instructional Design Models and their Application – Team Presentations
2. Discuss what role can technology play in the teaching-learning process – 1 page reflection paper – Individual work

3rd Workshop: Instructional Design Models and Technology Enhanced Learning		
DATE:	**TIME**	**TOPICS**
Session-1	9.30 – 11.00	Instructional Design Models – Team Presentations
	11.00 - 11.10	Break
Session-2	11.10 - 12.40	Technology Enhanced Learning – Explore
	12.40-13.20	Lunch Break
Session-3	13.20-14:50	Technology Enhanced Learning – Explore
	14.50-15.00	Break
Session-4	15.00-16.30	Technology Enhanced Learning – Team Presentations

Assignments due before 4th Workshop:

1. Develop Formative Assessments Strategies – Team Presentations
2. Critique rubrics for at least 1 existing course– Individual work

4th Workshop: Assessment and Evaluation		
DATE:	**TIME**	**TOPICS**
Session-1	9.30 – 11.00	Basics of Assessment and Evaluation
	11.00 - 11.10	Break
Session-2	11.10 - 12.40	Formative Assessments – Team Presentations
	12.40-13.20	Lunch Break
Session-3	13.20-14:50	Develop Rubrics – Practice and Peer Review
	14.50-15.00	Break
Session-4	15.00-16.30	Develop Rubrics for Team Final Presentations

Assignments due before 5th Workshop:

1. Each team will select a topic/subject area for a teaching demo (microteaching). This demo should incorporate the fundamental principles and best practices of Engineering Education

5th Workshop: Engineering Learning Modules		
DATE:	**TIME**	**TOPICS**
Session-1	9.30 – 11.00	Microteaching – Team Presentations
	11.00 - 11.10	Break
Session-2	11.10 - 12.40	Microteaching – Team Presentations
	12.40-13.20	Lunch Break
Session-3	13.20-14:50	Microteaching – Team Presentations
	14.50-15.00	Break
Session-4	15.00-16.30	Microteaching – Team Presentations

Assessment, Evaluation, and Grading

After every workshop, there will be follow-up assignments due before the next workshop. There will be total 4 assignments of 10 points each. For active participation in workshop activities, maximum of 40 points will be allocated. The last workshop in the course will be teaching demos by participants (microteaching) worth 20 points.

Points

Assignments: 40
Participation: 40

Microteaching: 20

Grades

91-100: S

81-90: A

71-80: B

61-70: C

Below 60: Unacceptable

Course Code: **15ECSE714**	Course Title: **Mobile Application Development**		
L-T-P: **3-1-0**	Credits: **4**	Contact Hrs:**5 hrs/week**	
CIE Marks: **50**	SEE Marks: **50**	Total Marks: **100**	
Teaching Hrs: **42 hrs**		Exam Duration: **3 hrs**	

1	Introduction to mobile communication and computing: Introduction to mobile computing, Novel applications, limitations and GSM architecture, Mobile services, System architecture, Radio interface, protocols, Handover and security. Smart phone operating systems and smart phones applications.	**08 Hrs**
2	Fundamentals of Android Development: Introduction to Android: The Android 4.1 Jelly Bean SDK, Understanding the Android Software Stack, Installing the Android SDK, Creating Android Virtual Devices, Creating the First Android Project, Using the Text View Control, Using the Android Emulator, The Android Debug Bridge (ADB), Basic Widgets Understanding the Role of Android Application Components, Event Handling , Displaying Messages Through Toast, Creating and Starting an Activity, Using the Edit ext Control . 10 Hours	**10 Hrs**
3	The Android Debug Bridge (ADB): Basic Widgets Understanding the Role of Android Application Components, Event Handling , Displaying Messages Through Toast, Creating and Starting an Activity, Using theEdit ext Control Building Blocks for Android Application Design, Laying Out Controls in Containers, Utilizing Resources and Media, Using Selection Widgets and Debugging Displaying and Fetching Information Using Dialogs and Fragments	**08 Hrs**
4	Widgets and Debugging: Using Selection Widgets and Debugging Displaying and Fetching Information Using Dialogs and Fragments Advanced Android Programming: Internet, Entertainment, and Services, Implementing drawing and animations	**08 Hrs**
5	Displaying web pages and maps: Displaying web pages and maps communicating with SMS and emails. Creating and using content providers: Creating and consuming services, Publishing android applications.	**08 Hrs**

Text Book:

1. Mobile Computing: technologies and Applications- N. N. Jani S chand2009.

References:

1. *B.M.Hirwani- Android programming Pearson publications-2013* M. Tekalp, “Digital Video Processing,” Prentice Hall, USA, 1995.

Course Code: 16ECSC713	Course Title: **Software Testing**	
L-T-P :3-0-0	Credits: 4	Contact Hrs: 4 hrs/week
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 42		Exam Duration: 3 hrs

Content	**Hrs**
Chapter No. 1. Principles of Testing Context of testing in producing software: About the chapter, The incomplete Car, Dijkstra's Doctrine, A test time , The cat and the saint, Test the test first, The pesticide paradox, The convoy and the rags, The police man on the bridge, The Ends of Pendulum, Men in black, Automation syndrome, Putting it all together.	3 hrs
Chapter No. 2. Software Development Life Cycle Models Phases of Software Project: Requirements gathering and analysis, Planning, Design, Development or coding, Testing, Development and Maintenance, Quality, Quality assurance, and Quality Control, Testing, Verification and validation, Process model to represent different phases: Life cycle Models, Waterfall model, Prototyping and Rapid Application Development models, Spiral or Iterative model, The V model, Comparison of various life cycle models, References.	5 hrs
Chapter No. 3. Defect Testing White Box Testing: What is white box testing, Static testing, Static testing by humans, Static analysis tools: Structural testing, Unit /code fundamental testing, Code coverage testing, Code complexity testing, Black Box Testing: What is black box testing?, Why black box testing?, When to do black box testing?, How to do black box testing?, Requirement based testing, Positive and negative testing, Boundary value analysis, Decision tables, Equivalence participating , State based or graphic based testing, Compatibility testing, User documentation testing, Domain testing.	5 hrs
Chapter No. 4. Regression Testing What is regression testing?, Types of regression testing, When to do regression testing?, How to do regression testing?, Performing an initial "smoke" or "sanity" test, Understanding the criteria for selecting the test cases, Classifying the test cases, Methodology for selecting test cases, Resetting the test cases for regression testing, Concludes the results of regression testing, Best practices in regression testing.	4 hrs
Chapter No. 5. Unit Testing & Integration Testing What is integration testing?, Types of integration testing, Top-down integration, Bottom– up integration, Bi-directional integration, System integration, Choosing integration method, Integration testing as a phase of testing, Scenario testing, System scenarios, Use case scenarios, Defect bash, Choosing the frequency and duration of defect bash, Selecting right product build, Communicating the object of defect bash, Setting up monitoring lab, Taking action and Fixing issues, Optimizing the effort involved in defect bash.	5 hrs
Chapter No. 6. System and Acceptance Testing System Testing overview: Why is System testing done?, Functional versus Non-Functional testing, Functional system testing, Design/Architecture verification, Business vertical testing, Development testing, Beta testing, Certification, Standards and testing compliance, Non – Function testing, Setting up the configuration, Coming up with entry/exit criteria, Balancing key resources, Scalability testing, Reliability testing, Stress testing, Interoperability testing, Acceptance testing, Acceptance criteria, Selecting test cases for acceptance testing, Executing acceptance tests, Summary of testing phases, Multiphase testing model.	5 hrs

Chapter No. 7. Performance Testing Introduction, Factors governing performance testing, Methodology for performance testing, Collecting requirements, Writing test cases, Automating performance test cases, Executing performance test cases, Analyzing the performance test results, Performance tuning, Performance bench marking, Capacity planning, Tools for performance testing, Processes for performance testing, Challenges, Problems and Exercises.	5 hrs	
Chapter No. 8. Test Planning, Management and Execution Introduction, Test planning, Preparing a test plan, Scope management – deciding features to be tested / not tested, Deciding test approach/strategy, Setting up criteria for testing, Identifying responsibilities, Staffing, and Training needs, Identifying resource requirements, Identifying test deliverables, Testing tasks – Size and effort estimation, Activity breakdown and scheduling, Communication management, Risk management: Test management, Choice of standards, Test infrastructure management, Test people management, Integration with product release, Test process, Putting together and base lining a test plan, Test case specifications, Update of traceability matrix, Identifying possible candidates for automation, Developing and base lining test cases. Executing test cases and keeping traceability matrix current, Collecting and analyzing matrix	5 hrs	
Chapter No. 9. Reporting and Software Test Automation Preparing test summary report, Recommending product release criteria: Test reporting, Recommending product release, Best practices, Process related best practices, People related best practices, Technology related best practices, What is Test automation?, Terms used in automation, Skills needed for automation, What to automate?, Scope of automation- Identifying the types of testing amenable to automation, Automating areas less prone to change, Automate tests that pertain to standards, Management aspects in automation, Design and architecture for automation.	5 hrs	
Text Book: 1. Desikan Srinivasan and Gopalswamy, Ramesh, Software Testing- Principles and Practices, Published by Person Education, 2nd edition, Pearson Education, 2007. ***References:*** 1. Edward Kit, Software Testing in the Real World Improving the Process, Published by Person Education, 1995. 2. Ron, Patton, Software Testing, 2nd edition Person Education, 2004. 3. Marnie, Hutcheson L., Software Testing Fundamentals, Wiley India, 2003. **4.** Roger S. Pressman, Software Engineering A Practitioners Approach, 5th edition McGraw Hill.		

Program: Master of Technology		
Course Title: **Big Data Analytics**		Course Code: **17ECSE801**
L-T-P: **3-0-1**	Credits: **4**	Contact Hrs: 5 per week
ISA Marks: **50+50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **42hrs**	Exam Duration: **3 hrs**	

1	**Big Data Overview** Data Structures,Analyst Perspective on Data Repositories, State of the Practice in Analytic, BI Versus Data Science, Current Analytical Architecture, Drivers of Big Data,Emerging Big Data Ecosystem and a New Approach to Analytics, Key Roles for the New Big Data Ecosystem, Examples of Big Data Analytics.	**05hrs**
2	**Data Analytics Lifecycle** Data Analytics Lifecycle Overview, Key Roles for a Successful Analytics Project, Background andOverview of Data Analytics Lifecycle, Phase Discovery, Phase 2: Data Preparation,Phase 3:Model Planning, Phase 4: Mode Building, Common Tools for the Model Building Phase.	**05 hrs**
3	**Review of Basic Data Analytic Methods Using R** Introduction to R :R Graphical User Interfaces , Data Import and Export ,Attribute and Data Types, Descriptive Statistics ,Exploratory Data Analysis, Visualization Before Analysis, DirtyData, Visualizing a Single Variable , Examining Multiple Variables, Data Exploration Versus Presentation, Statistical Methods for Evaluation, Hypothesis Testing.	**07 hrs**
4	**Advanced Analytical Theory and Methods : Clustering** Overview of Clustering: K-means, Use Cases, and Overview of the Method, Determining the Number of Clusters, Diagnostics, Reasons to Choose and Cautions	**05 hrs**
5	**Advanced Analytical Theory and Methods : Regression** Linear Regression, Use Cases, Model Description, Diagnostics, Logistic Regression, Model Description, Diagnostics, Reasons to Choose and Cautions, Additional Regression Models.	**05 hrs**
6	**Advanced Analytical Theory and Methods: Time Series Analysis** Overview of Time Series Analysis, Box-Jenkins Methodology, ARIMA Model, Autocorrelation Function (ACF), Autoregressive Models, Moving Average Models, ARMA and ARIMA Models, Building and Evaluating an ARIMA Model.	**07 hrs**
7	**Advanced Analytical Theory and Methods: Text Analysis** Text Analysis Steps, A Text Analysis Example, Collecting Raw Text, Representing Text, Term Frequency—Inverse Document Frequency (TFIDF), Categorizing Documents by Topics, Determining Sentiments.	**04 hrs**
8	**Advanced Analytics—Technology and Tools: MapReduce and Hadoop** Analytics for Unstructured Data , Use Cases ,MapReduce , Apache Hadoop ,The Hadoop Ecosystem, Pig, Hive, HBase, Mahout, NoSQL.	**04 hrs**

Text Books:

1. EMC Education Services, Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data, Wiley Publications.

References:

1. Frank J Ohlhorst, ―Big Data Analytics: Turning Big Data into Big Money‖, Wiley and SAS Business Series, 2012.
2. Colleen Mccue, ―Data Mining and Predictive Analysis: Intelligence Gathering and Crime Analysis‖, Elsevier, 2007.
3. Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer, 2007.
4. Bill Franks, ―Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics‖, Wiley and SAS Business Series, 2012.

Program: Master of Technology		
Course Title: **Applied Mathematics**		Course Code: **18ECSC701**
L-T-P: **3-0-1**	Credits: **4**	Contact Hrs: **3 hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **42**	Exam Duration: **3 hrs**	

1	**Introduction to Statistics** Statistical Thinking, Collecting data, Statistical Modeling Framework, Measure of Central Tendency and Variance, Importance of Data symmetry and Display, Graphical and Tabular Display.	**04 hrs**
2	**Discrete Random Variables and Probability Distribution** Discrete Random variables, Probability distributions and Probability mass function, Cumulative distribution function, Mean and Variance of a discrete random variable, Discrete Uniform distribution, Binomial distribution, Geometric distribution, Poisson distribution, Applications.	**07 hrs**
3	**Continuous Random Variables and Probability Distributions** Continuous random variables, Probability distributions and probability density functions, cumulative distribution functions, Mean and Variance of a continuous random variable, Uniform distribution, Normal Distribution, Normal approximation to Binomial and Poisson distribution, Exponential distribution.	**07 hrs**
4	**Testing of Hypothesis** Estimation theory, Hypothesis testing, Inference on the mean of population (variance known and unknown) Inference on the variance of a normal population, Inference on a population proportion, Testing for Goodness of fit, Inference for a difference in Means(variances known), Inference for a difference in means of two normal distributions (variances unknown), Inference on the Variances of two normal populations, Inference on two population proportions.	**08 hrs**
5	**Simple Linear Regression and Correlation** Simple Linear Regression, Properties of Least square Estimators and Estimation of Variances, Transformations to a Straight line, Correlation, Multiple linear regression model, Least square Estimation of parameters, Matrix approach to multiple linear regression, Properties of least square estimators and estimation of variance.	**06 hrs**
6	**Queuing Theory 1 :** Basics of queuing models, Model I (M /M/ 1): (∞/FIFO), Single Server with Infinite Capacity, Model II (M/M/s): (∞/FIFO), Multiple Server with Infinite Capacity	**05 hrs**
7	**Queuing Theory 2:** Model III (M/M/1): (k/FIFO), Single Server with Finite Capacity, Model IV (M/M/s): (k/FIFO), Multiple Server with Finite Capacity.	**05 hrs**

Text Books:

References:

1. Douglas C Montgomery, George C Runger, Applied Statistics for Engineers, 2nd Edition,John Wiley and Sons, ISBN-0-471-170027-5.
2. Richard I Levin, David S Rubin, Statistics for Management, 6th Edition, Prentice Hall India.
3. Willian W Hines, Douglas C Montgomery, Probability and Statistics in Engineering, 2nd Edition, John Wiley and Sons.
4. V. Sundarapandian, Probability, Statistics and Queuing theory, PHI, 2009.
5. Arnold Oral Allen, Probability, statistics, and queuing theory: with computer science applications, Gulf Professional Publishing, Edition: 2 ,28-Aug-1990

Program: Master of Technology		
Course Title: **Internet Of Things**		Course Code: **18ECSC702**
L-T-P: **3-0-0**	Credits: **3**	Contact Hrs: **3 hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **42**	Exam Duration: **3 hrs**	

1	**Introduction to Internet of Things (IoT):** Definition & Characteristics of IoT, Physical Design of IoT: IoT protocols, Logical Design of IoT: IoT functional blocks, communication models and APIs.	**04 hrs**
2	**IoT Enabling Technologies:** Wireless Sensor Networks, Cloud Computing, Big Data Analytics, Communication Protocols, Embedded Systems, IoT Levels and Deployment Templates.	**06 hrs**
3	**Domain specific IoTs:** Home Automation, Cities, Environment, Energy, Retail, Logistics, Agriculture, Industry, Health and Lifestyle.	**06 hrs**
4	**IoT Platforms Design Methodology:** IoT Design Methodology, Case Study on IoT System for Weather Monitoring.	**04 hrs**
5	**IoT systems – Logical design using Python:** Introduction to Python, Data types, data structures, Control of flow, functions modules, packages, file handling, data/time operations, classes, Python packages - JSON, XML, HTTPLib, URLLib, SMTPLib.	**06 hrs**
6	**IoT Physical Devices and Endpoints:** Basic building blocks of an IoT device, Exemplary device: Rasyberry Pi, interface (serial, SPI, I2C), Programming Rasyberry Pi with Python.	**06 hrs**
7	**IoT Physical Servers & Cloud Offerings:** Introduction to Cloud Storage models and communication APIs ,Webserver – Web server for IoT, Cloud for IoT, Python web application framework, Designing a RESTful web API	**05 hrs**
8	**Case Studies Illustrating IoT Design:** Home Automation-smart lighting, home intrusion detection, Cities-smart parking.	**05 hrs**

Text Books:

1. Internet of Things - A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, Universities Press, 2015, ISBN: 9788173719547

References:

1. Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2014, ISBN: 9789350239759

Program: Master of Technology		
Course Title: **Computer Networks**		Course Code: **18ECSC704**
L-T-P: **3-0-1**	Credits: **4**	Contact Hrs: **5 hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **42**	Exam Duration: **3 hrs**	

1	**Fundamental Concepts of computer Networks** Basic Definitions in Data Networks, Applications, Requirements, Network Architecture, Packet Size and Optimizations, Performance.	**04 hrs**
2	**Data Link Layer** Perspectives on Connecting, Encoding (NRZ, NRZI,Manchester, 4B/5B), Framing, Error Detection, Reliable Transmission, Ethernet and Multiple Access Networks	**08 hrs**
3	**The Network Layer: Data Plane** Overview of Network Layer, Router Architecture, The Internet Protocol (IP): IPv4, Addressing, IPv6, Generalized Forwarding and SDN	**08 hrs**
4	**The Network Layer: Control Plane** Introduction, Routing Algorithms, Intra-AS Routing in the Internet: OSPF, Routing Among the ISPs: BGP, The SDN Control Plane, ICMP: The Internet Control Message Protocol, Multicast, Multiprotocol Label Switching (MPLS)	**08 hrs**
5	**Transport Layer** Introduction and Transport-Layer Services, Multiplexing and De-multiplexing, connectionless Transport: UDP, Connection-Oriented Transport: TCP , Principles of Congestion Control, TCP Congestion Control	**08 hrs**
6	**Application Layer** Principles of Network Applications, The Web and HTTP, Electronic Mail in the Internet, DNS—The Internet's Directory Service, Peer-to-Peer Applications, Video Streaming and Content Distribution Networks	**06 hrs**

Text Books:

1. J. F. Kurose and K. W. Ross, , Computer Networking, A Top-Down Approach, 7th Ed, , Pearson , 2017
2. Larry L Peterson & Bruce S Davien, Computer Networks A System Approach, 5th Ed , Morgan Kaufmann (Elsevier),, 2011

References:

1. Nader F. Mir, Computer and Communication Networks, 2nd Edition, Pearson Prentice-Hall, 2015
2. Behrouz Forouzan, Data Communications and Networking, 5th Ed, McGraw Hill, 2012.
3. A S Tanenbaum, D J Wetherall, Computer Networks, 5th Ed., Prentice-Hall, 2010.

Program: Master of Technology		
Course Title: **Data Structures and Algorithms Lab**		Course Code: **18ECSP706**
L-T-P: **0-0-3**	Credits: **3**	Contact Hrs: **6 hrs/week**
ISA Marks: **80**	ESA Marks: **20**	Total Marks: **100**
Teaching Hrs: **72**	Exam Duration: **3 hrs**	

1	**Introduction**	
	Introduction to data structures, abstract data types and analysis of algorithms.	**04 hrs**
2	**Creation and manipulation of data structures**	
	Stacks and Queues : Array implementation of stacks, queue, Circular queue and Applications of stacks and queues	
	Linked Lists: Singly linked list, doubly linked list. Circular Singly and doubly Linked lists and Applications of linked list.	
	Trees and Graphs: Introduction to trees, Binary search trees, binary tree and tree traversals, Basics of graphs, graph traversals and Applications of trees and graphs.	**06 hrs**
3	**Algorithms**	
	Brute force and Decrease and conquer method : selection sort, insertion sort, radix sort and searching.	
	Hashing: Direct Address Table, Hash Table, Hash Function and Collision Resolution Techniques.	**07 hrs**
4	**Variants of Tree Data Structures:**	
	Dictionaries, Skip lists, Priority queues, Heaps, Leftist trees, AVL, Red Black, B-Trees, Alternative decision tree, Radix trees and Applications	**04 hrs**

List of Sample Assignments:

1. Computer systems must often provide a “holding area” for messages between two processes, two programs, or even two systems. This holding area is usually called a “buffer” and is often implemented as a queue. Simulate the I/O operation of buffer.
2. When you phone the toll-free number for your bank, you may get a recording that says, "Thank you for calling A-1 Bank. Your call will be answered by the next available operator. Please wait”. Simulate the process of answering the calls.
3. Simulate the phonebook feature of mobile.(find name, add entry, owner number and delete all options)
4. Simulate the process of Baggage Scanning machine in the airport.
5. Implement to list the possible correct words when you search for a word in a file or misspell a word
6. An application requires a structure where new nodes can easily added to the front and back of a given node in O(1)
7. Any node can be a starting point. We can traverse the whole list by starting from any point. We just need to stop when the first visited node is visited again.
8. Round robin scheduling by CPU
9. Back word key operation to visit web pages
10. Issuing tickets at the counter in railway station
11. WAP to generate the following pyramid of digits.

```
   232
  34543
 4567654
567898765
```

67890109876
7890123210987
890123454321098
90123456765432109
0123456789876543210

Evaluation:

Students Assessment through CIE (80%) + SEE (20%)

ISA (80%)	Assessment	Weightage in Marks
	Minor 1	15
	Minor 2	15
	Hacker Rank Test/ Code chef	20
	Structured Enquiry(2 evaluations)	20
	Hackathon (Industry standard tool based evaluation)	10
ESA (20%)	Refined output of Hackathon evaluation	20
	Total	100

Reference Books

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C, 2, Pearson Education, 2003
2. Aron M. Tenenbaum, Data Structures using C, 2, PHI, 2006
3. Sartaj Sahni, Data Structures, Algorithms and applications in C++, 2, Universities Press, 2008
4. Horowitz, Sahni, Rajasekaran, , Fundamentals of Computer Algorithms, 1, Galgotia Publications, 2010
5. Michael T. Goodrich, Roberto Tamassia, Algorithm Design and Applications, Wiley Publications, 2015

Program: Master of Technology		
Course Title: **Python Programming Lab**		Course Code: **18ECSP707**
L-T-P: **0-0-1.5**	Credits: **1.5**	Contact Hrs: **3 hrs/week**
ISA Marks: **80**	ESA Marks: **20**	Total Marks: **100**
Teaching Hrs: **12**	Exam Duration: **3 hrs**	

1	**Python Basics** Types, Variables, and Simple I/O, Branching and Looping, Numbers, Arrays, Lists, Comprehensions, tuples, and Dictionaries, Regular Expressions, Functions, Files and Exceptions,	**03 hrs**
2	**Python libraries :** Data manipulation and processing using numpy, scipy and pandas. Data visualization using matplotlib.	**04 hrs**
3	**Python Frameworks** Introduction to Python Frameworks, components of frameworks, building RESTful web services.	**02 hrs**
4	**Django framework** Introduction to Django, Django's take on MVC: Model, View and Template, Django Forms: Form classes, Validation, Authentication, Advanced Forms processing techniques, working with databases, Integrate with RESTful web services.	**03 hrs**

References:

1. Jeff Forcier, "Python Web Development with Django", 1st edition, Pearson Education, 2008.
2. Mark Lutz, "Programming Python", 4th Edition, O'Reilly, 2010.
3. Michael Dawson, Python Programing for the Absolute Beginner, Premier Press, 3rd Edition 2010.

Evaluation:

Students Assessment through ISA (70%) + ESA (30%)

ISA (70%)	**Assessment**	**Weightage in Marks**
	Exercises (4-Evaluation)	40
	Hacker-rank	20
	Structured Enquiry(1-evaluations)	10
ESA (30%)	Course Project	30
	Total	100

School of Computer Science and Engineering

Program: Master of Technology		
Course Title: **Design and Analysis of Algorithms**		Course Code: **18ECSCP709**
L-T-P: **2-0-2**	Credits: **4**	Contact Hrs: **4 hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **42**	Exam Duration: **3 hrs**	

1	**Introduction** Analysis Framework, Asymptotic Notations and Basic Efficiency Classes, Mathematical Analysis of Non-Recursive Algorithms and Mathematical Analysis of Recursive Algorithms.	**06 hrs**
2	**Hashing Technique** Direct Address Table, Hash Table, Hash Function and Collision Resolution Techniques.	**06 hrs**
3	**Algorithm design techniques:** **Divide and conquer:** General Method, Merge sort, quick sort, Matrix Computations **Greedy Technique:** General Method, Huffmann Coding, knapsack problem, Task Scheduling and minimum spanning tree. **Dynamic Programming:** General Method, Floyd-Warshall algorithm, String Editing, Longest Common Subsequence and shortest paths	**15 hrs**
4	**Combinatorial Problem solving Techniques:** **Backtracking Method**: General Method, Sum of subsets, knapsack Problem and Game strategies **Branch and Bound method:** General Method, knapsack Problem, Approximation algorithms and Randomized algorithms. **NP- Hard and NP Complete:** Examples, proof of NP-hardness and NP-completeness.	**15 hrs**

Reference Books:

1. Introduction to Design and Analysis of Algorithms – Anany Levitin 3rd Edition, Pearson, 2012
2. T.H.Cormen, C.E.Leiserson, R.L.Rivest, C. Stein, Introduction to Algorithms, 3nd edition, MIT, 2009.
3. Michael T. Goodrich, Roberto Tamassia, Algorithm Design and Applications, Wiley Publications, 2015

Evaluation Scheme
CIA Scheme

Assessment	Weightage in Marks
Minor -1	15
Minor 2	15
DAA Lab Manual Evaluation coding challenge websites (topcoder/Hackerrank)	10+10
Total	50

Program: Master of Technology		
Course Title: **Distributed and Cloud Computing**		Course Code: **18ECSC710**
L-T-P: **2-0-1**	Credits: **3**	Contact Hrs: **4 hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **42**	Exam Duration: **3 hrs**	

1	**Distributed System Models and Enabling Technologies** Scalable Computing over the Internet, Technologies for Network-Based Systems, System Models for Distributed and Cloud Computing	**04 hrs**
2	**Virtual Machines and Virtualization of Clusters** Implementation Levels of Virtualization, Virtualization Structures/Tools and Mechanisms, Virtualization of CPU, Memory, and I/O Devices, Virtual Clusters and Resources Management.	**06 hrs**
3	**Cloud Platform Architecture over Virtualized Data Centers** Cloud Computing and Service Models, Architectural Design of Compute and Storage Clouds, Public Cloud Platforms.	**06 hrs**
4	**Cloud Programming and Software Environments** Challenges and Opportunities in cloud application, architectural styles, workflows: co-ordination of multiple activities, MapReduce programming model.	**06 hrs**
5	**Cloud Resource Management** Policies and mechanisms for resource management, Applications of control theory to task scheduling on a cloud, Stability of a two-level resource allocation architecture, Feedback control based on dynamic thresholds, Coordination of specialized autonomic performance managers.	**08 hrs**
6	**Cloud Resource Scheduling** Resource bundling; combinatorial auctions for cloud resources, Scheduling algorithms for computing clouds. Fair queuing, Start-time fair queuing, Borrowed virtual time, Cloud scheduling subject to deadlines, Scheduling Map Reduce applications subject to deadlines.	**06 hrs**
7	**Cloud Security** Cloud security risks, Security; the top concern for cloud users, Privacy; privacy impact assessment, Trust, Operating system security, Security of virtualization, Security risks posed by shared images, Security risks posed by a management OS, Xoar - breaking the monolithic design of the TCB, A trusted virtual machine monitor.	**06 hrs**

Text Books:

1. 1. Kai Hwang, Geoffrey C. Fox, Jack J. Dongarra, Distributed and Cloud Computing from Parallel Processing to the Internet of Things, 1, Elsevier, 2012
2. Dan C. Marinescu , Cloud Computing Theory and Practice, 1, Elsevier, 2013

References:

1. RajkumarBuyya, Christian Vecchiola, S.ThamaraiSelvi , Mastering Cloud Computing, 1, McGraw Hil, 2013
2. 2. Anthony T. Velte, Toby J. Velte, Robert Elsenpeter, Cloud Computing, A Practical Approach, 1, McGraw Hil, 2010

Program: Master of Technology		
Course Title: **Machine Learning**		Course Code: **18ECSC711**
L-T-P: **2-0-1**	Credits: **3**	Contact Hrs: **4 hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **42**	Exam Duration: **3 hrs**	

1	**Introduction & Data Pre-Preprocessing** Introduction to data mining, Introduction to Machine Learning, Applications of Machine Learning, Major tasks in data preprocessing - data reduction, data transformation and data Discretization, data cleaning and data integration.	**08 hrs**
2	**Mining Frequent Patterns, Associations and Correlations: Concepts and Methods** Basic Concepts, Efficient and Scalable Frequent Item set Mining Methods, finding interesting Patterns, Pattern Evaluation Methods, Applications of frequent pattern and associations, Advanced Frequent Pattern Mining- Frequent Pattern and Association Mining: A Road Map, Mining Various Kinds of Association Rules. Pattern Mining in Multilevel, Multidimensional Space.	**07 hrs**
3	**Supervised Learning: Classification** Model Evaluation and Selection, Techniques to Improve Classification Accuracy: ensemble Methods; Bayesian belief networks, Introduction to perceptron learning, Back propagation algorithm.	**08 hrs**
4	**Unsupervised Learning: Cluster Analysis** Partitioning methods, Hierarchical Methods, Density based methods, Outlier Detection.	**07 hrs**
5	**Regression Analysis** ANOVA, Linear Discriminant Analysis, Support Vector Machines	**06 hrs**
6	**Reinforcement Learning** Introduction to Reinforcement Learning (RL), Sequential Decision Problems, Passive RL, Active RL, Generalization in RL, Applications of RL	**06 hrs**

Text Books:

4. Jiawei Han, MichelineKamber, and Jian Pei, Data Mining: Concepts and Techniques, 3rd, Morgan Kaufmann, 2011

5. Pang-Ning, Michael Steinbach, Vipin Kumar, Introduction to Data Mining, Pearson Education, 2007

References:

1. Ian H. Witten, Eibe Frank, Mark A. Hall, Data Mining - Practical Machine Learning Tools and Techniques, 3rd, Elsevier Inc, 2011.
2. M. H. Dunham, “Data Mining: Introductory and Advanced Topics”, Pearson Education. 2008.

Program: Master of Technology		
Course Title: **Image and Video Processing**		Course Code: **18ECSC713**
L-T-P: **2-0-1**	Credits: **3**	Contact Hrs: **4 hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **42**	Exam Duration: **3 hrs**	

1	**Fundamentals of Image processing and Image Transforms:** Basic steps of Image processing system sampling and quantization of an Image – Basic relationship between pixels. Image Transforms: 2 D Discrete Fourier Transform, Discrete Cosine Transform (DCT), Discrete Wavelet transforms.	**07 hrs**
2	**Image Enhancement:** Spatial Domain methods: Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial filters, Sharpening Spatial filters. Frequency Domain methods: Basics of filtering in frequency domain, image smoothing, image sharpening, selective filtering.	**08 hrs**
3	**Image Analysis:** Spatial feature extraction, Transform features, Edge detection Boundary Extraction, Boundary representation, Region representation, Moment representation, Structure, Shape features, Texture, Scene matching & detection, Image segmentation and Classification Techniques.	**08 hrs**
4	**Basics of Video Processing**: Analog video, Digital Video, Time varying Image Formation models : 3D motion models, Geometric Image formation, Photometric Image formation, sampling of video signals, filtering operations	**07 hrs**
5	**2-D Motion Estimation:** Optical flow, pixel based motion estimation, Block matching algorithm, Mesh based motion Estimation, global Motion Estimation, Region based motion estimation, multi resolution motion estimation.	**06 hrs**
6	**Video Segmentation and Tracking :** Change detection, Spatiotemporal change detection, Motion segmentation, Motion tracking in video : Rigid object tracking and articulated object tracking	**06 hrs**

Text Books:

1. R. C. Gonzalez and R. E. Woods, “Digital Image Processing,” 3rd edition, Pearson Education(Asia) Pte. Ltd/Prentice Hall of India, 2009.
2. M. Tekalp, “Digital Video Processing”, 2nd edition, Prentice Hall, USA, 2015.

References:

1. Anil K. Jain, “Fundamentals of Digital Image Processing," Pearson Education (Asia) Pte. Ltd./Prentice Hall of India, 2004.
2. Alan C Bovik “ Essential Guide to Video Processing”, AP Elsevier publication, 2009
3. Z. Li and M.S. Drew, “Fundamentals of Multimedia,” Pearson Education (Asia) Pte. Ltd., 2004.

School of Computer Science and Engineering

Program: Master of Technology		
Course Title: **Cryptography and Network Security**		Course Code: **18ECSC714**
L-T-P: **2-0-1**	Credits: **3**	Contact Hrs: **4 hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **42**	Exam Duration: **3 hrs**	

1	**Network Security Overview** Computer Security Principles, The OSI Security architecture: Security attacks, services and mechanisms, A model for Network Security, Classical Encryption techniques: Substitution ciphers- Caesar, Monoalphabetic, Playfair and Hill ciphers, Substitution ciphers, Taxonomy of Cryptography and Cryptanalysis.	**08 hrs**
2	**Data Encryption Algorithms** Traditional block cipher structure, Data Encryption Standard, DES example, strength of DES, Multiple DES, block cipher design prinicples, Advanced Encryption Standard, block-cipher modes of operation, Stream Ciphers: RC4 and A5/1.	**08 hrs**
3	**Public-Key Cryptography and Key Management** Elementary Concepts and Theorems In Number Theory, principles of public-key cryptosystems, The RSA algorithm, Diffie-Hellman Key Exchange, Elliptic curve arithmetic, Elliptic key cryptography, Key Distributions and Management, X.509 certificates, public key infrastructure	**08 hrs**
4	**Data Authentication** Cryptographic Hash Functions: applications and requirements, Hash functions based on cipher block chaining, Secure Hash algorithm, SHA3, Message authentication codes: requirements and functions, HMAC, Digital Signatures, and Digital Signature Standard.	**06 hrs**
5	**Application, Transport and Network layer Security** Web security considerations, Pretty Good Privacy and S/MIME,Secure Sockets Layer, HTTPs, Kerberos, SSH, DomainKeys Identified Mail (DKIM), IPSec overview, Encapsulating security payload, combining security associations, Internet key exchange	**06 hrs**
6	**Wireless Network Security** Wireless security threats and measures, mobile device security, IEEE 802.11 WLAN Standard, IEEE 802.11i Wireless Lan Security: Services and phases of operation, WPA and WPA2	**06 hrs**

Text Books:

1. William Stallings, Cryptography and Network Security Principles And Practices, 6th Edition, Pearson, 2014.

References:

2. Behrouz A. Forouzan, "Cryptography and Network Security**",** 6th Edition, Tata McGraw-Hill, 2014.
3. Mark Stamp, "Information Security: Principles and Practices", 2nd Edition, John Wiley and Sons, 2011.

Lab Plan

Expt./Job No.	***Brief description about the experiment/job***	***No. of Lab. Slots***
1.	Demo and practice on Crypto Library	1
2.	Implementation of symmetric key algorithm algorithms	1
3.	Implementation of asymmetric key algorithm algorithms, Hash algorithms	2
4.	Web Security using SSL certificates	1

5.	Secure access to resources to Kerberos	2
6.	Web server security using CAPTCHA	1
7.	Implemenetation of access Control	1
8.	Configuring Firewall, IDS	1

Program: Master of Technology		
Course Title: **Principles and Practices of Engineering Education**		Course Code: **18ECRC701**
L-T-P: **3-0-0**	Credits: **3**	Contact Hrs: **3 hrs/week**
ISA Marks: **80**	ESA Marks: **20**	Total Marks: **100**
Teaching Hrs: **40**	Exam Duration: **3 hrs**	

1	**Module 1. Basics of Assessment and Evaluation** **Different Methods, Techniques.**	**04 hrs**
2	Module 2. Fundamental Principles of Effective Teaching and Learning Teaching Philosophy, How Learning Works, Classroom Communication Skills, Teaching and Learning Styles, Bloom's Taxonomy.	**06 hrs**
3	Module 3. Fundamentals of Instructional Design Different Instructional Design Models.	**07 hrs**
4	Module 4. Technology Enhanced Learning Role of Technology, TPACK Model, Technology Tools.	**04 hrs**

Text Books:

4. Ambrose, S., Bridges, M., DiPietro, M., Lovett, M., & Norman, M, How learning works: 7
5. Research-Based principles for smart teaching. San Francisco: Jossey-Bass. , San Francisco:Jossey-Bass, 2010

Suggested Web Resources:

1. https://cft.vanderbilt.edu/guides-sub-pages/blooms-taxonomy/
2. http://educationaltechnology.net/instructional-design/
3. https://www.nwea.org/blog/2014/33-digital-tools-advancing-formative-assessmentclassroom/
6. http://oedb.org/ilibrarian/101-web-20-teaching-tools/

Program: Master of Technology		
Course Title: **Distributed and Cloud Computing**		Course Code: **19ECSC710**
L-T-P: **2-0-1**	Credits: **3**	Contact Hrs: **4 hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **42**	Exam Duration: **3 hrs**	

1	**Distributed System Models and Enabling Technologies** Scalable Computing over the Internet, Technologies for Network-Based Systems, System Models for Distributed and Cloud Computing	**04 hrs**
2	**Virtual Machines and Virtualization of Clusters** Implementation Levels of Virtualization, Virtualization Structures/Tools and Mechanisms, Virtualization of CPU, Memory, and I/O Devices, Virtual Clusters and Resources Management.	**06 hrs**
3	**Cloud Platform Architecture over Virtualized Data Centers** Cloud Computing and Service Models, Architectural Design of Compute and Storage Clouds, Public Cloud Platforms.	**06 hrs**
4	**Cloud Programming and Software Environments** Challenges and Opportunities in cloud application, architectural styles, workflows: co-ordination of multiple activities, MapReduce programming model.	**06 hrs**
5	**Cloud Resource Management** Policies and mechanisms for resource management, Applications of control theory to task scheduling on a cloud, Stability of a two-level resource allocation architecture, Feedback control based on dynamic thresholds, Coordination of specialized autonomic performance managers.	**08 hrs**
6	**Cloud Resource Scheduling** Resource bundling; combinatorial auctions for cloud resources, Scheduling algorithms for computing clouds. Fair queuing, Start-time fair queuing, Borrowed virtual time, Cloud scheduling subject to deadlines, Scheduling Map Reduce applications subject to deadlines.	**06 hrs**
7	**Cloud Security** Cloud security risks, Security; the top concern for cloud users, Privacy; privacy impact assessment, Trust, Operating system security, Security of virtualization, Security risks posed by shared images, Security risks posed by a management OS, Xoar - breaking the monolithic design of the TCB, A trusted virtual machine monitor.	**06 hrs**

Text Books:

3. 1. Kai Hwang, Geoffrey C. Fox, Jack J. Dongarra, Distributed and Cloud Computing from Parallel Processing to the Internet of Things, 1, Elsevier, 2012
4. Dan C. Marinescu , Cloud Computing Theory and Practice, 1, Elsevier, 2013

References:

3. RajkumarBuyya, Christian Vecchiola, S.ThamaraiSelvi , Mastering Cloud Computing, 1, McGraw Hil, 2013
4. 2. Anthony T. Velte, Toby J. Velte, Robert Elsenpeter, Cloud Computing, A Practical Approach, 1, McGraw Hil, 2010

Program: III Semester Bachelor of Engineering (Electronics & Communication Engineering)			**Teaching Hours**
Course Title: Circuit Analysis		**Course Code: 15EECC201**	
L-T-P-SS: 4-0-0-0	**Credits: 4**	**Contact Hours: 4Hrs/week**	
CIE Marks: 50	**SEE Marks: 50**	**Total Marks: 100**	
Teaching Hours: 50Hrs	**Examination Duration:3 Hrs**		
Unit I **Chapter 1: Basics** Active and passive circuit elements, Voltage & current sources, Resistive networks, Nodal Analysis, Super node, Mesh Analysis, Super mesh, Star – Delta Transformation. [Text 1: Chapter 4,5, 7]			06
Chapter 2: Network Theorems Homogeneity, Superposition and Linearity, Thevenin's & Norton's Theorems, Maximum Power Transfer Theorem, Miller's theorem, Reciprocity principle. [Text 1 : Chapter 5]			08
Chapter 3: Network topologies Graph of a network, Concept of tree and co-tree, incidence matrix, tie set and cut set schedules, Formulation of Equilibrium equations in matrix form, Solution of resistive networks.[Text 1: Chapter 5]			04
Unit II **Chapter 4: Two Port Networks** Two port variables, Z,Y, H,G, A- Parameter representations, Input and output impedance calculation, Series, Parallel and Cascade network connections, and their (suitable) models. [Text 2 : Chapter 11]			06
Chapter 5: Time and Frequency domain Representation of Circuits Order of a system, Concept of Time constant, System Governing equation, System Characteristic equation, Initial conditions, Transfer Functions (Fourier and Laplace domain representation) [Text 2: Chapter 4]			06
Chapter 6: First order circuits Transient response of R-C and R-L networks (with Initial conditions) Concept of phasor, Phasor diagrams, Frequency response characteristics, Polar plots R-C , R-L circuits as differentiator and integrator models, time and frequency domain responses R-C , R-L circuits as Low pass and high pass filters [Text 2: Chapter 5, Text 1: Chapter 8,9,10]			08
Unit III **Chapter 7: Higher order circuits** Higher order R-C, R-L, and R-L-C networks, time domain and frequency domain representation, Phasor diagrams, Polar and logarithmic plots, Series R-L-C circuit, Transient response, Damping factor, Quality factor, Frequency response curve , Peaking of frequency curve and its relation to damping factor, Resonance Parallel, R-L-C circuit, Tank circuit, Resonance, Quality factor and Bandwidth [Text 2: Chapter 7,8]			12

Text Books

1. W H Hayt, J E Kemmerly, S M Durban, Engineering Circuit Analysis, 7th edition, McGraw – Hill.
2. M E. Van Valkenburg, Network Analysis, 3rd edition, Pearson Education..

Reference Books

1. Joseph Edminister, MahmoodNahavi, Electric Circuits, 3rd edition, Tata McGraw – Hill.
2. V. K. Aatre, “Network Theory and Filter Design”, 2nd edition, Wiley Western Limited.

KLE TECH. CREATING VALUE LEVERAGING KNOWLEDGE

Earlier known as
B. V. B. College of Engineering & Technology

School of Electronics & Communication Engineering

Program: III Semester Bachelor of Engineering (Electronics & Communication Engineering)			Teaching Hours
Course Title: Analog Electronic Circuits		**Course Code: 15EECC202**	
L-T-P-SS: 4-0-0-0	**Credits: 4**	**Contact Hours: 4Hrs/week**	
CIE Marks: 50	**SEE Marks: 50**	**Total Marks: 100**	
Teaching Hours: 50Hrs	**Examination Duration: 3 Hrs**		
Unit I **Chapter 1: Applications of a Junction diode:** Recap of diode models: piece-wise linear model, constant voltage drop model, ideal diode model, small signal model. Applications of diodes as a Clipping circuit and clamping circuits Voltage doubler. (T1 : 2.2,2.3.1 to 2.3.8,2.6.1to 2.6.3.)			06
Chapter 2: MOSFETs structure and physical operation: Device structure, operation with no gate voltage, creating a channel for current flow, applying small vds, operation as vds is increased, derivation of the id-vds relationship, the P-channel MOSFET, complementary MOS or CMOS, operating the mos transistor in the sub threshold region.Current-voltage characteristics: circuit symbol, the id vs vds characteristics, finite output resistance in saturation, characteristics of the p-channel MOSFET, the role of the substrate-the body effect, temperature effects, breakdown and input protection. MOSFET circuits at DC. **(T1: 4.1, 4.2 ;4.3)**			12
Unit II **Chapter 3:Current mirrors** Basic current mirror,Widlar, Cascode and Wilson : Output impedance and Voltage swing. **Chapter 4: MOSFET amplifiers** Biasing in mos amplifier circuits, small signal operation and models, single stage MOS amplifiers, the MOSFET internal capacitance and high frequency model, frequency response of CS amplifier.(CD and CG),Cascode Connection: Implications on gain and Bandwidth (T1:4.4,4.5, 4.6.1 to 4.6.7 ; 4.7.1, 4.7.2, 4.7.3, 4.7.5, 4.7.6, 4.7.7;4.8.1,4.8.2, 4.8.3,4.8.4, 4.9.1 to 4.9.3)			08 12
Unit III **Chapter 5: Feedback Amplifiers :** General feedback structure (Block schematic), Feedback desensitivity factor, positive and negative feedback Nyquist stability Criterion, RC phase shift oscillator, wein bridge Oscr, merits of negative feedback, feedback topologies: series-shunt feedback amplifier, series-series feedback amplifier, and shunt-shunt and shunt-series feedback amplifier with examples (T1:7.1 to 7.6) **Chapter 6: Large Signal Amplifiers :** Classification of amplifiers: (A, B, AB and C); Transformer coupled amplifier, push-pull amplifier Transistor case and heat sink. (T1:12.1 to 12.6;12.8.4)			06 06

Text Books

1. A.S. Sedra & K.C. Smith, "Microelectronic Circuits", 5th Edition, Oxford Univ. Press, 1999.

References

1. Jacob Millman and Christos Halkias, “Integrated Electronics”, McGraw Hill.
2. David A. Bell, “Electronic Devices and Circuits” 4th edition , PHI publication 2007.
3. Grey, Hurst, Lewis and Meyer, “Analysis and design of analog integrated circuits,” 4th edition.
4. Thomas L. Floyd, “Electronic devices”, Pearson Education, 2002
5. Richard R. Spencer & Mohammed S. Ghousi, “ Introduction to Electronic Circuit Design”, Pearson Education, 2003
6. J. Millman & A. Grabel, "Microelectronics"-2nd edition, McGraw Hill, 1987.
7. Behzad Razavi, “Fundamentals of Microelectronics”, reprint 2015 Wiley publications.

Program: III Semester Bachelor of Engineering (Electronics & Communication Engineering)		
Course Title: Digital Circuits lab		**Course Code: 15EECP201**
L-T-P: 0-0-1	**Credits: 1**	**Contact Hours: 2Hrs/week**
CIE Marks: 80	**SEE Marks: 20**	**Total Marks: 100**
Teaching Hours: 28Hrs	**Examination Duration: 3 Hrs**	

List of Experiments:

1. Characterization of TTL & CMOS Gates– Propagation delay, Fan-in, Fan-out and Noise Margin.
2. Design and implement binary to gray, gray to binary, BCD to Ex-3 and Ex-3 to BCD code converters.
3. Design and implement BCD adder and Subtractor using 4 bit parallel adder.
4. Design and implement given functionality using decoders and multiplexers.
5. Design and implement n bit magnitude comparator using 4- bit comparators.
6. Design and implement Ring and Johnson counter using shift register.
7. Design and implement mod-6 synchronous and asynchronous counters using flip flops.
8. Design and implement a digital system to display a 3 bit counter on a 7 segment display. Demonstrate the results on a general purpose PCB.
   Design and implement 1-bit serial adder. Demonstrate the results on a general purpose PCB.

Reference Books

1. K.A.Krishnamurthy "Digital lab primer", Pearson Education Asia Publications, 2003."Electronic Principles" by A.P.Malvino, TaTa MGH,5th ED

KLE TECH. CREATING VALUE LEVERAGING KNOWLEDGE Earlier known as B. V. B. College of Engineering & Technology	School of Electronics & Communication Engineering

Program: III Semester Bachelor of Engineering (Electronics & Communication Engineering)		
Course Title: Analog Electronic Circuits Lab		**Course Code: 15EECP202**
L-T-P: 0-0-1	**Credits: 1**	**Contact Hours: 2Hrs/week**
CIE Marks: 80	**SEE Marks: 20**	**Total Marks: 100**
Teaching Hours: 28Hrs	**Examination Duration: 3 Hrs**	

List of Experiments:

1. Design &Testing of Diode Clipping (single/double ended) circuits
2. Design &Testing of Clamping circuits for Positive and Negative Clamping.
3. MOSFET characteristics
4. Design of a single stage CS (MOSFET) amplifier &determination of the gain – frequency response.
5. Design of source follower using MOSFET.
6. Design of Darlington Emitter follower with and without Bootstrapping and determination of the gain, i/p and o/p impedance
7. Design and testing Current mirror circuit with MOSFET
8. Design of two stage voltage series feed-back amplifier & determination of the gain, frequency response, i/p &o/p impedance with &without feedback
9. Design and testing of Transformer-less push-pull class B power amplifier

****Note-All above experiments are to be conducted along with simulation.**

***Analog Electronic Circuits Lab:** Simulation of MOSFET based circuits using netlist based Spice Simulators (Avoid using drag n drop), with the spice models of MOSFETs in the same netlist file before using hardware using breadboard.

Reference Books

1. **"**Electronic Devices & circuit Theory " by Nashelsky & Boylstead,PHI,9th Ed
2. "Integrated Electronics" By 'Jacob Millman and Christos Halkias',McGraw Hill,
3. **"**Electronic Principles" by A.P. Malvino, TaTa MGH,5th Ed

Program: III Semester Bachelor of Engineering (Electronics & Communication Engineering)				Lab.+ Teaching Hours
Course Title: Microcontroller Architecture & Programming			Course Code: 15EECE202	
L-T-P: 0-0-2		Credits: 2	Contact Hours: 4Hrs/week	
CIE Marks: 80		SEE Marks:20	Total Marks: 100	
Teaching + Lab. Hours: 48Hrs		Examination Duration:3 Hrs		
1.	**Overview of Architecture of 8051:** • Processor Core and Functional Block Diagram • Description of memory organization • Overview of ALL SFR's and their basic functionality			02+02
2.	**Low Level programming Concepts:** • Addressing Modes • Instruction Set and Assembly Language programming(ALP) • Developing, Building, and Debugging ALP's			02+02
3.	**Middle Level Programming Concepts:** • Cross Compiler • Embedded C language implementation, programming, & debugging • Differences from ANSI-C • Memory Models • Library reference • Use of directives • Functions, Parameter passing and return types			04+04
4.	**On-Chip Peripherals Study,Programming, and Application:** • Ports: Input/Output • Timers & Counters • UART • Interrupts			04+04
5.	**External Interfaces Study,Programming and Applications :** • LEDS • Switches(Momentary type, Toggle type) • Seven Segment Display: (Normal mode, BCD mode,Internal Multiplexing & External Multiplexing)			04+04

	• LCD (8bit, 4bit, Busy flag, custom character generation) • Keypad Matrix	
6.	**Selective Discussion during Project Development** • A/D & D/A Converter • Stepper Motor, DC Motor • ZIGBEE • GSM/GPS • USB • MMC & SD • Ethernet MAC	08+08

Text Books:

1. Kenneth J. Ayala ; "The 8051 Microcontroller Architecture, Programming & Applications" 2e, Penram International, 1996 / Thomson Learning 2005
2. Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D. McKinlay; "The 8051 Microcontroller and Embedded Systems – using assembly and C "- PHI, 2006 / Pearson, 2006

References Books:

1. Predko ; "Programming and Customizing the 8051 Microcontroller" –, TMH
2. Raj Kamal, "Microcontrollers: Architecture, Programming, Interfacing and System Design", Pearson Education, 2005
3. Ajay V.Deshmukh; "Microcontrollers- Theory and Applications",TMH,2005
4. Dr.RamaniKalpathi and Ganesh Raja; "Microcontroller and its applications", Sanguine Technical publishers,Bangalore-2005

Program: IV Semester Bachelor of Engineering (Electronics & Communication Engineering)			Teaching Hours
Course Title: Control systems		**Course Code: 15EECC206**	
L-T-P: 4-0-0-0	**Credits: 4**	**Contact Hours: 4Hrs/week**	
CIE Marks: 50	**SEE Marks: 50**	**Total Marks: 100**	
Teaching Hours: 50Hrs	**Examination Duration: 3 Hrs**		
Unit – I **Chapter 1: Control System representation** Concepts of Control Systems- Open Loop And Closed Loop Control Systems, Feed-Back characteristics, Examples, System representation : Differential Equations, Transfer function, Impulse response , System Modeling : Electrical Mechanical, Electro mechanical , Rotational Mechanical Systems.			06
Chapter 2: Block Diagram And Signal Flow Graphs Transfer Functions, Block Diagram Algebra and Representation By Signal Flow Graph - Reduction Using Mason's Gain Formula.			06
Chapter 3: Stability Analysis In S-Domain The Concept Of Stability(BIBO, all system poles on LHS, Impulse response is convergent, Marginal stability-necessary conditions) – Routh's Stability Criterion – Limitations of Routh's Stability Criterion (Applications only).			08
Unit II **Chapter 4: Frequency Response Analysis** Introduction, Correlation Between Time And Frequency Response, Bode Diagrams-Determination Of Frequency Domain Specifications And Transfer Function From The Bode Diagram-Phase Margin And Gain Margin-Stability Analysis From Bode Plots,All Pass And Minimum Phase Systems.Root Locus Technique: The Root Locus Concept - Construction Of Root Loci-Effects Of Adding Poles And Zeros To G(S)H(S) on Root Loci.			06
Chapter 5: Stability Analysis In Frequency Domain Polar Plots, Nyquist Plots Stability Analysis, Assessment Of Relative Stability Using Nyquist Criterion.			06
Chapter 6: Time Response Analysis Standard Test Signals (impulse, step, ramp, parabola)-Order and Type of System, Concept of Dominant pole, Time Response of First Order Systems – Characteristic Equation of Feedback Control Systems, Transient Response of Second Order Systems - Time Domain Specifications – Steady State Response - Steady State Errors and Error Constants – Effects Of Proportional Derivative, Proportional Integral Systems			08

Unit – III	
Chapter 7: Introduction to Controller Design The Design Problem. Preliminary Consideration Of Classical Design, Realization Of Basic Compensators(Lag ,Lead and dominant pole compensation), P, I, PI, PD & PID Controllers. **Chapter 8: State Space Analysis** Concepts Of State, State Variable And State Models For Electrical Systems, Solution Of State Equations.	06 04

Text Books:

1. Control Systems Engineering, 5th edition – by I. J. Nagrath and M. Gopal, New Age International (P) Limited, Publishers.2011
2. Modern Control Systems, 11th edition- Richord C Dorf and Robert H. Bishop, Pearson,2013
3. Automatic Control Systems, 8th edition(9th edition)– by B. C. Kuo 2003– John wiley and Son's.
4. Control System by Dazo-3rd edition

Reference Books

1. Automatic Control Systems, 8th edition– by B. C. Kuo 2003– John wiley and Son's.
2. Modern Control Engineering, 3rd edition – by Katsuhiko Ogata, Prentice Hall of India Pvt. Ltd.
3. Control Systems Engg. by NISE, 4th Edition – John wiley
4. Control Systems Engg. by S Palani, 2nd Edition—McGraw Hill

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Program: IV Semester Bachelor of Engineering (Electronics & Communication Engineering)			Teaching Hours
Course Title: ARM Processor & Applications		**Course Code: 15EECC207**	
L-T-P: 3-0-0-0	**Credits: 3**	**Contact Hours: 4Hrs/week**	
CIE Marks: 50	**SEE Marks: 50**	**Total Marks: 100**	
Teaching Hours: 50Hrs	**Examination Duration: 3 Hrs**		

Content	
Unit I	
Chapter 1: ARM Architecture Architectural inheritance, Architecture of ARM7TDMI, ARM programmers model, ARM development tools, 3 stage pipeline ARM organization, ARM instruction execution.	06
Chapter 2: ARM Assembly language programming **ARM Instruction Set:** Introduction, ARM instruction set-Data processing instruction, Branch instruction, Load store instruction, Software interrupt instruction, Program status register instruction, Conditional execution, Example programs. **Thumb instruction set** The Thumb programmer model, Thumb branch instructions, Thumb software interrupt instructions, Thumb data processing instructions, Thumb breakpoint instruction, Thumb implementation, and Thumb applications. Example programs	08
Unit II	
Chapter 3: Assembler rules and Directives Introduction, structure of assembly language modules, Predefined register names, frequently used directives, Macros, Miscellaneous assembler features.	04
Chapter 4: Exception handling Introduction, Interrupts, error conditions, processor exception sequence, the vector table, Exception handlers, Exception priorities, Procedures for handling exceptions.	05
Chapter 5: Architectural support for high level languages Abstraction in software design, data types, floating point data types, The ARM floating point architecture, use of memory, run time environment.	05
Unit – III **Chapter 8: LPC 2129/2148 Controller Architectural overview** On-chip memory, GPIOs, Timers, UART, ADC, I2C, SPI , RTC, ARM interfacing techniques and programming: LED, LCD, Stepper Motor, Buzzer, Keypad, ADC	10

Text Book:

1. "ARM System- on-Chip Architecture" by 'Steve Furber' , LPE, Second Edition.
2. "ARM Assembly Language fundamentals and Techniques" by William Hohl, CRC press, 2009.

References:

1. "ARM system Developer's Guide"- Hardbound, Publication date: 2004 Imprint: MORGAN KAUFFMAN
2. User manual on LPC21XX.

"The 8051 Microcontroller Architecture, Programming and Applications", Kenneth J. Ayala, 3rd E.

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<table>
<tr><td colspan="3">Program: IV Semester Bachelor of Engineering (Electronics & Communication Engineering)</td><td rowspan="5">Lab+ Teaching Hours</td></tr>
<tr><td colspan="2">Course Title: Digital System Design using Verilog</td><td>Course Code: 15EECC208</td></tr>
<tr><td>L-T-P: 0-0-2</td><td>Credits: 2</td><td>Contact Hours: 4Hrs/week</td></tr>
<tr><td>CIE Marks: 80</td><td>SEE Marks:20</td><td>Total Marks: 100</td></tr>
<tr><td>Teaching + Lab. Hours: 48 Hrs</td><td>Examination Duration:3 Hrs</td><td></td></tr>
</table>

1.	**Introduction to verilog:** Verilog as hdl, levels of design description, simulation and synthesis, digital design flow.	02+02
2.	**Programming on Data flow description:** Structure of data-flow description, data type – vectors. Simple combinational circuit design like decoder, multiplexers, code converters.	02+02
3.	**Programming on Behavioral Descriptions:** Behavioral Description highlights, sequential statements. Introduction to Testbench. Design of sequence multiplier, Booth multiplier. Introduction to FPGAs, Synthesis	04+04
4.	**Programming on Structural Descriptions:** Highlights of structural Description, Organization of the structural Descriptions, state Machines, Generate, Generic, statements. Design of 16 bit RCA and CLA	02+02
5.	**Programming on Tasks and Functions:** Highlights of Tasks, and Functions, FSM, design like counter, Mealy and Moore machine, Sequence Detector.	04+04
6.	**Programming on Interfacing :** Interfacing with 7-segment display and push buttons. Interfacing with PS/2 Keyboard and VGA display.	04+04
7.	**Programming on Advanced HDL Descriptions:** Block RAMs on an FPGA and understand memory interfacing, File operations in Verilog, File processing examples.	02+04
8.	**Open ended Experiment:** Bowling Score Keeper / Floating Point Unit Arithmetic Units/pipelined processor/traffic light controller	06

Text Book

1. Nazeih M. Botros , “HDL Programming VHDL and Verilog”, Dreamtech Press, 2006
2. J. Bhaskar, “A Verilog Primer’’, BSP, 2nd edition 2003. References

Reference Books

1. Samir Palnitkar, “Verilog HDL”, Pearson Education, 2nd Edition,2003.
2. Thomas and Moorby, “The Verilog Hardware Description Language”, kluwer academic publishers, 5th edition, 2002.
3. Stephen Brown and Zvonko Vranesic, “Fundamentals of Logic Design with Verilog”, TMH publications, 2007.
4. Charles.H.Roth,Jr., Lizy Kurian John “Digital System Design using VHDL” , Thomson, 2nd Edition, 2008.

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Program: IV Semester Bachelor of Engineering (Electronics & Communication Engineering)		
Course Title: Data acquisition and Controls Lab		**Course Code: 15EECP203**
L-T-P: 0-0-1	**Credits: 1**	**Contact Hours: 2Hrs/week**
CIE Marks: 80	**SEE Marks: 20**	**Total Marks: 100**
Teaching Hours: 25Hrs	**Examination Duration: 2 Hrs**	

Data acquistion Experiments:

1) Resistive, Capacitive and Inductive transducer characterization..
2) Voltage series, voltage shunt feedback amplifier.
3) Transconductance and Transresistance amplifier.
4) Comparator. (ZCD & Schmitt trigger) , Precision rectifier.
5) Waveform generators.
6) Sample and hold circuit.
7) Instrumentation Amplifier using op-amp.
8) Data converters to determine their performance parameters.
   a. 4-bit R-2R D-A Converter.
   b. 2-Bit flash ADC/8-Bit ADC (Using 0808IC)
9) 1st and 2nd order Low pass and High pass filter.
10) DAQ system for measuring given parameter.

Controls Experiments:

11) Determine Transient Response of RLC circuits, Lag, Lead and Lag-Lead networks
12) Stability Analysis:
    a) Poles and Zeros
    b) Open loop and Closed Loop Gain.
    c) Comparative study of Bode, Nyquist and Root locus with respect to Stability.
13) P, PI, PD and PID controllers.

Program: IV Semester Bachelor of Engineering (Electronics & Communication Engineering)		
Course Title: ARM Microcontroller Lab		**Course Code: 15EECP204**
L-T-P: 0-0-1	**Credits: 1**	**Contact Hours: 2Hrs/week**
CIE Marks: 80	**SEE Marks: 20**	**Total Marks: 100**
Teaching Hours: 25Hrs	**Examination Duration: 2 Hrs**	

List of Experiments:

1. Write a C language programs to perform Basic ARM controller based applications.
    - Addition of n number in an array
    - Sort a list of values
    - Finding largest no in an array Write a program to count up in from 00 to 99
2. Write a C language programs to perform following operations.
    - Count no of chars in a string.
    - Concatenating two strings.
    - Compare two strings for equality.
    - Replace character in a string
3. Write a program to turn on led on the mbed board using online compiler.
4. Write a program to interface 7-seg to mbed board and write a program to count 0 to 99
5. Write a program to interface LCD to mbed board and write a program to display the string on the LCD
6. Write a program to generate interrupts to serve two tasks
7. Write a program for scheduling of a thread in RTOS using ARM cortex M3
8. Design and develop an Data monitoring system using ARM controller for access the data from the sensor and transfer the same serially to PC through hyper terminal

Program: III Semester Bachelor of Engineering (Electronics & Communication Engineering)			Teaching Hours
Course Title: Engineering Design		**Course Code: 17EECF201**	
L-T-P: 0-0-3	**Credits: 3**	**Contact Hours: 03 Hrs/week**	
ISA Marks: 80	**ESA Marks: 20**	**Total Marks: 100**	
Teaching Hours:	**Examination Duration: 2 Hrs**		
PART A			
Planning Introduction to Engineering Design, Problem Definition, Design attributes Gantt Chart, Design Objectives, Design Specifications			**02**
Conceptual Design Functional Analysis, Concept generation, Concept Evaluation			**03**
System Level Design Product Architecture, Configuration Design, Parametric Design			**03**
Detail Design Sub-system Design, Design Verification			**03**
PART B			
OrCAD Functional simulation of basic Analog and Digital application circuits using OrCAD eCAD tool			**01**
Schematic Capture of the reference design using using OrCAD eCAD tool.			**01**
Layout Design of the reference design using using OrCAD eCAD tool.			**01**
Creation of Symbols/Cell/Part			**01**
LabVIEW Introduction to LabVIEW and functional simulation of basic Analog and Digital application circuits in LabVIEW			**01**
Functional Simulation of the circuit for selected problem statement			**01**
Co-simulation of the circuit for selected problem statement.			**01**

Text Book

1. Simon Haykin, Barry Van Veen, Signals and Systems, John Wiley,2002
2. Peter V. O'neil, Advanced Engineering Mathematics, Thmoson – Books/Cole,Singapore
3. AdvancedEngineeringMathematics,3ed,DennisGZillandMichaelRCullin, NarosaPublishingHouse,NewDelhi,2009

References

1. Kreyszig E., Advanced Engineering Mathematics, 8ed, John Wiley & sons,2003.
2. Stanley J Farlow, Partial differential equations for Scientists and Engineers, Dover publications, INC, New York,1993

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Semester: IV

Course Title: **Product Realization**	Course Code: 17EECF203
Total Contact Credits: **2** **(0-0-2)**	Duration of SEE Credits: -
ISA Marks: 80	ESA Marks: 20

Week #	Particulars	Template #	Venue
Week 1 **and** **Week 2**	➢ Introduction to Prototyping ➢ Defining- Specifications, Part Drawings, Assembly Drawings, PCB Layout, Wireframe , Pseudocode, BOM, Process Plan, Fabrication and Test Plan Validation ➢ IOT Workshop		Studio Engagement
Week 3	➢ Identifying sub-assemblies (minimum of 3) ➢ Selection of materials for all the parts and joining techniques		Makers Space/
Week 4	➢ Process plan ➢ Identifying the proper machines and tools required for prototyping. ➢ Preparing of raw materials for prototyping. ➢ Plan and procure the bought out parts.		
Week 5	➢ Fabricate the parts for sub assembly 1		
Week 6	➢ Fabricate the parts for sub assembly 2		
Week 7	➢ Fabricate the parts for sub assembly 3		
Week 8	➢ Assemble the sub assemblies and check for interference and functionality		
Week 9	➢ Test the functional prototype using proper identified test		

	methods.		
Week 10	➢ Analyse the test results ➢ System modification		
Week 11	➢ Final concluding review ➢ Product catalogue		Studio/ Makers Space

References

1. Pahl, G., Beitz, W., Feldhusen, J. and Grote ; "Engineering Design-A Systematic Approach" by, K.-H- Springer; 3rd ed. 2007

Program: V Semester Bachelor of Engineering (Electronics & Communication Engineering)			Teaching Hours
Course Title: Communication Systems		Course Code: 17EECC302	
L-T-P: 4-0-0	Credits: 4	Contact Hours: 4 Hrs/week	
ISA Marks: 50	ESA Marks: 50	Total Marks: 100	
Teaching Hours: 50Hrs	Examination Duration: 3 Hrs		
Content			
Unit – 1			
Chapter No. 1. Principles of Amplitude modulation Introduction to AM : DSBFC,DSBSC,SSB,VSB- Frequency domain and time-domain description of modulated wave, Generation and detection of VSB modulated wave, Frequency division multiplexing (FDM)			06
Chapter No. 2. Principles of Angle modulation Basic definitions: Phase and frequency modulation, phase and frequency deviation, narrow and wide band frequency modulation, spectrum and phase diagram of FM, transmission band width of FM waves, effect of modulation index on bandwidth, generation of FM Waves: indirect FM, direct FM and demodulation.			06
Chapter No. 3. Noise and its characteristics/ Effects of Noise on Receiver Sources of noise: shot noise, thermal noise, white noise frequency receiver model, noise in AM receivers, noise in FM receivers, pre-emphasis and de-emphasis in FM.			08
Unit – 2			
Chapter No. 4. Introduction to Sampling process Sampling theorem, quadrature sampling of band pass signals, reconstruction of a message from its samples,signal distortion in sampling, practical aspects of sampling and signal recovery, PAM, digital switching technologies, SONET.			08
Chapter No. 5. Quantization and coding techniques Pulse Code modulation (PCM), coding techniques, PCM, quantization noise and SNR, robust quantization, DPCM, DM. adaptive DM.			06
Chapter No. 6. Binary Digital Modulation Techniques Geometric interpretation of signals, Gram-Schmidt orthogonalization procedure, digital modulation formats, coherent binary modulation techniques: ASK, FSK, PSK.			08
Unit - 3			
Chapter No. 7. Quadrature Digital Modulation Techniques: Coherent quadrature and M-QAM modulation/ demodulation techniques, non-coherent binary demodulation techniques, comparison of binary and quaternary modulation techniques.			08

Text Book:

1. Simon Haykin, Communication Systems, 4th edition, John Wiley 2003.
2. Simon Haykin, Digital communications, 4th edition, JohnWiley, 2003.

Reference Books:

1. K.Sam Shanmugam, Digital and analog communication systems, John Wiley, 1996.
2. Simon Haykin, An introduction to Analog and Digital Communication, John Wiley, 2003
3. B.P. Lathi and Zhi Ding,Modern Digital and Analog Communication Systems, 4th edition, 2016

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Program: V Semester Bachelor of Engineering (Electronics & Communication Engineering)			**Teaching Hours**
Course Title: Digital Signal Processing		**Course Code: 17EECC303**	
L-T-P: 4-0-0	**Credits: 4**	**Contact Hours: 4Hrs/week**	
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**	
Teaching Hours: 50Hrs	**Examination Duration: 3 Hrs**		
Content			
Unit - 1			
Chapter No. 1. Discrete Fourier Transforms Brief review of signals and systems: Basic definitions, properties and applications. Discrete Fourier Transforms (DFT): Frequency domain sampling and reconstruction of discrete time signals. DFT as a linear transformation, its relationship with other transforms. Properties of DFT, multiplication of two DFTs- the circular convolution, additional DFT properties, use of DFT in linear filtering, overlap-save and overlap-add method.			12
Chapter No. 2. Fast-Fourier-Transform (FFT) algorithms Fast-Fourier-Transform (FFT) algorithms: Direct computation of DFT, Need for efficient computation of the DFT (i.e. FFT algorithms), Radix-2 FFT algorithm for the computation of DFT and IDFT: Decimation-in-time and Decimation-in-frequency algorithms, Composite FFT.			08
Unit - 2			
Chapter No. 3. Design of Digital FIR Filters Design of digital filters: Considerations and characteristics of practical digital filters. design of digital filters: symmetric and anti-symmetric FIR filters, design of linear phase FIR filters using windowing method- Rectangular, Hamming, Hanning, Bartlet and Kaiser windows. Design of linear phase FIR filters using frequency sampling technique.			10
Chapter No. 4. Design of IIR filters from analog filters Design of IIR filters from analog filters: approximation of derivative, impulse invariance method, bilinear transformation, Characteristics of commonly used analog filters: Butterworth and Chebyshev filters, frequency transformation in the digital domain.			10
Unit - 3			
Chapter No. 5. Realization of Digital FIR Systems Implementation of Digital systems: structures for FIR systems: direct form I, direct form II, cascade, frequency sampling and lattice structure, Comparison of the realization techniques.			05
Chapter No. 6. Realization of Digital IIR Systems Structures for IIR systems - direct form I, direct form II, cascade, parallel and lattice structure, Comparison of the realization techniques.			05
Text Books 1. Proakis&Manolakis, Digital signal processing Principles Algorithms & Applications, 4th edition, PHI, New Delhi, 2007 2. S.K. Mitra, Digital Signal Processing, 2nd edition, Tata Mc-Graw Hill, 2004 **References** 1. Oppenheim& Schaffer, Discrete Time Signal Processing, 5th edition, PHI, New Delhi, 2000			

Program: V Semester Bachelor of Engineering (Electronics & Communication Engineering)			Teaching Hours
Course Title: Operating System and Embedded System Design		**Course Code: 17EECC304**	
L-T-P: 3-0-0	**Credits: 3**	**Contact Hours: 3Hrs/week**	
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**	
Teaching Hours: 40 Hrs	**Examination Duration: 3 Hrs**		
Unit I			
Chapter 1: Introduction and System structures what is an operating system? Goals of an operating system. Operation of an os .Resource allocation and related functions. Classes of an operating system. Operating System Services . System Calls and Types. Operating system Structure – Simple, Layered, Microkernels, Modules and Hybrid systems. System Boot			03
Chapter 2: Process Management Process concept- operating on process, inter process communication, process scheduling- CPU scheduler-preemptive scheduling , scheduling criteria, scheduling algorithms- first come first served scheduling, shortest job first scheduling, priority scheduling, round robin scheduling.			05
Chapter 3: Memory Management Memory Management Strategies: process address space static vs dynamic loading. Swapping, memory allocation; fragmentation Paging; Structure of page table; Segmentation, Virtual Memory.			06
Unit II			
Chapter 4: Introduction To Real-Time Operating Systems Introduction To Real-Time Operating Systems: Introduction to OS, Introduction to real time embedded system- real time systems, characteristics of real time systems and the future of embedded systems. Introduction to RTOS, key characteristics of RTOS, its kernel, components in RTOS kernel, objects, scheduler, services, context switch, Scheduling types: Preemptive priority-based scheduling, Round-robin and preemptive scheduling.			08
Chapter 5: Tasks, Semaphores and Message Queues: Tasks, Semaphores and Message Queues: A task, its structure, A typical finite state machine, Steps showing the how FSM works. A semaphore, its structure, binary semaphore, mutual exclusion (mutex) semaphore, Synchronization between two tasks and multiple tasks, Single shared-resource-access synchronization, Recursive shared- resource-access synchronization. A message queue, its structure, Message copying and memory use for sending and receiving messages, Sending messages in FIFO or LIFO order, broadcasting messages.			08
Unit III			
Chapter 6: Typical Embedded System: Classification and purposes of embedded system, Characters and Quality attributes of embedded system, Core and Supporting components of embedded system, Embedded firmware			05
Chapter 7: Wired and Wireless Protocols: Bus communication protocol (USB,I2C,SPI), Wireless and mobile system protocol (Bluetooth, 802.11 and its variants, ZigBee), Embedded design cycle-case study-ACVM			05

Text Books

1. Silberschatz ,Galvin and Gagne ,‖Operating system concepts‖,9th edition, WILEY Publication.
2. Qing Li with Caroline Yao, Real-Time Concepts for Embedded Systems, 1E, Published, 2011
3. Shibu K V,‖Introduction to Embedded systems‖,6th reprint 2012
4. Raj Kamal,‖ Embedded Systems‖, McGraw-Hill Education

References

1. Dhananjay Dhamdhere, Operating Systems a Concept Based Approach‖,2nd edition, McGraw-Hill Education

Program: V Semester Bachelor of Engineering (Electronics & Communication Engineering)			Teaching Hours
Course Title: Communication and Signal Processing Lab		Course Code: 17EECP301	
L-T-P: 0-0-1	Credits: 1	Contact Hours:2 Hrs/week	
ISA Marks: 80	ESA Marks: 20	Total Marks: 100	
Teaching Hours: 24Hrs	Examination Duration: -		

List of Experiments

Proof of concept on Discrete ICs

1. DSBSC modulator and demodulator.
2. Frequency modulator and demodulator
3. Frequency Shift Keying (FSK) modulator and demodulator.
4. Time Division Multiplexing with minimum four channels

Mathematical Modeling and Simulation

1. Design Square Law Modulator and detect the signal using square law and envelop schemes.
2. Design Frequency Modulator and Demodulator and analyze the performance without and with noise.
3. Design, analyze and compare the BER for different digital modulation techniques.
4. Develop a model and simulate BPSK using Costas loop.

Implementation on Real Time Hardware

1. Design and Implement a complete real-time RF transceiver on Advanced Omni Software Radio Transceiver (AOSRT) for Narrow Band Frequency Modulation and Wide band Frequency Modulation and perform analysis.
2. Design and Implement a real-time RF transceiver for audio input using M-array PSK modulation scheme and analyze performance in terms of SNR and BER.

Open Ended Experiment

1. Explore the features of SDR to design an appropriate and robust frequency selective system to eliminate noise present in an audio signal.

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Program: V Semester Bachelor of Engineering (Electronics & Communication Engineering)		
RTOS Laboratory Experiments		**Course Code: 17EECP302**
ISA Marks: 80	**ESA Marks: - 20**	**Total Marks: 100**
Teaching Hours: 24Hrs	**Examination Duration: -**	**Contact Hours: 2 Hrs/week**

List of Experiments:

1. Analyze and Demonstrate debugging skills for programs given.
2. Program & demonstrate interfaces I2C-memory to LPC2148 Microcontroller.
3. Program & demonstrate interfaces SPI-RTC to LPC2148 Microcontroller.
4. Program & demonstrate concept of H/W Interrupts interface to LPC2148 Microcontroller.
5. Program & demonstrate concept of Task Scheduling.
6. Program & demonstrate concept of Semaphore.
7. Program & demonstrate concept of Mailbox.
8. Program & demonstrate concept of S/W Interrupts.
9. Program & demonstrate concept of interrupts.
10. Program & demonstrate concept of Inter Task Communication.

Reference Books

1. –ARM System- on-Chip Architecture by 'Steve Furber , LPE, Second Edition.
2. –Embedded Systems- Architecture, Programming and Design by Raj Kamal, TMH
3. Dr. K.V.K.K. Prasad, –Embedded/Real-time systems: concepts, Design & Programming , published by dreamtech press.

Manual

1. LPC2148 datasheet by NXP.
2. LPC2148 board manual by ALS, Bangalore.

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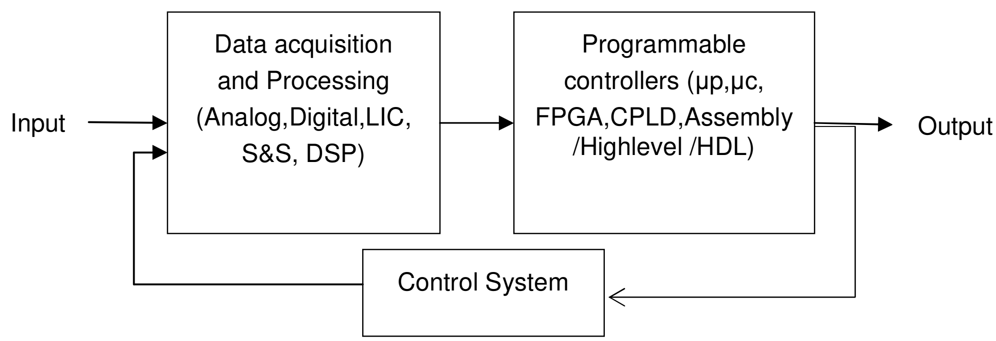
Laboratory Title: **Mini Project**	Lab. Code: **17EECW301**
Total Hours: **60**	Duration of ESA Hours: **3 Hours**
ISA Marks: **50**	ESA Marks: **50**

1. The project needs to encompass the concepts leant in a subject/s studied in the previous four semesters, so that the student will learn to integrate, the knowledge base acquired to provide a solution to the identified need.
2. Project should be able to exhibit sensing, controlling and actuation sections.
3. The mini project essentially will comprise of two components:
    - The hardware design
    - The graphical user interface (GUI) for application and data analysis with report generation.



4. Student can select a project which leads to a product or model or prototype related to following areas (not limited to these areas).
    - Pulse and digital circuits: simulate the working of one or more circuits
    - Signals and systems: simulate the behavior of a system by considering different signals
    - Analog Electronic: simulate working of different devices
    - Control systems: simulate the behavior of a control system
    - Linear Integrated Circuits: simulate working of one or more circuits
    - Micro-controllers: simulate the ALU/control unit of microcontroller
5. Time plan: Effort to do the project should be between 120-150 Hrs per team, which includes self study of an individual member (80-100 Hrs) and team work (40-50hrs).
6. Learning overhead should be 20-25% of total project development time.

Evaluation Process

Continuous Internal Assessment (CIA) is carried out through reviews and there exist
2 Committee reviews and 4 Guide reviews

Review schedule

Students will have a meeting with guide every week to update the progress and assessment will be carried on as per review schedule

Review No	Type of review	Marks allotted	Timeline
1	Committee	5	2nd week of semester
2	Guide	5	3rd week of semester
3	Guide	10	7th week of semester
4	Guide	10	15th week of semester
5	Committee	15	13th week of semester
6	Guide	5	16th week of semester

Program: VI Semester Bachelor of Engineering (Electronics & Communication Engineering)			**Teaching Hours**
Course Title: Computer Communication Networks		**Course Code: 17EECC306**	
L-T-P: 4-0-0	**Credits: 4**	**Contact Hours: 4 Hrs/week**	
ISA Marks:50	**ESA Marks: 50**	**Total Marks: 100**	
Teaching Hours: 50Hrs	**Examination Duration: 3 Hrs**		
Content			**Hrs**
Unit - 1			
Chapter No. 1. Computer Networks and the Internet What is Internet?The Network Edge, the network Core,delay -loss—throughput in packet switched networks. Protocol layers (OSI layers) and their service models,networks under attack.			08
Chapter No. 2. Application Layer Principles of network applications,the web and HTTP,DHCP, file transfer-FTP,electronic mail in the internet,DNS,peer-to-peer applications,socket programming-creating network applications			12
Unit - 2			
Chapter No. 3. Transport Layer Introduction and transport-layer services-relationship between transport and network layers - overview of the transport layer in the internet, multiplexing and de multiplexing, connectionless transport: UDP, principles of reliable data transfer, connection oriented transport TCP, TCP congestion control.			10
Chapter No. 4. Network layer Introduction, virtual circuit and datagram networks, what's inside router? The Internet protocol (IP): forwarding and addressing in the internet, routing algorithms, routing in the internet, broadcast and multi cast routing.			10
Unit - 3			
Chapter No. 5. The link layer: Links, Access networks, and LANs Introduction to the link layer, error-detection and correction techniques, multiple access links and protocols, switched local area networks, link virtualization: A network as a link layer, data center networking, retrospective: A day in the life of a web page request.			10

Text Book

1. Kurose & Ross, Computer Networking A Top-Down Approach, 6th editionPEARSON, 2013.

References

1. Larry L. Peterson & Bruce S. Davie, Computer Networks: A Systems Approach, 4th edition, Elsevier, 2004
2. Behrouz A. Forouzan, Data Communication and Networking, 4th edition, TMG, 2002

Program: VI Semester Bachelor of Engineering (Electronics & Communication Engineering)			**Teaching Hours**
Course Title: Machine Learning		**Course Code: 17EECC307**	
L-T-P: 2-0-1	**Credits: 3**	**Contact Hours: 4 Hrs/week**	
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**	
Teaching Hours: 50Hrs	**Examination Duration: 3 Hrs**		

Content	
Unit – 1	
Chapter No. 1. Introduction Introduction what is machine learning? Applications of machine learning, types of machine learning: supervised, unsupervised and reinforcement learning, dataset formats, basic terminologies.	05
Chapter No. 2. Supervised Learning Linear regression, logistic regression linear regression: single and multiple variables, sum of squares error function, the gradient descent algorithm, application, logistic regression, the cost function, classification using logistic regression, one-v/s-all classification using logistic regression, regularization.	10
Unit – 2	
Chapter No. 3. Supervised Learning: Neural Network Introduction to perception learning, implementing simple gates XOR, AND, OR using neural network. Model representation, gradient checking, back propagation algorithm, multi-class classification, application- classifying digits, SVM.	10
Chapter No. 4. Unsupervised Learning: Clustering Introduction, K means clustering, algorithm, cost function, application.	05
Unit – 3	
Chapter No. 5. Unsupervised Learning: Dimensionality reduction Dimensionality reduction, PCA- principal component analysis, applications, clustering data and PCA.	04

Text Book

1. Tom Mitchell, Machine Learning, 1st edition, McGraw-Hill. , 1997
2. Christopher Bishop, Pattern Recognition and Machine Learning, 1st edition, Springer, 2007

References

1. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning : Data Mining, Inference and Prediction, 2nd edition, Springer, 2009

Course Title: Analog Circuit Design		Course Code: 17EECE301
L-T-P-SS: 3-0-0-0	Credits: 3	Contact Hours: 3
CIE Marks: 50	SEE Marks: 50	Self-Study : --
Teaching Hours: 40	Examination Duration: 3 hours	Total Marks: 100

UNIT I	
1. Basic MOS Device Physics: General considerations, MOS I/V characteristics, second order effects and MOS device models.	04
2. Current Mirrors: Basic current Mirror, Widlar, Cascode and Wilson Current Mirrors.	04
3. Single Stage Amplifiers: CS, CG, CD, Cascode and Folded Cascode. Frequency response curves	08
UNIT II	
4. Differential Amplifiers: Differential Amplifier, 5 pack differential Amplifier, CMRR, PSRR	05
5. Op-Amp: Performance parameters, Two stage (7-pack) Op-amp, Slew rate, PSRR , Noise in Op-amps	05
6. Compensation Technique: Nyquist stability Criterion, Gain and Phase margins, Compensation of Two stage op-amp and Dominant pole compensation technique.	06
UNIT III	
7. Reference Circuits: Current reference, startup circuits, Bandgap reference circuit, Current mode Bandgap reference.	04
8. Comparators: Basic Comparator architecture, non-idealities-offset error, bandwidth consideration, Dynamic comparator,	04

Text Books

1. B Razavi 'Design of Analog CMOS Integrated Circuits' First Edition McGraw Hill 2001
2. Phillip. E. Allen, Douglas R. Holberg, "CMOS Analog circuit Design" Oxford University Press, 2002.
3. Baker, Li, Boyce, "CMOS: Circuit Design, Layout and Simulation", Prentice Hall of India, 2000

Reference Books 1. N. Weste and K. Eshranghian, Principles of CMOS VLSI Design, Addison Wesley. 1985. 2. J. Rabaey, Digital Integrated Circuits: A Design Perspective, Prentice Hall India, 1997

Course Title: Advanced Digital Logic Design	Course code: 17EECE302	
L-T- P: 0-0-3	Credits: 03	Contact Hrs: 04hrs/week
CIE Marks: 100	SEE Marks: 00	Total Marks: 100
Teaching Hrs: 16hrs Lab Hrs: 24 hrs		

Chapter No. 1. Digital Integrated Circuits Challenges in digital design, Design metrics, Cost of Integrated circuits, ASIC , Evolution of SoC ASIC Flow Vs SoC Flow, SoC Design Challenges. Introduction to CMOS Technology, PMOS & NMOS Operation, CMOS Operation principles, Characteristic curves of CMOS, CMOS Inverter and characteristic curves, Delays in inverters, Buffer Design, Power dissipation in CMOS, CMOS Logic, Stick diagrams and Layout diagrams. Setup time, Hold Time, Timing Concepts.	8 hrs
Chapter No. 2. Digital Building Blocks Decoder, encoder, code converters, Priority encoder, multiplexer, demultiplexer, Comparators, Parity check schemes, Multiplexer, De-multiplexer, Pass Transistor Logic, application of multiplexer as a multi-purpose logical element. Asynchronous and synchronous up-down counters, Shift registers. FSM Design, Mealy and Moore Modelling, Adder & Multiplier concepts, Memory Concept	6 hrs
Chapter No. 3. Logic Design Using Verilog Evolution & importance of HDL, Introduction to Verilog, Levels of Abstraction, Typical Design Flow, Lexical Conventions, Data Types Modules, Nets, Values, Data Types, Comments, arrays in Verilog, Expressions, Operators, Operands, Arrays, memories, Strings , Delays , parameterized designs Procedural blocks, Blocking and Non-Blocking Assignment, looping, flow Control, Task, Function, Synchronization, Event Simulation. Need for Verification, Basic test bench generation and Simulation	10 hrs
Chapter No. 4. Principles of RTL Design Verilog Coding Concepts, Verilog coding guide lines: Combinational, Sequential, FSM. General Guidelines, Synthesizable Verilog Constructs, Sensitivity List, Verilog Events, RTL Design Challenges, Clock Domain Crossing. Verilog modeling of combinational logic and sequential logic	8 hrs
Chapter No. 5. Design and simulation of Architectural building blocks Basic Building blocks design using Verilog HDL: Arithmetic Components – Adder, Subtractor, and Multiplier design, Data Integrity – Parity Generation circuits, Control logic – Arbitration, FSM Design – overlapping and non-overlapping Mealy and Moore state machine design	8 hrs

Reference Books:

1. Digital Design by Morris Mano M, 4th Edition.
2. Verilog HDL: A Guide to Digital Design and Synthesis by Samir Palnitkar, 2nd Edition.
3. Principles of VLSI RTL Design: A Practical Guide by Sapan Garg, 2011.

Tools: Questa Sim, NC Verilog, NC Sim, CVER + GTKWave, VCSMX, Modelsim for Verilog

Course Title: **Embedded Intelligent Systems**		Course Code: 17EECE310
L-T-P: 0-0-3	Credits: 3	Contact Hrs: **6hrs/week**
ISA Marks: 80	ESA Marks: 20	Total Marks: 100
Teaching Hrs: 60	Exam Duration: 3 hrs	

	Unit - I	
1	**Basics of embedded systems** Linux Application Programming, System V IPC, . Linux Kernel Internals and Architecture , Kernel Core , Linux Device Driver Programming, Interrupts & Timers , Sample shell script, application program, driver source build and execute	**10 hrs**
2	**Heterogeneous computing** Basics of heterogeneous computing with various hardware architectures designed for specific type of tasks, Advanced heterogeneous computing with a. Introduction to Parallel programming b.GPU programming (OpenCL). Open standards for heterogeneous computing (Openvx) , Basic OpenCL examples - Coding, compilation and execution	**12 hrs**
	Unit - II	
3	**ML Frameworks with the target device** Caffe, tensorflow, TF Lite machine learning frameworks & architecture ,Model parsing, feature support and flexibility ,Supported layers , advantages and disadvantages with each of these frameworks, Android NN architecture overview , Full stack compilation and execution on embedded device	**16 hrs**
4	**Model Development and Optimization** Significance of on device AI ,Quantization , pruning, weight sharing, Distillation ,Various pre-trained networks and design considerations to choose a particular pre-trained model ,Federated Learning , Flexible Inferencing	**8 hrs**
	Unit - III	
5	**Android Anatomy** Android Architecture ,Linux Kernel , Binder , HAL Native Libraries , Android Runtime, Dalvik Application framework , Applications, IPC	**8 hrs**

Text Books

1. Linux System Programming , by Robert Love , Copyright © 2007 O'Reilly Media
2. Heterogeneous Computing with OpenCL, 2nd Edition by Dana Schaa, Perhaad Mistry, David R. Kaeli, Lee Howes, Benedict Gaster , Publisher: Morgan Kaufmann

Reference Books:

1. Deep Learning , MIT Press book ,Goodfellow, Bengio, and Courville’s
2. Beginning Android , by Wei-Meng Lee , Publisher: Wrox , O'Reilly Media

Scheme for End Semester Assessment (ESA)

UNIT	Experiments to be set of 10 Marks Each	Chapter Numbers	Instructions
I	Project Examination	1,2,3,4,5	Project implementation and demonstration 20 marks

Program: VI Semester Bachelor of Engineering (Electronics & Communication Engineering)		
Automotive Electronics Laboratory Experiments(17EECP304)		
ISA Marks: 80	**ESA Marks: - 20**	**Total Marks: 100**
Teaching Hours: 24Hrs	**Examination Duration:-**	**Contact Hours: 2 Hrs/week**

List of Experiments

1. Demonstration of cut section modules: Engine, Transmission, Steering, Braking, Suspension - Automobile dept.
2. Electronic engine control system: Injection and Ignition control system Transmission trainer modules
3. Modeling a vehicle motion on a flat surface during hard acceleration, deceleration and steady acceleration.
4. Simulation and modeling of a system and realization on the hardware platform.
5. Modeling Seat belt warning system, and Vehicle speed control based on the gear input.
6. EGAS modeling and simulation using Simulink and realization on the hardware platform.
7. Interior lighting control modeling with state flow.
8. Gear input transmission over CAN bus using ARM Cortex m3 and signal analysis using CANalyzer/BusMaster software.
9. Realize Steer by wire system using model based design.
10. Realize cruise application using model based design

Text Books

1. Ribbens, Understanding of Automotive electronics, 6th , Elsevier, 2003
2. Denton.T , Automobile Electrical and Electronic Systems, Elsevier, 3rd Edition, 2004

KLE TECH. Earlier known as B. V. B. College of Engineering & Technology	School of Electronics & Communication Engineering

Program: VI Semester Bachelor of Engineering (Electronics & Communication Engineering)		
Computer Communication Networks Laboratory Experiments(17EECP303)		
ISA Marks: 80	**ESA Marks: - 20**	**Total Marks: 100**
Teaching Hours: 24Hrs	**Examination Duration:-**	**Contact Hours: 2 Hrs/week**

List of Experiments

1. Introduction to Hardware components and Ethernet LAN set up.
2. Introduction to socket programming
3. Implementation of FTP
4. Implementation of error control techniques.
5. Implementation of flow control ARQs
6. Introduction to Network operating system.
7. Subnet design
8. VLAN setup
9. OSPF and RIP configuration and performance analysis
10. eBGP and iBGP configuration and performance analysis

Text Book

1. Kurose & Ross, Computer Networking A Top-Down Approach, 6th edition PEARSON, 2013.

References

1. Cisco networking academy, https://www.netacad.com/
2. Juniper networking academy, https://learningportal.juniper.net/

Laboratory Title: **Minor Project**	Lab. Code: **17EECW302**
Total Hours: **60**	Duration of SEE Hours: 3
SEE Marks: **50**	CIE Marks: **50**

Experiment wise Plan

List of experiments/jobs planned to meet the requirements of the course.

Category: Open Ended		**Total Weightage: 50.00**		**No. of lab sessions: 4.00**
Expt./ Job No.	**Experiment / Job Details**	**No. of Lab Session(s) per batch (estimate)**	**Marks / Experiment**	**Correlation of Experiment with the theory**
1	Review1. Read, understand and interpret the scope of the given problem.	1.00	10.00	
	Learning Outcomes: The students should be able to: • Perform need analysis • Identify and define a problem in societal context • Perform literature survey • Identify multiple solutions for a given problem and select the best suited solution with justifications			
2	Review 2 1.Project Planning (Gantt chart) and WBS (Work Breakdown Structure) 2.Functional block diagram (black box and white box), Morphological chart, Design specifications and Bill of Materials (BOM	1.00	10.00	
	Learning Outcomes: The students should be able to: 1. Do project Planning (Gantt chart) and WBS(Work Breakdown Structure) 2. Write functional block diagram (black box and white box), Morphological chart, Design specifications and Bill of Materials (BOM)			

3	Review 3 1. Detailed block diagram, algorithm and programming 2. Simulation and Implementation 3. Initial discussion on optimization 4. Draft of report	1.00	10.00	
	Learning Outcomes: The students should be able to: 1. Develop detailed block diagram, algorithm and programming 2. Simulate and demonstrate the partial results. 3. Plan for the optimization. 4. Document the work done.			
4	Review 4 1. Demonstration of working prototype. 2. Analysis of results 3. Optimization 4. Report	1.00	20.00	
	Learning Outcomes: The students should be able to: 1. Demonstrate the working of designed proptotye. 2. Analyse the results 3. Comment on the optimization technique. 3. Write technical report with report			

Course Title: **Product Design Realization**	Course Code: 17EECO401
Total Contact Credits: **3** **(0-0-3)**	Duration of SEE Credits: -
ISA Marks: 80	ESA Marks: 20

Week #	Particulars	Template #	Venue
Week 1 **and** **Week 2**	Introduction to Prototyping Defining- Specifications, Part Drawings, Assembly Drawings, PCB Layout, Wireframe , Pseudocode, BOM, Process Plan, Fabrication and Test Plan Validation IOT Workshop		Studio Engagement
Week 3	Identifying sub-assemblies (minimum of 3) Selection of materials for all the parts and joining techniques		Makers Space/
Week 4	Process plan Identifying the proper machines and tools required for prototyping. Preparing of raw materials for prototyping. Plan and procure the bought out parts.		
Week 5	Fabricate the parts for sub assembly 1		
Week 6	Fabricate the parts for sub assembly 2		
Week 7	Fabricate the parts for sub assembly 3		
Week 8	Assemble the sub assemblies and check for interference and functionality		

▪ **Week 9**	➢ Test the functional prototype using proper identified test methods.	▪	
▪ **Week 10**	➢ Analyse the test results ➢ System modification	▪	
▪ **Week 11**	➢ Final concluding review ➢ Product catalogue	▪	▪ Studio/ Makers Space

References

1. Pahl, G., Beitz, W., Feldhusen, J. and Grote ; "Engineering Design-A Systematic Approach" by, K.-H- Springer; 3rd ed. 2007

Laboratory Title: **C Programming (for Diploma)**	Lab. Code: 18EECF204
Total Hours: 20	Duration of Exam: 02
ESA Marks: 20	Total ISA. Marks: 80

Experiment wise plan

1. **List of experiments/jobs planned to meet the requirements of the course.**

Expt./Job No.	Experiment/job Details	No. of Lab. Session/s per batch (estimate)	Marks/Experiment
1.	Write a C program to perform addition , subtraction , multiplication and division of two numbers .	01	8.00
2.	Write a C program to i) Identify greater number between two numbers using C program. ii) To check a given number is Even or Odd .	01	8.00
3.	Write a C program to i) To find the roots of a quadratic equation. ii) Find the factorial of given number.	01	8.00
4.	Write a C program to i) To find the sum of n natural numbers. ii) Print the sum of 1 + 3 + 5 + 7 + + n	01	8.00
5.	Write a C program to i) Print the pattern . * * * * * * * * * * * * * * * ii) Print the pattern 1 1 2 1 2 3 1 2 3 4	01	8.00

	1 2 3 4 5		
6.	Write a C program to To test whether the given character is Vowel or not. (using switch case)	01	8.00
7.	Write a C program to To accept 10 numbers and make the average of the numbers using one dimensional array.	01	8.00
8.	Write a C program to Find out square of a number using function.	01	8.00
9	Write a C program to To find the summation of three numbers using function.	01	8.00
10	Write a C program to Find out addition of two matrices.	01	8.00

1. **Materials and Resources Required:**

Text Book

1. Programming in ANSI C, E Balagurusamy

Program: III Semester Bachelor of Engineering (Electronics & Communication Engineering)				**Teaching + Lab Hours.**
Course Title: Data Structure using C			**Course Code: 18EECF201**	
L-T-P: 0-0-3		**Credits: 3**	**Contact Hours: 6Hrs/week**	
ISA Marks: 80		**ESA Marks:- 20**	**Total Marks: 100**	
Teaching + Lab. Hours: 72 Hrs				
1.	**Programming on pointer concepts**: Pointer concepts,1D and 2D arrays, pointers to functions, memory management functions			**02+06**
2.	**Programming on string handling functions using pointers, structures, bit-fields**: Perform string handling functions like String length, String concatenate, Strings compare, String copy and Strings reverse, Implementing Structures, union andbit-field.			**02+06**
3.	**Programming on files:** Open, Close, Read, Write and Append the file.			**02+04**
4.	**Programming on stack data structures and applications:** Insert delete and display an integer in a stack, Conversion from Infix to postfix & Infix to Prefix, Recursion.			**04+04**
5.	**Programming on queue data structures:** Insert at rear end ,delete at front end and display the integers in queue, Deque and circular queue.			**04+04**
6.	**Programming on linked lists:** Insert, delete and display a node in Singly Linked List, Doubly Linked List and Circular Linked List.			**04+06**
7.	**Programming on trees:** Perform various operations on binary trees, find max, min value in a binary search trees, find the height of a tree, count nodes in a tree, delete a node in a tree.			**04+04**
8.	**Programming on sorting:** Merge sort, Quick sort, Heap sort, Shell sort, Radix sort**.**			**04+04**
9.	**Programming on hashing tables:** Implement different methods of hash tables.			**02+02**
10.	**Open ended experiment:** Implement given Data structures.			**02+02**

Text Book

1. Horowitz, Sahani, Anderson-Feed, —Fundamentals of Data Structures in C , 2ed,Universities Press, 2008
2. Richard F. Gilberg, Behrouz A. Forouzan —Data Structures: A Pseudocode Approach With C , 2nd Edition , Course Technology, Oct 2009.

References

1. E Balaguruswamy, —The ANSI C programming Language , 2ed., PHI, 2010.
2. YashavantKanetkar, —Data Structures through C , BPB publications 2010

Program: IV Semester Bachelor of Engineering (Electronics & Communication Engineering)			**Teaching Hours**
Course Title: Electromagnetic Fields and Waves		**Course Code: 18EECC209**	
L-T-P: 3-0-0	**Credits: 3**	**Contact Hours: 3 Hrs/week**	
ISA Marks: 40	**ESA Marks: 50**	**Total Marks: 100**	
Teaching Hours: 50Hrs	**Examination Duration: 3 Hrs**		
Content			**Hrs**
Unit – 1			
Chapter No. 1. Introduction to Electromagnetic (EM) Waves Study of Maxwell's equations, applications of EM waves. Basic quantities and laws of electromagnetic, Maxwell's Equations, modified Ampere's law surface charge and surface current, boundary conditions at mediainterface			**08**
Chapter No. 2. Uniform Plane Wave Homogeneous unbound medium, wave equation for time harmonic fields, solution of the wave equation, uniform plane wave			**07**
Unit - 2			
Chapter No. 3. Uniform Plane Wave Propagation Wave Polarization, wave propagation in conducting medium, skin depth, phase velocity of a wave, power flow & pointing vector, surface current & power loss in a conductor			**08**
Chapter No. 4. Plane Waves at Media Interface Plane wave in arbitrary direction, plane wave at dielectric interface, reflection and refraction of waves at dielectric interface, normal and oblique incidence of plane waves, Brewster's Angle			**07**
Unit - 3			
Chapter No. 5. Radio Wave Propagation Modes of propagation, surface wave propagation, space wave of Ionospheric propagation, structure of troposphere and ionosphere, characteristic of Ionospheric layers, wave bending mechanism, sky wave propagation, critical frequency, virtual height, MUF, skip distance, duct propagation, fading, multi-hop propagation.			**10**

Text Book(List of books as mentioned in the approved syllabus)

1. William Hayt. Jr. John A. Buck, Engineering Electromagnetics , 6th edition, TMH.,2001
2. John D. Kraus, Ronald J. M.and Ahmad S. Khan, Antennas and Wave Propagation: 4th Edition, THM,2010.

References

1. EdwardC.JordanandKeithGBalmain,–ElectromagneticWavesAndRadiating Systems, Prentice–HallofIndia/ Pearson Education, 2nd edition, 1968.Reprint2002
2. R. K. Shevgaonkar, Electromagnetic Waves, Tata McGraw-Hill Company Ltd, 2006.
3. Mathew N. O. Sadiku, Elements of Electromagenics, 4th Edition, Oxford University Press,2007
4. David J. Griffiths, Introduction to Electrodynamics, 3rd Edition, PHI,2012
5. J A Edminister, Electromagnetics, 2nd Edition, McGraw-Hill ,2006
6. DavidKCheng,–FieldandWaveElectromagnetics PearsonEducationAsia, 2ndedition,-1989,IndianReprint –2001.
7. JohnKraussand DanielA.Fleisch,–ElectromagneticswithApplications ,McGraw-Hill,5thedition, 1999
8. K.D.Prasad,–Antenna&WavePropagation ,Satyaprakash Publications

<table>
<tr><td colspan="4">Program: IV Semester Bachelor of Engineering (Electronics & Communication Engineering)</td><td rowspan="5">Lab+ Teaching Hours</td></tr>
<tr><td colspan="3">Course Title: Data Structures Application Lab</td><td>Course Code: 18EECC210</td></tr>
<tr><td colspan="2">L-T-P: 0-0-2</td><td>Credits: 2</td><td>Contact Hours: 4Hrs/week</td></tr>
<tr><td colspan="2">ISA Marks: 80</td><td>ESA Marks:20</td><td>Total Marks: 100</td></tr>
<tr><td colspan="2">Teaching + Lab. Hours: 48 Hrs</td><td>Examination Duration:2 Hrs</td><td></td></tr>
<tr><td>1.</td><td colspan="3">Hashing
Hash, Hash function, Hash Table, Collision resolution techniques, Hashing Applications</td><td>12Hrs</td></tr>
<tr><td>2.</td><td colspan="3">Trees
Computer representation, Tree properties, Binary Tree properties, Binary search trees properties and implementation, Tree traversals, AVL tree, 2-3 Tree</td><td>20Hrs</td></tr>
<tr><td>3.</td><td colspan="3">Graphs
Computer representation, Adjacency List, Adjacency Matrix, Graph properties, Graph traversals</td><td>16Hrs</td></tr>
</table>

Book

1. Data Structures A Psedocode Approach with C, Richard F. Gilberg & Behrouz A. Forouzan, second edition, CENGAGE Learning.

2. Data Structures Using C. Author, Aaron M. Tenenbaum. Publisher, Pearson Education.

Program: VII Semester Bachelor of Engineering (Electronics & Communication Engineering)		
Course Code: 18EECC401	Course Title: Wireless & Mobile Communication	
L-T-P-SS: 3-0-0-0	Credits: 3	Contact Hrs: 40
CIE Marks: 50	SEE Marks: 50	Total Marks: 100
Teaching Hrs: 40		Exam Duration: 3 hrs

Content	Hrs
Unit - 1	
Chapter No. Chapter 01 Radio Propagation Free space propagation model, Relating power to electric field., Relation, ground reflection, scattering, Practical link budget design using path loss model, Outdoor propagation models, Signal penetration into buildings, Ray tracking and site specific modeling, Small scale Multipath measurements, Parameters of mobile Multipath channels, Types of small scale fading.	16
Unit - 2	
Chapter No. Chapter 02 Diversity techniques Concept of Diversity branch and signal paths, Combining and switching methods, C/N, C/I performance improvements, RAKE receiver.	4
Chapter No. Chapter 03 Cellular concept Frequency reuse, Channel assignment strategies, Handoff strategies, Interference and system capacity, Trucking and grade of service, Improving coverage, Capacity in cellular systems, FDMA, TDMA, Spread spectrum multiple access, SDMA packet radio. Capacity of cellular systems.	12
Unit - 3	
Chapter No. Chapter 04 Personal Mobile satellite Communications Integration of GEO, LEO satellite, MEO satellite, Terrestrial mobile systems and Personal satellite communication programs.	4
Chapter No. Chapter 05 CDMA system implementation IS-95 system architecture, Soft handoff, Power control in IS-95 CDMA, CDMA 2000 system.	4

Text Book (List of books as mentioned in the approved syllabus)

1. T.S. Rapport, Wireless Communication, 2, Pearson Education, 2002

References

1. Kamil O Feher, Wireless digital communications: Modulation and spread spectrum Techniques, Prentice Hall of India, 2004
2. Vijay K Garg, IS_95 CDMA and cdma 2000, Pearson publication pvt. Ltd, 2004
3. Xiaodong Wang and Vincent Poor, wireless Communicating system: Advanced Techniques for signal Reception, Pearson publication pvt. Ltd, 2004

Course Title: **Advanced Digital Logic Verification**	Course code: 18EECE418	
L-T- P: 0-0-3	Credits: 03	Contact Hrs: 06hrs/week
CIE Marks: 100	SEE Marks: 00	Total Marks: 100
Teaching Hrs: 16hrs Lab Hrs: 24 hrs		

Chapter No. 1. Verification Concepts: Concepts of verification, importance of verification, Stimulus vs Verification, functional verification, test bench generation, functional verification approaches, typical verification flow, stimulus generation, direct testing, Coverage: Code and Functional coverage, coverage plan.	8 hrs
Chapter No. 2. **Language Constructs System Verilog constructs:** Data types: two-state data, strings, arrays: queues, dynamic and associative arrays, Structs, enumerated types. Program blocks, module, interfaces, clocking blocks, modports.	6 hrs
Chapter No. 3. Classes & Randomization SV Classes: Language evolution, Classes and objects, Class Variables and Methods, Class instantiation, Inheritance, and encapsulation, Polymorphism. Randomization: Directed Vs Random Testing. Randomization: Constraint Driven Randomization.	10 hrs
Chapter No. 4. Assertions & Coverage Assertions: Introduction to Assertion based verification, Immediate and concurrent assertions. Coverage driven verification: Motivation, Types of coverage, Cover Group, Cover Point, Cross Coverage, Concepts of Binning and event sampling.	8 hrs
Chapter No. 5. Building Testbench: Layered testbench architecture. Introduction to Universal Verification Methodology, Overview of UVM Base Classes and simulation phases in UVM and UVM macros. Unified messaging in UVM, UVM environment structure, Connecting DUT- Virtual Interface	8 hrs

References:

1. System Verilog LRM
2. Chris Spear, Gregory J Tumbush - SystemVerilog for verification - a guide to learning the testbench language features - Springer, 2012
3. Step-by-Step Functional Verification with SystemVerilog and OVM by Sasan Iman SiMantis Inc. Santa Clara, CA Spring 2008

Tools: Questa Sim, NC Verilog, NC Sim, CVER + GTKWave, VCSMX, Modelsim for Verilog

			Teaching Hours
Course Title: Multimedia Communication		**Course Code: 18EECE410**	
L-T-P-SS: 2-0-1-0	**Credits: 3**	**Contact Hours: 3 Hrs/week**	
CIE Marks: 50	**SEE Marks: 50**	**Total Marks: 100**	
Teaching Hours: 42Hrs	**Examination Duration: 3 Hrs**		
Unit I			
Chapter 1: Introduction to Multimedia: Multimedia and Hyper media, WWW, overview of multimedia software tools.			02Hrs
Chapter 2: Graphics and Image representation: Graphics / Image data types, Popular file formats.			02Hrs
Chapter 3: Fundamental concepts in video: Types of video signals, analog video, digital video.			06Hrs
Chapter 4: Basics of digital audio: Digitization of sound, MIDI, Quantization and transmission of audio.			05Hrs
Unit II			
Chapter 4: Lossless compression algorithms: Introduction, run-length coding, variable length coding, dictionary based coding, arithmetic coding, lossless image compression.			05Hrs
Chapter 5: Lossy compression algorithms: Introduction, distortion measures, quantization, transform coding, wavelet based coding, wavelet packets, embedded zero tree of wavelet coefficients.			06Hrs
Chapter 6: Image compression standards: The JPEG standard, The JPEG2000 standard, The JPEG-LS standard, Bi level image compression standard.			06Hrs
Unit III			
Chapter 7: Basics video compression techniques: Overview, video compression based on motion compensation, H.261			08Hrs
Chapter 8: Overview of MPEG-1, 2 4 and 7.			02Hrs

Text Books

2. Ze-Nian Li & Mark S Drew**, “**Fundamentals of multimedia**”**, Pearson Education, 2004.

References

8. Ralf Steinmetz & Kalra Nahrstedt , “Multimedia: Computing, Communication & Applications”, Pearson Education, 2004
9. K R Rao, Zoran S Bojkovic, Dragord A Milovanvic, Pearson education, “Multimedia communication systems: Techniques, Standards, & Networks”,. Second Indian reprint, 2004.

Course Title: **Physical Design-Analog**	Course code: 18EECE419	
L-T- P: 0-0-3	Credits: 03	Contact Hrs: 06hrs/week
CIE Marks: 100	SEE Marks: 00	Total Marks: 100
Teaching Hrs: 16hrs Lab Hrs: 24 hrs		

Chapter No 1. Standard cell Layout creation Layout Practice Sessions (DRC/LVS Dirty layout), Understanding verification errors, Error debugging skills, Hands on experience of using layout editor, Quality of the layout, Half DRC rules, Mega module creation.	8 hrs
Chapter No 2. Analog layout Importance of performance in Analog layout, Importance of floor planning and placement, Attributes need to be taken care during routing stage, Introduction to DRC, LVS, Density and RCX.	8 hrs
Chapter No 3. Matching and Guard rings, Matching: Introduction to mismatch concepts, Causes for mismatch, Types of mismatch, Rules for matching, Activities. Guard ring : What is guard ring, Usage of guard ring	6 hrs
Chapter No 4. Reliability issues Introduction to failure mechanism, Causes of reliability issues, Process enhancement techniques and Layout considerations to reduce reliability issues	8 hrs
Chapter No 5. Physical design of amplifier and buffer Applying the studied concepts and doing layout, Prioritising the constraints given, Quality checks, Buddy reviews and implementations, Documentation	10 hrs

Reference:

The Art of Analog Layout – Alan Hastings

CMOS IC layout – Dan Clien

IC Layout Basics – Chris saint and Judy saint

Course Title: **Active Directory Domain Services**		Course Code:18EECE413
L-T-P: **3-0-0**	Credits: **3**	Contact Hrs: **03 hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **40**	Exam Duration: **03 hrs**	

Unit –I		
1	**Introduction to Microsoft Active Directory** Introduction to Microsoft Active Directory, Roles of Active directory services, Features in ADDS.	**06 hrs**
2	**Domains and Forests** Active Directory Structure Storage and Technologies, Data Store Components, Active Directory Domains and Forests, The Logical Structure of Active Directory.	**05 hrs**
3	**Physical Structure** The Physical Structure of Active Directory, Network Ports used by Domains and Forests.	**04 hrs**
Unit –II		
4	**Installation of R2 server** Requirements for installing ADDS, Understanding of Active Directory Domain Services Functional levels.	**06 hrs**
5	**Administration** Guidelines for raising domain and forests functional levels, Introduction to various AD Snap-ins and their functions	**04 hrs**
6	**Domain Services** Active Directory Users and Computers, Active Directory Domains and Trusts, Active Directory Sites and Services.	**05 hrs**
Unit –III		
7	**Backup/Restore** Backing Up Directory Domain Services Active, Recovering Active Directory Domain Services. Authoritative restore, Methods of authoritative restore	**10 hrs**

Text Books:

1. Introduction to MICROSOFT Active Directory Domain Services (ADDS), Microsoft reference materials.

Course Code: 18EECE409	Course Title: Design and Analysis of Algorithms	
L-T-P: **2-0-1**	Credits: 3	Contact Hrs: 50
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
	Semester: III	Exam Duration: 3 hrs

Content	
Unit - 1	**Hrs**
Chapter No. 1 : Framework for Analysis of Algorithm Efficiency Analysis Framework, Asymptotic Notations and Basic Efficiency Classes, Mathematical Analysis of Non-Recursive Algorithms, Mathematical Analysis of Recursive Algorithms.	**4**
Chapter No 2: Trees and Graphs Overview of Trees. AVL Trees. Red – Black Trees. Graphs, DFS and its applications, BFS and its applications. Topological Sorting. Shortest path algorithms. Minimum Spanning Tree.	**8**
Chapter No 3 : Hashing Direct Address Table, Hash Table, Hash Function, Collision Resolution Techniques.	**3**
Unit - 2	
Chapter No 4 : Substring Matching and Sorting Techniques. Brute-force method, Boyer-Moore – Hoorspool Algorithm, Knuth-Morris-Pratt Algorithm, Bubble sort, selection sort. Divide and Conquer: insertion sort, merge sort, quick sort and heap sort	**8**
Chapter No 5: Greedy Technique Introduction, Interval Scheduling, Proof Strategies, Huffmann Coding, 0/1 knapsack	**2**
Chapter No 6: Dynamic Programming Introduction and Definition. Memorization, Fibonacci Series, Edit Distance, Longest Increasing Subsequence, Longest Common Subsequence, Matrix multiplication, Coin Change problem, Subset Sum problem.	**5**
Unit - 3	
Chapter No 7 : Backtracking Introduction. N-Queens Problem, Generating string permutation, Hamiltonian Cycle.	**5**
Chapter No 8 : Branch and Bound	**5**

Introduction. Travelling Salesman problem, Job Assignment Problem.	

Text Books:

1. Data Structures with C -- Seymour Lipschutz, Schaum's Outline Series
2. Introduction to Design and Analysis of Algorithms – Anany Levitin 3rd Edition

Reference Books:

1. Introduction to Algorithms – Thomas H. Cormen 3rd edition
2. Data Structures, Algorithms and Applications In C++ -- Satraj Sahani
3. Data Structures and Algorithms Made Easy – Narshiman Karumunchi, Career Monk

Course Title: **CMOS ASIC Design**	Course code: 18EECE420	
L-T- P: 0-0-3	Credits: 03	Contact Hrs: 06hrs/week
CIE Marks: 100	SEE Marks: 00	Total Marks: 100
Teaching Hrs: 16hrs Lab Hrs: 24 hrs		

Chapter No. 1. Introduction: Design of combinational and sequential logic gates in CMOS. Layout and characterization of standard cells. Verilog for representing gate level netlists.	8 hrs
Chapter No. 2. Timing Analysis: Sequential circuit timing and static timing analysis. Cell and net delays and cross-talk. Rationale and implementation of scan chains for testing standard-cell based logic circuits. Timing Verification: Setup Timing Check, Hold Timing Check, Timing across Clock Domains	10hrs
Chapter No. 3: Physical design Physical design of standard-cell based CMOS ASICs: scan insertion, placement, and clock tree synthesis and routing. Netlist transformations at each step of the physical design process. Net parasitic and parasitic extraction. Use of PLLs for clock generation and de-skew.	12 hrs
Chapter No. 4. Standard Data formats: Standard data formats for representing technology and design: LEF, Liberty, SDC, DEF and SPEF. Clock gating and power gating for reduction of device power consumption. Design for reliability: electro- migration, wire self heat and ESD checks and fixes.	6 hrs
Chapter No. 5. Packaging An overview of package design and implementation and system level timing.	4 hrs

Reference Books:

1. The Design & Analysis of VLSI Circuits, L. A. Glassey & D. W. Dobbepahl, Addison Wesley Pub Co. 1985.
2. H. Bhatnagar, Advanced ASIC Chip Synthesis Using Synopsys Design Compiler Physical Compiler and PrimeTime, 2nd edition, 2001.
3. Static Timing Analysis for Nanometer Designs A Practical Approach, J. Bhasker • Rakesh Chadha, ? Springer Science+Business Media, LLC 2009

Tools: Cadence Innovous, Encounter

			Teaching Hours
Course Title: Embedded Linux		Course Code: 18EECE405	
L-T-P-SS: 3-0-0-0	Credits: 3	Contact Hours: 3 Hrs/week	
CIE Marks: 50	SEE Marks: 50	Total Marks: 100	
Teaching Hours: 42Hrs	Examination Duration: 3 Hrs		

Content	Teaching Hours
Unit I	
Chapter 1: Introduction to Embedded Linux : A Brief History of Linux -Benefits of Linux -Acquiring and Using Linux -Examining Linux Distributions -Devices and Drives in Linux-Components: Kernel, Distribution, Sawfish, and Gnome.	04 Hrs
Chapter 2: Overview of Embedded Linux : Overview: Development-Kernel architectures and device driver model- Embedded development issues-Tool chains in Embedded Linux-GNU Tool Chain (GCC,GDB, MAKE, GPROF & GCONV)- Linux Boot process.	06 Hrs
Chapter 3: System Management and user interface Boot sequence-System loading, sys linux, Lilo, grub-Root file system-Binaries required for system operation-Shared and static Libraries overview-Writing applications in user space-GUI environments for embedded Linux system	06 Hrs
Unit II	
Chapter 4: File system in Linux: File system Hierarchy-File system Navigation -Managing the File system –Extended file systems-INODE-Group Descriptor-Directories-Virtual File systems- Performing File system Maintenance -Locating Files –Registering the File systems- Mounting and Un-mounting –Buffer cache-/proc file systems-Device special files	06 Hrs
Chapter 5:Configuration: Configuration, Compilation & Porting of Embedded Linux-Examining Shells -Using Variables -Examining Linux Configuration Script Files -Examining System Start-up Files -Creating a Shell Script	04 Hrs
Chapter 6: Process management and Inter process communication: Managing Process and Background Processes -Using the Process Table to Manage Processes -Introducing Delayed and Detached Jobs - Configuring and Managing Services -Starting and Stopping Services -Identifying Core and Non-critical Services -Configuring Basic Client Services -Configuring Basic Internet Services –Working with Modules. IPC-Benefits of IPC- Basic concepts-system calls-creating pipes-creating a FIFO-FIFO operations-IPC identifiers-IPC keys-IPCS commands- Message queues-Message buffer-Kernel Ring Buffer semaphores-semtools-shared memory semtools- signals-sockets	08 Hrs

Unit III **Chapter 7: Linux device drivers** Devices in Linux- User Space Driver APIs- Compiling, Loading and Exporting- Character Devices- Tracing and Debugging- Blocking and Wait Queues- Accessing Hardware- Handling Interrupts- Accessing PCI hardware- USB Drivers- Managing Time- Block Device Drivers- Network Drivers- Adding a Driver to the Kernel Tree.	08 Hrs

1.1 Text Books

3. Embedded Linux –Hardware, Software and Interfacing - Craig Hollabaugh, Addison-Wesley Professional, 2002
4. Embedded / Real-Time Systems: Concepts, Design and Programming Black Book, New ed (MISL-DT) Paperback – 12 Nov 2003.

1.2 References

10. Building Embedded Linux Systems, Karim Yaghmour, First edition, April 2003.
11. Embedded Linux- John Lombardo, Newriders.com

Program: VII Semester Bachelor of Engineering (Electronics & Communication)		
Course Code: 18EECE411	**Course Title: Microwave & Antenna**	
L-T-P: 3-0-0	**Credits: 03**	**Contact Hrs: 40**
CIE Marks: 50	**SEE Marks: 50**	**Total Marks: 100**
Teaching Hrs: 50		**Exam Duration: 03 hrs**

Content	Hrs
Unit - 1	
Chapter No. 1. Microwave Vacuum Tube Devices Introduction , Reflex Klystron , Problems	**04**
Chapter No. 2. Microwave components Directional couplers, Circulators, Magic T, Isolator, s-Matrix and Attenuators	**08**
Unit - 2	
Chapter No. 3. Antenna Parameters Introduction, Basic antenna parameters ,Pattern, Beam width, Radiation intensity, Beam efficiency, Directivity, Gain, Aperture, Effective height, Polarization, Antenna field zone, The radio communication link. Radiation resistance of Short electric dipole and half wave length antenna.	**10**
Chapter No. 4. Sources and Arrays Introduction, Point sources, Power patterns, Power theorem, Examples on power theorem, Directivity and beam width of point sources, Arrays of two isotropic point sources, Pattern multiplication, Linear array of n isotropic point sources of equal amplitude and spacing, Broad side array, End fire array.	**08**
Unit - 3	
Chapter No. 5. Antenna practice Yagi-Uda Antenna, Loop antenna, Horn antenna, Parabolic reflector, Helical antenna, Log periodic antenna, Mobile Station Antennas, Antennas for GPR : Pulse Bandwidth, Embedded Antennas, UWB Antennas for Digital Applications, The Plasma Antenna	**10**

Text Book (List of books as mentioned in the approved syllabus)

1. J.D.Kraus & Khan,MGH publication ,"Antennas" , 2006, third edition.
2. Samuel Y Liao, "Microwave Devices and Circuits", PHI Pearson Education, Third Edition.

References

1. F.E.Terman, "Electromagnetic and radio engineering" by, TMcH publication, second Edition.
2. E.C.Jordan', "Electromagnetic waves & radiating systems" , PHI publication, second edition
3. C.A.Balnis, "Antenna theory and analysis and design" ,1999,third edition.
4. K.D.Prasad ,"Antenna and wave propagation" by '1990, first edition.
5. Annapurna Das, Sisir K Das ,"Microwave engineering" , TMH Publications 2001.

Course Code: 18EECE415	Course Title: Cryptography and Network Security	
L-T-P: 3-0-0	Credits: 3	Contact Hrs: 42
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 42		Exam Duration: 3 hrs

Content	Hrs
Unit - 1	
Chapter No. 1. Overview Introduction, Services, Mechanisms and attacks of OSI architecture, Model	2 hrs
Chapter No. 2: Introduction to Finite Fields Groups, Rings and fields. Modular Arithmetic, Euclid's Algorithm, Extended Euclid's algorithm, Finite fields of the form GF (p), Finite fields of the form GF(2n) , Polynomial arithmetic, Euler's and format's theorem, Chinese remainder theorem	4 hrs
Chapter No. 3: Classical Encryption techniques Symmetric cipher model, substitution technique, Transposition Techniques	5 hrs
Chapter No. 4: Block Ciphers and DES Design and principles of Block Ciphers,DES, Strength of DES, Block Cipher Modes of Operation	5 hrs
Unit - 2	
Chapter No. 5: Advanced Encryption Standards Evaluation Criterion of AES, AES Encryption and AES Decryption	4 hrs
Chapter No. 6: Public Key Cryptography and RSA: Design and principles, Concept of confidentiality and Authentication, RSA algorithm, Other Public Key Crypto Systems, Key Management, Diffie Hellman Key Exchange, Elliptic curve Cryptography	6 hrs
Chapter No. 7: Message Authentication and Hash Functions: Message Authentication codes, Hash functions, Security of Hash and MAC functions	3 hrs
Chapter No. 8: Digital Signature, Authentication and Hash Functions Authentication Protocols, Digital signature Standard, DSS Algorithm	3 hrs

Unit - 3	
Chapter No. 9. Electronic Mail Security: Pretty good privacy, Data Compression, PGP random number generator	3 hrs
Chapter No. 10. IP Security & Web Security IP security Architecture, Security Associations, Key management , Web security Considerations,Secure Socket layer, Transport layer security, secure electronic transactions	7 hrs

Text Book (List of books as mentioned in the approved syllabus)

1. William Stallings, Cryptography and Network Security-Principles and practices, 3rd, PHI, 2003
2. Atul Kahate , Cryptography and Network Security , TMH, 2003
3. Behrouz A. Forouzan, Cryptography and Network Security, TMH, 2007

References

1. Koeblitz, Introduction to Number theory and Cryptography , Springler, 0000
2. Bruce Schneider, Applied Cryptography, 2nd , John Wiley, 2001
3. Eric Maiwad, Fundamentals of Network security, 2nd , TMH, 2002

Course Title: Digital Image Processing		Course Code: 18EECE414	
L-T-P: 2-0-1	Credits: 3	Contact Hours: 3 Hrs/week	
ISA Marks: 50	ESA Marks: 50	Total Marks: 100	
Teaching Hours: 42Hrs	Examination Duration: 3 Hrs		

Unit I

Chapter 1: Introduction

2D systems, mathematical preliminaries- FT, Z-transform, Optical and Modulation transfer functions (OTF and MTF). — 04Hrs

Chapter 2: Image perception — 04Hrs

Light, luminance, brightness, contrast, MTF of the visual system, visibility function, monochrome vision models, Image fidelity criteria, colour representation, colour models.

Chapter 3: Image sampling and quantization — 07Hrs

2D sampling theory, limitations in sampling and reconstruction, quantization, optimal quantizer, compandor and visual quantization.

Unit II

Chapter 4: Image transforms — 10Hrs

2D orthogonal and unitary transforms, DFT, DCT, DST, Hadamard, Harr, Slant, KLT transforms.

Chapter 5: Image enhancement — 07Hrs

Histograms modeling, spatial operations, transform operations, multispectral image enhancement, color image enhancement.

Unit III

Chapter 6: Image filtering and restoration — 10Hrs

Image observation models, Inverse and wiener filtering, fourier domain filters. Smoothing splines and interpolation. SVD and iterative methods. Maximum entropy restoration, Bayesian methods, co-ordinate transformation and geometric corrections. Blind deconvolution.

Text Books

1. A.K. Jain, ''Fundamentals of Digital Image Processing'', Pearson Education (Asia) Pvt. Ltd

References

1. Rafael C. Gonzalez, Richard E. Woods, “Digital Image Processing”, Pearson Education (Asia) Pvt. Ltd
2. Rafael C. Gonzalez, Richard E. Woods and Steven L Edidins. ''Digital Image Processing Using Matlab'', Pearson Education (Asia) Pvt. Ltd

Course Title: Analog & Mixed Mode Circuits		**Course Code: 18EECE402**	
L-T-P-: 3-0-0	**Credits: 3**	**Contact Hours: 3Hrs/week**	
CIE Marks: 50	**SEE Marks: 50**	**Total Marks:100**	
Teaching Hours: 40Hrs	**Examination Duration:3Hrs**		

Unit I.	
Chapter 01: Basic Current reference, and Voltage (Bandgap) reference circuits, OPAMP based references, Current mode bandgap reference	06 Hrs
Chapter 02: DAC architecture, weighted R and R-2R network models, their Limitations, Current source based DAC	03 Hrs
Chapter 03: Bidirectional analog switch, Sample and Hold circuit, Basic Comparator architecture, non-idealities (offset error, bandwidth consideration), Dynamic comparator , Sense amplifier	07 Hrs
Unit II	
Chapter 04: ADC basics, Flash ADC, Tracking ADC , Dual slope ADC, SAR ADC, and their applications	10 Hrs
Chapter 05: Pipeline ADC architecture and algorithm .	06 Hrs
Unit III	08 Hrs
Chapter 06: PLL-operating principles, Phase detector and VCO; Phase frequency Detector, Charge pump models, stability issues, Jitter in PLL .	

Text Books

1. Phillip. E. Allen, Douglas R. Holberg, “CMOS Analog circuit Design” Oxford University Press, 2002.
2. Baker, Li, Boyce, “CMOS: Circuit Design, Layout and Simulation”, Prentice Hall of India, 2000..

Reference Books

1. N. Weste and K. Eshranghian, Principles of CMOS VLSI Design, Addison Wesley. 1985.
2. J. Rabaey, Digital Integrated Circuits: A Design Perspective, Prentice Hall India, 1997
3. C. Mead and L. Conway, Introduction to VLSI Systems, Addison Wesley, 1979.
4. B Razavi ‘Design of Analog CMOS Integrated Circuits’ First Edition McGraw Hill 2001

Course Title: Automotive Electronics		**Course Code: 18EECO403**	
L-T-P: 3-0-0	**Credits: 3**	**Contact Hours: 3Hrs/week**	
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**	
Teaching Hours: 40 Hrs	**Examination Duration: 3 Hrs**		
Unit I **Chapter 1: Introduction: Automotive Systems, Design cycle and Automotive industry overview :** Overview of Automotive industry, Vehicle functional domains and their requirements, automotive supply chain, global challenges. Role of technology in Automotive Electronics and interdisciplinary design.. Introduction to modern automotive systems and need for electronics in automobiles and application areas of electronic systems in modern automobiles, Introduction to power train, Automotive transmissions system ,Vehicle braking fundamentals, Steering Control, ,Overview of Hybrid Vehicles, ECU Design Cycle : Types of model development cycles(V and A) , Components of ECU, Examples of ECU on Chassis, Infotainment, Body Electronics and cluster.			**07**
Chapter 2: Embedded system in Automotive Applications & Automotive safety systems Automotive grade microcontrollers: Architectural attributes relevant to automotive applications, Automotive grade processors ex: Renesas, Quorivva, Infineon. EMS: Engine control functions, Fuel control, Electronic systems in Engines , Development of control algorithm for EMS, Look-up tables and maps, Need of maps, Procedure to generate maps, Fuel maps/tables, Ignition maps/tables, Engine calibration, Torque table, Dynamometer testing Safety Systems in Automobiles: Active and Passive safety systems: ABS, TCS, ESP, Brake assist, Airbag systemsetc.			**08**
Unit II **Chapter 3: Automotive Sensors and Actuators** Sensor characteristics, Sensor response, Sensor error, Redundancy of sensors in ECUs, Avoiding redundancy, Smart Nodes , Examples of sensors : Accelerometer (knock sensors),wheel speed sensors, Engine speed sensor, Vehicle speed sensor, Throttle position sensor, Temperature sensor, Mass air flow (MAF) rate sensor, Exhaust gas oxygen concentration sensor, Throttle plate angular position sensor, Crankshaft angular position/RPM sensor, Manifold Absolute Pressure (MAP) sensor. Actuators: ENGINE CONTROL ACTUATORS, Solenoid actuator, Exhaust Gas Recirculation Actuator.			**08**
Chapter 4: Automotive communication protocols : Overview of Automotive communication protocols : CAN, LIN , Flex Ray, MOST			**07**
Unit III **Chapter 5:Advanced Driver Assistance Systems (ADAS) and Functional safety standards :** Advanced Driver Assistance Systems (ADAS):Examples of assistance applications: Lane Departure Warning, Collision Warning, Automatic Cruise Control, Pedestrian Protection, Headlights Control, Connected Cars technology and trends towards Autonomous vehicles. Functional Safety: Need for safety standard-ISO 26262, safety concept, safety process for product life cycle, safety by design, validation.			**05**
Chapter 6: Diagnostics : Fundamentals of Diagnostics**,** Basic wiring system and Multiplex wiring system, Preliminary checks and adjustments, Self-diagnostic system. Fault finding and corrective measures, Electronic transmission checks and Diagnosis, Diagnostic procedures and sequence, On board and off board diagnostics in Automobiles, OBDII,			**05**

Concept of DTCs, DLC, MIL, Freeze Frames, History memory, Diagnostic tools, Diagnostic protocols KWP2000 and UDS	

Text Books

1. Ribbens, Understanding of Automotive electronics, 6th , Elsevier,2003
2. Denton.T , Automobile Electrical and Electronic Systems, Elsevier, 3rd Edition,2004
3. Denton.T , Advanced automotive fault diagnosis.

References

1. Ronald K Jurgen, Automotive Electronics Handbook, 2nd Edition, McGraw-Hill,1999
2. James D Halderman, Automotive electricity and Electronics, PHI Publication ,0000
3. Allan Bonnick, Automotive Computer Controlled Systems Diagnostic Tools and Techniques, Elsevier Science,2001
4. Nicholas Navet , Automotive Embedded System Handbook ,2009

Course Code: 18EECO404	Course Title: Embedded System	
L-T-P-Self Study: 3-0-0-0	Credits: 3	Contact Hrs: 40
CIA Marks: 50	SEE Marks: 50	Total Marks: 100
Teaching Hrs: 40		Exam Duration: 3 hrs

Content	Hrs
Unit - 1	
Chapter No. 1 Introduction to embedded system Introduction, Classification of Embedded System, Major Application Areas, Purpose of Embedded System. Characteristics and quality attributes of Embedded Systems, Design Metric and Optimizing the metrics.	6 hrs
Chapter No. 2 Typical Embedded Systems Core of Embedded System, Memory, Sensor and Actuators, Communication Network, Embedded Firmware, Components of Embedded System	5 hrs
Chapter No. 3 Devices and Communication Buses for Devices Networks-I I/O types and examples, Serial communication devices, parallel device ports, sophisticated interfacing, Features in device ports, Wireless devices.	5 hrs
Unit - 2	
Chapter No. 4 Devices and Communication Buses for Devices Networks II Timer and counting devices, Watchdog timer, Real time clock, Networked embedded systems, Serial bus communication protocols, Parallel bus device protocols, Internet enabled systems, Wireless and mobile system protocols.	8 hrs
Chapter No. 5 Device Drivers and Interrupts Service Mechanism Device access without interrupts, ISR concept, Interrupt sources, Interrupt servicing mechanism, Multiple interrupts, Context and the periods for context-switching, interrupt latency and deadline, Classification of processors' interrupt service mechanism from context-saving angle.	8 hrs
Unit - 3	
Chapter No. 6 Programming concepts and embedded programming in C Software programming in assembly and high level language, C program elements and program elements.	4 hrs
Chapter No. 7 Embedded Design Cycle Embedded product development life cycle, Trends in Embedded Industry Case Study: Small & large embedded system like Washing Machine, AVCM	4 hrs

Text Books (List of books as mentioned in the approved syllabus)

- Shibu K V, Introduction to Embedded Systems , 1E, McGraw Hil, 2014

- Rajkamal, Embedded Systems Architecture: Programming and Design , 2E, McGraw Hil, 2008

References

- Frank Vahid and Tony Givargis, Embedded System Design, 2E, John Wiley, 2002
- Steve Heath, Embedded Systems Design , 2E, , Elsevier, 2003

Course Code: **18EECO402**	Course Title: **MEMS**		
L-T-P: **3-0-0**	Credits: 3	Contact Hrs: 40	
ISA Marks: 50	ESA Marks: 50	Total Marks: 100	
Teaching Hrs: 40		Exam Duration: 3 hrs	

No	**Unit I**	**Hrs**
1	**Overview of MEMS and Microsystems** Evolution of Microsystems, Miniaturization, Applications of Microsystems in Automotive, Aerospace, Health Care Industry, Industrial Products, Consumer Products and Telecommunications.	**05**
2	**Working principles of Microsystems** Micro-sensors: Acoustic wave sensor, Biomedical Sensors and Biosensors, Chemical Sensors Optical Sensors, Pressure Sensors, Thermal Sensors. Micro-actuation: Actuation Using Thermal Forces, Shape Memory Alloys (SMA), Piezoelectric Crystals and Electrostatic Forces. Applications of Micro-actuations: Micro-grippers, Micro-motors, Micro-valves, Micro-pumps. Micro-accelerometers, Micro-fluidics, Numerical Problems.	**10**
	Unit II	
3	**Scaling laws in miniaturization:** Introduction to scaling, Scaling in Geometry, Rigid-Body Dynamics, Electrostatic Forces, Electromagnetic Forces, Electricity, Fluid Mechanics, Heat Transfer, Numerical problems.	**10**
4	**Materials for MEMS and Microsystem:** Substrate and Wafers, Active Substrate Materials, Silicon as Substrate Material, Silicon Compounds, Silicon Piezo resistors, Gallium Arsenide, Quartz, Piezoelectric Crystals, Polymers, Packaging Materials.	**05**

	Unit – III	
5	**Microsystems Fabrication Processes:** Photolithography, Ion Implantation, Diffusion, Oxidation, Chemical Vapor Deposition (CVD), Physical Vapor Deposition (PVD), Etching.	**05**
6	**Micro-manufacturing:** Bulk Micro-manufacturing, Surface Micromachining, The LIGA Process.	**05**

Text Book:

"MEMS and Microsystems – Design and Manufacture", Tai-Ran Hsu, TMH Edition 2002.

References:

"Micro system Design", Stephen D. Senturia, Kluwer Academic Publishers, 2001.

"Foundations of MEMS", Chang Liu, Pearson Edition 2012.

"RF MEMS:Theory, Design, and Technology", Gabriel M. Rebeiz, John Wiley & Sons Publication, 2003.

Course Code: **18EECO405**	Course Title: Industrial Automation	
L-T-P-SS: 3-0-0-0	Credits: 03	Contact Hrs: 40
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 40		Exam Duration: 3 hrs

Content	**Hrs**
Unit - 1	
Chapter No. 1.Introduction to Process control Process control block diagram, control system evaluation, final control elements, P & ID symbols and diagrams: flow sheet symbols, inter logic symbols, graphic symbols.	5 hrs
Chapter No. 2.Controller Principles Introduction, process characteristics, control system parameters, discontinuous control modes, continuous control modes and composite control modes, problems	5 hrs
Chapter No. 3.Analog Controllers Introduction, general features, electronic controllers, pneumatic controllers, problems	5 hrs
Unit - 2	
Chapter No. 4.Introduction to Automation & Programmable Logic Controllers Introduction and evolution of Automation, Hierarchical levels of automation, introduction to plant automation. Expectations from automation, basic functions, historical developments, current trends in computer control of plants, Introduction to PLC operation-The digital concept, Analog signals, input status file, output status file, Sixteen point I/O modules, Input modules: Discrete input modules, Discrete AC and DC input modules. Output Modules: Discrete output modules PLC memory, Logic, Conventional Ladder v/s LPLC ladder, Analysis of rung, OR, AND, NOT logic, Ex Or logic	5 hrs
Chapter No. 5.PLC Programming and Instructions The basic relay instructions normally open and normally closed instructions, output latching instructions, interfacing start stop pushbutton and motor to PLC, On delay and Off delay and retentive timer instructions. PLC counter up and down instructions, combining counters and timers, Comparison and data handling instructions: Data handling instructions, Sequencer instructions: programming sequence output instructions, developing ladder diagram with analytical problems.	5 hrs
Chapter No. 6.Different BUS configurations used for industrial automation GPIB, HART and OLE protocol, Industrial field bus- FIP (Factory Instrumentation protocol), PROFIBUS (Process field bus), Bit bus, Dive Net, Control Net and Ether CAT.	5 hrs
Unit - 3	
Chapter No. 7. SCADA Introduction to supervisory control and data acquisition (SCADA), block diagram, channel scanning, conversion to engineering units, data processing, distributed SCADA system, Remote Terminal Unit.	5 hrs
Chapter No. 8.Industrial Control Applications	5 hrs

Introduction to cement plant automation, thermal power plant automation, water treatment, Irrigation canal management	

Text Book (List of books as mentioned in the approved syllabus)

1. C D Johnson, Process Control Instrumentation Technology, 8, Prentice hall of India, 2002
2. Garry Dunning, Introduction to Programmable Logic Controllers, 3, Cengage Learning Indian edition, 2000
3. Krishna Kant, Computer Based Industrial control, 2, P H I, 2001

References

1. B G Liptak, Instrument Engineers Handbook, Process Control, 1, Butterworth-Heine mall Ltd, Linacre house, Oxford, 0000
2. M. Chidambaram, Applied Process Control, 2, Allied Publisher. Ltd, 0000

Program: III Semester Bachelor of Engineering (Electronics & Communication Engineering)			Teaching Hours
Course Title: Digital Circuits		**Course Code: 19EECC201**	
L-T-P: 4-0-0	**Credits: 4**	**Contact Hours: 4Hrs/week**	
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**	
Teaching Hours: 50 Hrs	**Examination Duration: 3 Hrs**		
Unit-I **Chapter No. 1. Logic Families** Logic levels, output switching times, fan-in and fan-out, comparison of logic families			**03**
Chapter No. 2. Principles of Combinational Logic Definition of combinational logic, canonical forms, Generation of switching equations from truth tables, Karnaugh maps-3,4 variables, Incompletely specified functions(Don't care terms),Simplifying Maxterm equations, Quine-McCluskey minimization technique- Quine-McCluskey using don't care terms, Reduced Prime Implicant Tables.			**10**
Chapter No. 3. Analysis and design of combinational logic General approach, Decoders-BCD decoders, Encoders, Digital multiplexers- Using multiplexers as Boolean function generators. Adders and subtractors-Cascading full adders, Look ahead carry adders, Binary comparators.			**08**
Unit-II **Chapter No. 4.Introduction to Sequential Circuits** Basic Bistable Element, Latches, A SR Latch, Application of SR Latch, A Switch De bouncer, The SR Latch, The gated SR Latch, The gated D Latch, The Master-Slave Flip-Flops (Pulse-Triggered Flip-Flops): The Master-Slave SR Flip-Flops, The Master-Slave JK Flip-Flop, Edge Triggered Flip- Flop: The Positive Edge-Triggered D Flip-Flop, Negative-Edge Triggered D Flip-Flop; Characteristic Equations			**10**
Chapter No. 5. Analysis of Sequential Circuits Registers and Counters, Binary Ripple Counters, Synchronous Binary counters, Ring and Johnson Counters, Design of a Synchronous counters, Design of a Synchronous Mod-n Counter using clocked JK Flip-Flops Design of a Synchronous Mod-n Counter using clocked D, T or SR Flip-Flops.			**10**
Unit-III **Chapter No. 6. Sequential Circuit Design** Introduction to Sequential Circuit Design, Mealy and Moore Models, State Machine notations, Synchronous Sequential Circuit Analysis, Construction of state Diagrams and counter design.			**05**
Chapter No. 7. Introduction to memories Introduction and role of memory in a computer system, memory types and terminology, Read Only memory, MROM, PROM, EPROM, EEPROM, Random access memory, SRAM, DRAM, NVRAM.			**04**

Text Books

1. Donald D Givone, Digital Principles and Design, Tata McGraw Hill Edition,2002
2. John M Yarbrough, Digital Logic Applications and Design, Thomson Learning,2001
3. A Anand Kumar , Fundamentals of digital circuits, PHI,2003

References

1. Charles H Roth, Fundamentals of Logic Design, Thomson Learning,
2. ZviKohavi, Switching and Finite Automata Theory, 2nd, TMH
3. R.D. Sudhaker Samuel, Logic Design, Sanguine Technical Publishers, 2005
4. R P Jain, Modern Digital Electronics, 2nd, Tata McGraw Hill , 2000

Program: III Semester Bachelor of Engineering (Electronics & Communication Engineering)			Teaching Hours
Course Title: Signals and Systems		**Course Code: 19EECC202**	
L-T-P: 4-0-0	**Credits: 4**	**Contact Hours: 4Hrs/week**	
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**	
Teaching Hours: 50Hrs	**Examination Duration: 3 Hrs**		
Unit I			
Chapter No. 01: Signal Representation Definition of a signals and systems, classification of signals,(analog and discrete signal, periodic and aperiodic, deterministic and random signals, even and odd signals, energy and power) , basic operation on signals(independent variable, dependent variable , time scaling, multiplication, time reversal), elementary signals (Impulse, step, ramp, sinusoidal, complex exponential), Systems Interconnections(series, parallel and cascade), properties of linear systems. (homogeneity ,superposition, linearity and time invariance, stability, memory, causality)			**10**
Chapter No. 02 : LTI System Representation Impulse response representation and properties, Convolution, convolution sum and convolution integral. Differential and difference equation Representation, Block diagram representation			**10**
Unit II			
Chapter No. 03:Fourier representation for signals Introduction, Discrete time Fourier series(derivation of series excluded) and their properties. Discrete Fourier transform (derivation of transform excluded) and properties			**10**
Chapter No. 04:Applications of Fourier transform Introduction, frequency response of LTI systems, Fourier transform representation of periodic signals, Fourier transform representation of discrete time signals. Sampling of continuous time signals.			**10**
Unit III			
Chapter No. 05: Z-transform Definition of z-transform, Properties of ROC, Properties of Z-transforms: Inverse z-transforms (Partial Fraction method, long division method), Unilateral Z-transform, Transform of LTI.			**10**

Text Book (List of books as mentioned in the approved syllabus)

1. Simon Haykin and Barry Van Veen , Signals and Systems, Second, John Wiley & Sons,2002
2. Alan V Oppenheim ,Alan S Willsky and S. Hamid Nawab , Signals and Systems, Second, PHI public,1997

References

1. H. P Hsu, R. Ranjan, Signals and Systems , TMH,2006
2. GaneshRaoandSatishTunga,,SignalsandSystems,SanguineT,2004
3. M.J.Roberts, Fundamentals of Signals and Systems, first Edition, TMH

Program: IV Semester Bachelor of Engineering (Electronics & Communication Engineering)			Teaching Hours
Course Title: Linear Integrated circuits		Course Code:19EECC203	
L-T-P: 4-0-0	Credits: 4	Contact Hours: 4Hrs/week	
ISA Marks: 50	ESA Marks: 50	Total Marks: 100	
Teaching Hours: 50Hrs	Examination Duration: 3 Hrs		
UnitI			
Chapter No 1. Current Mirrors Current Mirror circuits, Current source and current sink, Figures of merit (output impedance, voltage swing), Widlar, Cascode and Wilson current Mirrors.			4
Chapter No 2. . Basic OPAMP architecture Basic differential amplifier, Common mode and difference mode gain, CMRR, 5-pack differential amplifier with design, 7-pack operational amplifier, Slew rate limitation, Bandwidth and frequency response curve.			6
Chapter No 3. OPAMP characteristics Ideal and non-ideal OPAMP terminal characteristics, Input and output impedance, output Offset voltage, Small signal and Large signal bandwidth.			8
Unit II			
Chapter No 4. OPAMP with Feedback OPAMP under Positive and Negative feedback, Impact Negative feedback on Bandwidth, Input and Output impedances, Offset voltage under negative feedback, Follower property & Inversion Property under linear mode operation			10
Chapter No 5. Linear applications of OPAMP DC and AC Amplifier, Summing, Scaling and Averaging amplifiers (Inverting, Non-inverting and Differential configuration), Instrumentation amplifier, Integrator, Differentiator, Active Filters –First and second order Low pass & High pass filters. V to I and I to V converters.			12
UnitIII			
Chapter No 6. Nonlinear applications of OPAMP Crossing detectors (ZCD. Comparator), Inverting Schmitt trigger circuits, Triangular/rectangular wave generators, Waveform generator, Voltage controlled Oscillator, Sample and Hold circuits, Phase Shift Oscillator, Wein Bridge Oscillator, Data Converters: Digital to Analog Converters: Weighted resistor R -2R DAC, Current steering DAC, Pipeline DAC, Analog to Digital Converters: Flash, Pipeline ADC, SAR			10

Text Book

1. BehzadRazavi, Fundamentals of Microelectronics , 2nd Edition.
2. Phillip E. Allen, Douglas R. Holberg, CMOS Analog CircuitDesign.
3. Ramakant A. Gayakwad, Op - Amps and Linear IntegratedCircuits.

References

1. A.S. Sedra& K.C. Smith, MicroelectronicCircuits,
2. Sergio Franco, Design with Operational Amplifiers and Analog IntegratedCircuits.
3. David A. Bell, Operational Amplifiers and LinearIC's.
4. B. Razavi, Design of Analog CMOS Integrated Circuits McGraw-Hill,2001

Course Code: **19EECF201**	Course Title: **Data Structures Applications Lab**	
L-T-P-PR/OR: **0-0-2**	Credits: **2**	Contact Hrs: **4Hrs/Week**
ISA marks: **80**	ESA marks: **20**	Total Marks: **100**
Teaching + Lab Hrs: **48**		Duration of ESA: 2 **hrs**

Content	**Hrs**
Unit - 1	
Chapter No 1. Applications of basic data structures Applications of Stacks, Queues, Linked lists	10 hrs
Chapter No 2. Trees Computer representation, Tree properties, Binary Tree properties, Binary search trees properties and implementation, Tree traversals, AVL tree.	18 hrs
Unit - 2	
Chapter No 3. Graphs Computer representation, Adjacency List, Adjacency Matrix, Graph properties, Graph traversals.	10 hrs
Unit - 3	
Chapter No 4. Hashing Hashing, Hash function, Hash Table, Collision resolution techniques, Hashing Applications	10 hrs

Text Books (List of books as mentioned in the approved syllabus)

1. Richard F. Gilberg & Behrouz A. Forouzan, Data Structures A Pseudocode Approach with C, Second Edition.
2. Aaron M. Tenenbaum, Data Structures Using C.

Program: III Semester Bachelor of Engineering (Electronics & Communication Engineering)			**Teaching + Lab Hours.**
Course Title: Data Structure (Diploma)		**Course Code: 19EECF202**	
L-T-P: 0-0-2	**Credits: 2**	**Contact Hours: 4Hrs/week**	
ISA Marks: 80	**ESA Marks:- 20**	**Total Marks: 100**	
Teaching + Lab. Hours: 72 Hrs			

		Teaching + Lab Hours.
1.	**Programming on pointer concepts**: Pointer concepts,1D and 2D arrays, pointers to functions, memory management functions	**02+06**
2.	**Programming on string handling functions using pointers, structures, bit-fields**: Perform string handling functions like String length, String concatenate, Strings compare, String copy and Strings reverse, Implementing Structures, union andbit-field.	**02+06**
3.	**Programming on files:** Open, Close, Read, Write and Append the file.	**02+04**
4.	**Programming on stack data structures and applications:** Insert delete and display an integer in a stack, Conversion from Infix to postfix & Infix to Prefix, Recursion.	**04+04**
5.	**Programming on queue data structures:** Insert at rear end ,delete at front end and display the integers in queue, Deque and circular queue.	**04+04**
6.	**Programming on linked lists:** Insert, delete and display a node in Singly Linked List, Doubly Linked List and Circular Linked List.	**04+06**
7.	**Programming on trees:** Perform various operations on binary trees, find max, min value in a binary search trees, find the height of a tree, count nodes in a tree, delete a node in a tree.	**04+04**
8.	**Programming on sorting:** Merge sort, Quick sort, Heap sort, Shell sort, Radix sort**.**	**04+04**
9.	**Programming on hashing tables:** Implement different methods of hash tables.	**02+02**
10.	**Open ended experiment:** Implement given Data structures.	**02+02**

Text Book

3. Horowitz, Sahani, Anderson-Feed, ―Fundamentals of Data Structures in C , 2ed,Universities Press, 2008
4. Richard F. Gilberg, Behrouz A. Forouzan ―Data Structures: A Pseudocode Approach With C , 2nd Edition , Course Technology, Oct 2009.

References

3. E Balaguruswamy, ―The ANSI C programming Language , 2ed., PHI, 2010.
4. YashavantKanetkar, ―Data Structures through C , BPB publications 2010

Program: V Semester Bachelor of Engineering(Electronics & Communication Engineering)			Teaching Hours
Course Title: CMOS VLSI Circuits		Course Code: 19EECC301	
L-T-P: 4-0-0	Credits: 04	Contact Hours: 4 Hrs/week	
ISA Marks: 50	ESA Marks: 50	Total Marks: 100	
Teaching Hours: 50 Hrs	Examination Duration: 3 Hrs		
Content			
Unit I **Chapter No. 1. Introduction to VLSI and IC fabrication technology** VLSI Design Flow, Semiconductor Technology - An Overview, Czochralski method of growing Silicon, Introduction to Unit Processes (Oxidation, Diffusion, Deposition, Ion-implantation), Basic CMOS technology - Silicon gate process, n-Well process, p-Well process, Twin-tub Process, Oxide isolation. FinFET device, The root cause of short channel effects in twenty-first century MOSFETS, The thin body MOSFET concept, The FinFET and a new scaling path for MOSFETs, Ultra-thin body FET, Recent trends in fabrication technology.			08
Chapter No. 2. Electronic Analysis of CMOS logic gates DC transfer characteristics of CMOS inverter, Beta Ratio Effects, Noise Margin, MOS capacitance models. Transient Analysis of CMOS Inverter, NAND, NOR and Complex Logic Gates, Gate Design for Transient Performance, Switch-level RC Delay Models, Delay Estimation, Elmore Delay Model, Power Dissipation of CMOS Inverter, Transmission Gates & Pass Transistors, Tristate Inverter.			14
Unit II **Chapter No. 3. Design of CMOS logic gates** Stick Diagrams, Euler Path, Layout design rules, DRC, Circuit extraction, Latch up – Triggering Prevention.			06
Chapter No. 4. Designing Combinational Logic Networks Gate Delays, Driving Large Capacitive Loads, Delay Minimization in an Inverter Cascade, Logical effort. Pseudo nMOS, Clocked CMOS, Dynamic CMOS Logic Circuits, Dual-rail Logic Networks: CVSL, CPL.			14
Unit – III **Chapter No. 5. Sequential CMOS Circuit Design** Sequencing static circuits, Circuit design of latches and flip-flops, Clocking- clock generation, clock distribution.			08

Text Books **(List of books as mentioned in the approved syllabus)**

1. John P.Uyemura, Introduction to VLSI Circuits and Systems, 1, Wiley, 2007
2. Neil Weste, David Harris &AyanBanerjee,CMOS VLSI Design, 3, Pearson Ed 2005
3. Sung-Mo Kang & Yusuf Leblebici, CMOS Digital Integrated Circuits: Analysis and Design, 3, Tata McGra, 2007

References

1. FinFET Modeling for IC Simulation and Design: Using the BSIM-CMG Standard By Yogesh Singh Chauhan, Darsen Duane Lu, VanugopalanSriramkumar, SourabhKhandelwal, Juan Pablo Duarte, NavidPayvadosi, Ai Niknejad, Chenming Hu, Elsevier Publication, 2015
2. Wayne, Wolf, Modern VLSI design: System on Silicon, 3, Pearson Ed,2005
3. Douglas A Pucknell and Kamran Eshraghian, Basic VLSI Design, 3, PHI,2005
4. Phillip. E. Allen, Douglas R. Holberg, CMOS Analog circuit Design, 1, Oxford University,2002

CMOS VLSI Circuits Laboratory Experiments		**Course Code: 19EECP301**	
ISA Marks: 80	**ESA Marks: 20**		**Total Marks: 100**
Teaching Hours: 25Hrs	**Examination Duration: 2 Hrs**		**Contact Hours: 2Hrs/week**

List of Experiments:

1. Introduction to Cadence EDAtool.
2. Static and Dynamic Characteristic of CMOSinverter.
3. Layout of CMOS Inverter(DRC,LVS)
4. Static and Dynamic Characteristic of CMOS NAND2 andNOR2.
5. Layout of NAND2, NOR2, XOR2 gates (DRC,LVS).

Structured Enquiry

1. Design a Phase Detector usingD-FF

Open Ended

1. Design complex combinational circuits and analyze the performance using Cadencetool.

Books/References:

1. JohnP.Uyemura,–IntroductiontoVLSICircuits and Systems‖,Wiley.
2. Neil Weste and K. Eshragian,‖Principles of CMOS VLSI Design: A System Perspective,‖ 2nd edition, Pearson Education (Asia) Ptv. Ltd.,2000.

Course Code: **19EECC302**	Course Title: OOPS using C++	
L-T-P: 2-0-1	Credits: 3	Contact Hrs: 42
ISA: Marks: 80	ESA Marks: 20	Total Marks: 100
Teaching Hrs: 42		Exam Duration:

Content	**Hrs**
Unit - 1	
Chapter 1: Fundamental concepts of object oriented programming: Introduction to object oriented programming, Programming Basics (keywords, identifiers, variables, operators, classes, objects),Arrays and Strings Functions/ methods (parameter passing techniques),	04 hrs
Chapter 2: OOPs Concepts: Overview of OOPs Principles, Introduction to classes & objects ,Creation & destruction of objects, Data Members, Member Functions , Constructor & Destructor , Static class member, Friend class and functions, Namespace	08hrs
Unit - 2	
Chapter 3: Inheritance: Introduction and benefits, Abstract class, Aggregation: classes within classes Access Specifier, Base and Derived class Constructors, Types of Inheritance. Function overriding	8 hrs
Chapter 4: Polymorphism: Virtual functions, Friend functions, static functions, this pointer	6 hrs
Unit - 3	
Chapter 5: Exception Handling: Introduction to Exception, Benefits of Exception handling, Try and catch block, Throw statement, Pre-defined exceptions in C++,Writing custom Exception class	8 hrs
Chapter 6: I/O Streams: C++ Class Hierarchy, File Stream, Text File Handling, Binary File Handling Error handling during file operations, Overloading << and >> operators	6 hrs

Books/References: **Text Book** **1. Robert Lafore, "Object oriented programming in C++", 4th Edition, Pearson education, 2009.** **References** **1. Lippman S B, Lajorie J, Moo B E, C++ Primer, 5ed, Addison Wesley, 2013.** **2. Herbert Schildt: The Complete Reference C++, 4th Edition, Tata McGraw Hill**	

Course Code: **19EECE322 / 19EECE422**	Course Title: **Introduction to Deep Learning**	
L-T-P: **2-0-1**	Credits: **3**	Contact Hrs: **4**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **42**		Exam Duration: **3 hrs**

Content	**Hrs**
Unit - 1	
Chapter 1: Introduction to Deep Learning: What is Deep Learning?, Applications of deep learning, Differences between machine learningand deep learning, Basics of Neural Networks, Supervised Learning with Neural Networks, Logistic regression as a neural network, Computation graph, shallow neural networks, Deep neural networks. Introduction to metric tensors and tensorflow, Basic programs in tensorflow.	8 hrs
Chapter 2: Hyper-Parameter Tuning, Regularization and Optimization: Basics of Hyper-parameters, Regularization, Need for regularization, dropout regularization, gradient checking, mini-batch gradient descent, exponentially weighted averages and its biascorrection, Gradient descent with decay, Adam's optimization algorithm, The problem of localminima, weight initialization in neural networks, Normalizing activations in a network, Fitting Batch norm into a network, Softmax regression, Softmax classifier.	8 hrs
Unit - 2	
Chapter 3: Convolutional Neural Networks Introduction to Computer Vision and Image Processing, 2D Convolutions, Strided convolution,convolution over volume, One layer of a convolution network, ReLu and pooling, Example of aConvNet, Classic CNN Networks, ResNet architecture, Inception Networks, Transfer learning,Data Augmentation, Residual networks, Object Localization, Landmark and object detection, Convolutional implementation of sliding windows, YOLO algorithm, Car detection algorithm using YOLO, One shot learning, Face recognition algorithm.	12 hrs
Chapter 4: Recurrent Neural Networks Backpropogation through time, RNN model, Types of RNN, Vanishing gradients with RNN,Gated Recurrent Unit, LSTM, Bidirectional RNN, Deep RNN, basics of NLP and Concept ofword embedding, speech recognition.	04 hrs
Unit - 3	
Chapter 5: Unsupervised Deep Learning Concepts of Unsupervised deep learning, RBM (Restricted Boltzman Machine) and auto encoders, structure of Auto encoders, collaborative filtering with RBM, Deep belief networks.	10 hrs

Text Books

- Deep Learning, Ian Goodfellow, Yoshua Bengio and Aaron Courville, MIT Press, http://www.deeplearningbook.org, 2016.
- Neural Networks and Deep Learning by Michael Nielsen.

References

- Deep Learning with Python, Francois Chollet, by Manning Publications, 2018.
- Deep Learning by Microsoft Research
- Deep Learning Tutorial by LISA lab, University of Montreal

Course Code: **19EECC302**	Course Title: OOPS using C++	
L-T-P: 2-0-1	Credits: 3	Contact Hrs: 42
ISA: Marks: 80	ESA Marks: 20	Total Marks: 100
Teaching Hrs: 42		Exam Duration:

Content	**Hrs**
Unit - 1	
Chapter 1: Fundamental concepts of object oriented programming: Introduction to object oriented programming, Programming Basics (keywords, identifiers, variables, operators, classes, objects),Arrays and Strings Functions/ methods (parameter passing techniques),	04 hrs
Chapter 2: OOPs Concepts: Overview of OOPs Principles, Introduction to classes & objects ,Creation & destruction of objects, Data Members, Member Functions , Constructor & Destructor , Static class member, Friend class and functions, Namespace	08hrs
Unit - 2	
Chapter 3: Inheritance: Introduction and benefits, Abstract class, Aggregation: classes within classes Access Specifier, Base and Derived class Constructors, Types of Inheritance. Function overriding	8 hrs
Chapter 4: Polymorphism: Virtual functions, Friend functions, static functions, this pointer	6 hrs
Unit - 3	
Chapter 5: Exception Handling: Introduction to Exception, Benefits of Exception handling, Try and catch block, Throw statement, Pre-defined exceptions in C++,Writing custom Exception class	8 hrs

Chapter 6: I/O Streams: C++ Class Hierarchy, File Stream, Text File Handling, Binary File Handling Error handling during file operations, Overloading << and >> operators	6 hrs
Books/References: **Text Book** **1. Robert Lafore, "Object oriented programming in C++", 4th Edition, Pearson education, 2009.** **References** **1. Lippman S B, Lajorie J, Moo B E, C++ Primer, 5ed, Addison Wesley, 2013.** **2. Herbert Schildt: The Complete Reference C++, 4th Edition, Tata McGraw Hill**	

Course Code: 19EECE416	Course Title: Biosensor	
L-T-P: 0-0-3	Credits: 3	Contact Hrs: 72
ISA Marks: 00	ESA Marks: 100	Total Marks: 100
Teaching Hrs: 72		Exam Duration: 3 hrs

Content	Hrs
Unit - 1	
Chapter No. 1. Basic Introduction to sensors Introduction to sensors: fundamental characteristics such as Sensitivity, linearity, repeatability, hysteresis, drift. Sensing Principles: optical sensors, electrochemical sensors, micromechanical sensors, surface Plasmon sensors, colorimetric Sensors, acoustic sensors	5 hrs
Chapter No. 2. Active Electrical Transducers Thermoelectric transducers, thermoelectric phenomenon, common thermocouple systems, piezoelectric transducers, piezoelectric phenomenon piezoelectric materials, piezoelectric force transducers, piezoelectric strain, piezoelectric torque transducers, piezoelectric pressure transducers, piezoelectric acceleration transducers. Magnetostrictive transducers Magnetostrictive force transducers, Magnetostrictive acceleration transducers, Magnetostrictive torsion transducers, Hall Effect transducers, and application of Hall transducer. Electromechanical transducers-Tachometers, variable reluctance tachometers Electrodynamic vibration transducers, Electromagnetic pressure electromagnetic flowmeter. Photoelectric transducers- photoelectric phenomenon, photoelectric transducers, Photo volatile transducers, Photo emissive transducers. Electrochemical transducers- basics of electrode potentials, reference electrodes, indicator electrodes, measurement of PH, measurement of bioelectric signals.	10 hrs
Unit - 2	
Chapter No. 3. Passive electrical transducer Introduction, Resistive transducers- resistance thermometers, hot wire resistance transducers, Resistive displacement transducer, Resistive strain transducer, resistive pressure transducer, resistive optical radiation transducers. Inductive transducers-Inductive thickness transducers, Inductive displacement transducers, Movable core-type Inductive transducers, eddy current type Inductive transducers. Capacitive transducers-Capacitive thickness transducers, capacitive displacement transducers, capacitive moisture transducers Substrate and Wafers, Active Substrate Materials, Silicon as Substrate Material, Silicon Compounds, Silicon Piezo resistors, Gallium Arsenide, Quartz, Piezoelectric Crystals, Polymers, Packaging Materials.	5 hrs
Chapter No. 4. Microfabrication Technology Design of process flow for device fabrication for application in biology and medicine: Introduction to the Clean room	10 hrs

and contaminants, Wafer cleaning processes (DI water, RCA, metallic impurities, etc.), Substrate materials: Silicon, polymer and PCB, Thermal oxidation: Wet and dry oxidation, thin film deposition techniques: PVD- DC and RF Magnetron Sputtering, thermal evaporation, e-beam evaporation, LPCVD, PLD. Types of masks: Hard and soft Lithography, Lithography – UV Photolithography, Soft lithography, additive manufacturing. Mask design and fabrication – Photo resists and mechanical mask such as stencils. Types of etching- Wet etching- anisotropic and Isotropic and dry etching RIE and DRIE. Device fabrication and inspection in the clean room.	
Unit - 3	
Chapter No. 5. Biosensors Introduction: Biosensors and its applications in health care, agriculture, drug discovery and environmental monitoring. Devices for biology and medicine: Microfluidic channels, flow cytometry/ sorting, microchip using electrophoresis, force measurement with cantilevers, micro engineered devices for medical therapeutics, blood pressure sensors, devices for drug delivery, and devices for minimally invasive surgery.	5 hrs
Chapter No. 6. Biological components for detection Enzymes, antigen-antibody reaction, biochemical detection of analysts, organelles, whole cell, receptors, DNA probe, pesticide detection, sensors for pollutant gases. Surface chemistry: Immobilization of biorecognition element, Antigen-Antibody functionalization, and assay labels including radioisotopes, fluorophores, dyes.	5 hrs

Text Books (List of books as mentioned in the approved syllabus):

1. Fundamentals of Microfabrication and Nanotechnology by Marc J. Madou, 3rd edition. Taylor and Francis group.
2. Transducers and Instrumentation – D.V.S. Murthy, 2nd Edn, PHI Ltd, 2010.
3. A.P.F. Turner, I. Karube & G.S. Wilson: Biosensors: Fundamentals & Applications, Oxford University Press, Oxford, 1987.

References:

1. Ernest O. Doeblin : Measurement Systems, Application and Design, McGraw-Hill, 1985.
2. Richard S.C. Cobbold : Transducers for Biomedical Measurements: Principles and Applications, John Wiley & Sons, 1974
3. John G. Webster (ed.) : Medical Instrumentation - Application and Design; Houghton Mifflin Co., Boston, 1992.
4. Stephen D. Senturia : "Micro system Design", Kluwer Academic Publishers, 2001

Course Code: **19EECC302**	Course Title: OOPS using C++	
L-T-P: 2-0-1	Credits: 3	Contact Hrs: 42
ISA: Marks: 80	ESA Marks: 20	Total Marks: 100
Teaching Hrs: 42		Exam Duration:

Content	**Hrs**
Unit - 1	
Chapter 1: Fundamental concepts of object oriented programming: Introduction to object oriented programming, Programming Basics (keywords, identifiers, variables, operators, classes, objects),Arrays and Strings Functions/ methods (parameter passing techniques),	04 hrs
Chapter 2: OOPs Concepts: Overview of OOPs Principles, Introduction to classes & objects ,Creation & destruction of objects, Data Members, Member Functions , Constructor & Destructor , Static class member, Friend class and functions, Namespace	08hrs
Unit - 2	
Chapter 3: Inheritance: Introduction and benefits, Abstract class, Aggregation: classes within classes Access Specifier, Base and Derived class Constructors, Types of Inheritance. Function overriding	8 hrs
Chapter 4: Polymorphism: Virtual functions, Friend functions, static functions, this pointer	6 hrs
Unit - 3	
Chapter 5: Exception Handling: Introduction to Exception, Benefits of Exception handling, Try and catch block, Throw statement, Pre-defined exceptions in C++,Writing custom Exception class	8 hrs
Chapter 6: I/O Streams: C++ Class Hierarchy, File Stream, Text File Handling, Binary File Handling Error handling during file operations, Overloading << and >> operators	6 hrs

Books/References: **Text Book** **1. Robert Lafore, "Object oriented programming in C++", 4th Edition, Pearson education, 2009.** **References** **1. Lippman S B, Lajorie J, Moo B E, C++ Primer, 5ed, Addison Wesley, 2013.** **2. Herbert Schildt: The Complete Reference C++, 4th Edition, Tata McGraw Hill**	

Course Code: 19EECE402	Course Title: Information Theory and Coding	
L-T-P-SS: 2-0-1	Credits: 3	Contact Hrs: 40
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 40		Exam Duration: 3 hrs

Content	Hrs
Unit - 1	
Chapter No. Chapter 1:Information Theory: Information Theory: Introduction, Measure of information, Average information content of symbols in long independent sequences, Average information content of symbols in long dependent sequences. Mark-off statistical model for information source, Entropy and information rate of mark-off source	7 hrs
Chapter No. Chapter 2: Source Coding: Encoding of the source output, Shannon's encoding algorithm. Communication Channels, Discrete communication channels, Continuous channels. Source coding theorem,, Huffman coding	8 hrs
Unit - 2	
Chapter No. Chapter 3: Channel coding Discrete memory less Channels, Mutual information, Channel Capacity Channel coding theorem, Differential entropy and mutual information for continuous ensembles, Channel capacity Theorem.	4 hrs
Chapter No. Chapter 4: Introduction to Error Control Coding: Introduction, Types of errors, examples, Types of codes Linear Block Codes: Matrix description, Error detection and correction, Standard arrays and table look up for decoding.	7 hrs
Chapter No. Chapter 5: Binary Cycle Codes Algebraic structures of cyclic codes, Encoding using an (n-k) bit shift register, Syndrome calculation.	4 hrs
Unit - 3	
Chapter No. Chapter 6: BCH codes RS codes Golay codes, Shortened cyclic codes, Burst error correcting codes. Burst and Random Error correcting codes. Convolution Codes, Time domain approach. Transform domain approach. Systematic Convolution codes	10 hrs

Text Book (List of books as mentioned in the approved syllabus)

1. K. Sam Shanmugam, Digital and analog communication systems, John Wiley, 1996
2. Simon Haykin, Digital communication, John Wiley, 2003

References

1. Ranjan Bose, ITC and Cryptography, TMH(reprint 2007), 2002
2. Glover and Grant, Digital Communications , 2, Pearson, 2008
3. D Ganesh Rao, K N Haribhat, Digital Communications, Sanguine, 2009

Course Code: **19EECE403**	Course Title: **Testing & Characterization**	
L-T-P-**SS**: **0-0-3**	Credits:6	Contact Hrs: **3Hrs/week**
CIE Marks: 50	SEE Marks: 50	Total Marks: 100
Teaching Hrs: 40		Exam Duration: 3 Hrs

Unit I

No	Content	Hrs
1	**Introduction:** Scope of testing and verification in VLSI design process; Issues in test and verification of complex chips; embedded cores and SOCs. Basics of Basic Semiconductor, Overview of Datasheet Parameters, Generic Details about IC , Concept of Source and Load, Basics of Resistor, Capacitor and Inductor, Diode, Op-Amp, AC/DC, Power Supply and Specifications, Measurement Instruments and Specifications, Voltage Regulators	4
2	**Fundamentals of VLSI testing** Fault models. Automatic test pattern generation, Design for testability, Scan design, Test interface and boundary scan. Measuring Methods: 2 Wire/4 Wire Connections, Basics of Digital, LA/PG, Generic details of Digital IC	12

Unit II

No	Content	Hrs
3	**Testing** System testing and test for SOCs, IDDQ testing, Delay fault testing, BIST for testing of logic and memories, Test automation.	8
4	**Design verification techniques** Design verification techniques based on simulation, analytical and formal approaches, Functional verification Tests: 1. Continuity Tests 2. Device power supply Tests: Output voltage, Input Current, Leakage Current 3. Power Supply Current Test 4. Digital output Voltage and Current Tests	8

	5. Digital Input Leakage Current Tests	
	Unit – III	
5	**Verification techniques** Timing verification, Formal verification, Basics of equivalence checking and model checking, Hardware emulation. 1. Functional Testing and Verification of ICs (Buffer IC, Transceiver) 2. Writing or Reading Data from Memory Device (I2C, SPI) 3. Characterization V_{min}/f_{max} of Memory Device.	**8**

Text Book:

1. M. Abramovici, M. A. Breuer and A. D. Friedman, "Digital Systems Testing and Testable Design", IEEE Press, 1990.(Available as JAICO Publication)
2. M. Bushnell and V. D. Agarwal, "Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits", Kluwer Academic Publishers, 2000.
3. T .Kropf, "Introduction to Formal Hardware Verification", Springer Verlag, 2000.

References:

1. P. Rashinkar, Paterson and L. Singh, "System-on-a-Chip Verification-Methodology and Techniques", Kluwer Academic Publishers, 2001.
2. M. Abramovici, M. A. Breuer, A. D. Friedman, “Digital Systems Testing and Testable Design” Piscataway, New Jersey: IEEE Press, 1994
3. J.DiGiacomo, editor, “VLSI Handbook”, McGraw-Hill, 1989.
4. Samiha Mourad and Yervant Zorian, “Principles of Testing Electronic Systems”, Wiley (2000).
5. D. K. Pradhan (Editor). Fault-Tolerant Computing: Theory and Techniques, Prentice Hall, NJ, 1986.
6. Miczo. Digital Logic Testing and Simulation, John Wiley & Sons, 1987.
7. Barry Johnson. Design and Analysis of Fault-Tolerant Digital Systems, Addison Wesley, 1989.

Course Code: **19EECE322 / 19EECE422**	Course Title: **Introduction to Deep Learning**	
L-T-P: **2-0-1**	Credits: **3**	Contact Hrs: **4**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **42**		Exam Duration: **3 hrs**

Content	**Hrs**
Unit - 1	
Chapter 1: Introduction to Deep Learning: What is Deep Learning?, Applications of deep learning, Differences between machine learningand deep learning, Basics of Neural Networks, Supervised Learning with Neural Networks, Logistic regression as a neural network, Computation graph, shallow neural networks, Deep neural networks. Introduction to metric tensors and tensorflow, Basic programs in tensorflow.	8 hrs
Chapter 2: Hyper-Parameter Tuning, Regularization and Optimization: Basics of Hyper-parameters, Regularization, Need for regularization, dropout regularization, gradient checking, mini-batch gradient descent, exponentially weighted averages and its biascorrection, Gradient descent with decay, Adam's optimization algorithm, The problem of localminima, weight initialization in neural networks, Normalizing activations in a network, Fitting Batch norm into a network, Softmax regression, Softmax classifier.	8 hrs
Unit - 2	
Chapter 3: Convolutional Neural Networks Introduction to Computer Vision and Image Processing, 2D Convolutions, Strided convolution,convolution over volume, One layer of a convolution network, ReLu and pooling, Example of aConvNet, Classic CNN Networks, ResNet architecture, Inception Networks, Transfer learning,Data Augmentation, Residual networks, Object Localization, Landmark and object detection, Convolutional implementation of sliding windows, YOLO algorithm, Car detection algorithm using YOLO, One shot learning, Face recognition algorithm.	12 hrs
Chapter 4: Recurrent Neural Networks Backpropogation through time, RNN model, Types of RNN, Vanishing gradients with RNN,Gated Recurrent Unit, LSTM, Bidirectional RNN, Deep RNN, basics of NLP and Concept ofword embedding, speech recognition.	04 hrs
Unit - 3	
Chapter 5: Unsupervised Deep Learning Concepts of Unsupervised deep learning, RBM (Restricted Boltzman Machine) and auto encoders, structure of Auto encoders, collaborative filtering with RBM, Deep belief networks.	10 hrs

Text Books

- Deep Learning, Ian Goodfellow, Yoshua Bengio and Aaron Courville, MIT Press, http://www.deeplearningbook.org, 2016.
- Neural Networks and Deep Learning by Michael Nielsen.

References

- Deep Learning with Python, Francois Chollet, by Manning Publications, 2018.
- Deep Learning by Microsoft Research
- Deep Learning Tutorial by LISA lab, University of Montreal

Course Code: 20EECE340	Course Title: **Multicore Architecture and Programming**	
L-T-P : 2-0-1	Credits: 3	Contact Hrs: 4Hr/week
ISA Marks:50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 52		Exam Duration: 3

Content	Hrs
Unit - 1	
Chapter No. 1: Introduction to Multicore Drivers for Multicore Architectures: Low power, Performance/Throughput and need for memory bandwidth – Limits of single core computing – Moore's law - Limits to Instruction Level Parallelism (ILP) – Power and heat dissipation issue – Increased amount of data to process – Evolution from traditional System-On-Chip (SoC) to MPSoCs (Multi processor System-On-Chips) - Need for Multicore controllers in Automotive domain	4hrs
Chapter No. 2: Multicore Architecture Dependent Multicore software and hardware architectures –Multicore hardware architecture overview: Heterogeneous and Homogenous Multicore hardware – Communication between hardware processing elements: Point-to-point connections, Shared buses, On-chip cross bar, Network-On-Chip (NoC) - Memory access in Multicore architectures: Symmetric Multi-Processing (SMP), Asymmetric Multi processing aka NUMA (Add pros and cons)– Multicore architecture specific to applications - Example Multicore hardware used in Automotive – Infineon Tricore series, ST devices	12hrs
Unit - 2	
Chapter No. 3: Scheduling concepts and OS aspects What is Scheduling? – Static and Dynamic Scheduling - Scheduling algorithms: Rate Monotonic Scheduling (RMS), Fixed priority preemptive scheduling, Round robin scheduling, Earliest deadline first, First come First serve – Process and threads - What is pre-emption? Why is it needed?- Types of Multicore Scheduling: Global, Semi-partitioned and Partitioned –OS for General purpose and Real time systems - Scheduling in Single core vs Scheduling in Multicore – Timing Jitter	10 hrs
Chapter No. 4:Concurrency and Parallelism Amdahl's law – Need for Parallelism – Concurrency Fundamentals – Data parallelism, Functional Parallelism, loop Parallelism – Dependencies – Producer consumer`— Need for Synchronization, Loop dependencies–Shared resources – Caching aspects - Problems with no synchronization - Synchronization primitives – Semaphore, Mutex, spinlocks, Test and Set, Compare and swap–Synchronization related issues and how to avoid them: Data races, Livelocks, Deadlock, Non-atomic operations –	10hrs

Unit - 3	
Chapter 5: Advanced Multicore topics – Introduction/Overview Multicore timing analysis - Timing simulation: Why it is needed? – WCET (Worst Case Execution Time) analysis – Schedulability analysis – Additional challenges in Multicore - Tools used in automotive: Timing architect,ChronSIM, Sym TA/S- Deterministic behavior – Logical Execution Time (LET)	4hrs

References:

Highly Recommended: Real world Multicore embedded systems – Bryon Moyer

Highly Recommended for Embedded system and Real Time basics -Programming Embedded Systems with C and GNU Development Tools – Michael Barr

References in the internet for Multicore timing analysis:

Why is timing analysis important: http://embedded.cs.uni-saarland.de/publications/EnablingCompositionalityRTNS2016.pdf

Multicore timing simulation solutions:

https://www.vector.com/int/en/events/global-de-en/webinars/2020/timing-analysis-for-multicore-ecus/

https://www.rapitasystems.com/multicore-timing

https://www.inchron.com/tool-suite/chronsim/

https://www.absint.com/ait/symtas.htm

https://www.danlawinc.com/wp-content/uploads/MC-BR-006-Multicore-Timing-Analysis-Solution-For-Aerospace-v3.pdf

Logical Execution Time (LET)

https://ieeexplore.ieee.org/document/5577967

Laboratory Title: **Senior Design Project**	Lab. Code:**20EECW401**
Credit : 0-0-6 Total Hours: 70**hours/week**	Duration of exam: **2 hours**
Total Exam Marks: **100**	ISA Marks: **50**

Application Areas are,

- Smart City
- Connected Cars
- Home Automation
- Health care
- Smart energy
- Automation of Agriculture

Guide lines for selection of a project:

- The project needs to encompass the concepts learnt in the previous semesters, so that the student will learn to integrate, the knowledge base acquired to provide a solution to the defined problem statement of the project work.
- Student can select a project which leads to a product or model or prototype.
- Time plan: Effort to do the project should be between 60-70Hrs per team, which includes self-study of an individual member (80-100 Hrs) and team work (40-50hrs).
- Learning overhead should be 20-25% of total project development time.

Criteria for group formation:

- 3-4 students in a team.
- Role of teammates: Team lead and members.

Allocation of Guides and Mentors for the projects:

Every Project batch will be allocated with one faculty.

Details of the project batches:

- Number of faculty - members: 50
- Number of students:3-4 students in a team.

Role of a Guide

The primary responsibility of the guide is to help students to understand the meaning and need of various stages in the implementation of the project. At every stage of the project development, guide should help towards its successful completion as per the predefined standards.

How student should carry out a project:

- Define the problem.
- Specify the requirements.
- Specify the design in the understandable form (Block Diagram, Flowchart,Algorithm,etc).
- Analyze the design and identify hardware and software componentsseparately.
- Select appropriate simulation tool and development board for the design.
- Implement the design.
- Optimize the design and generate the results.
- Result representation and analysis.
- Prepare a document and presentation.

Report Writing

- The format for report writing should be downloaded from ftp://10.3.0.3/projects
- The report needs to be shown to guide and committee for each review.
-

Evaluation Scheme

- Internal semester assessment (ISA)
- Evaluation is done based on the evaluation rubrics given in Table 1
- Project shall be reviewed and evaluated by the concerned Guide for 50% of the marks.
- Project shall be evaluated by the review committeefor 50% of the marks.

Course Code: 20EECE406	Course Title: AUTOSAR	
L-T-P: 3-0-0	Credits: 3	Contact Hrs: 40
CIA Marks: 50	SEE Marks: 50	Total Marks: 100
Teaching Hrs: 40		Exam Duration: 3 hrs

Content	Hrs
Unit - 1	
Chapter No. 1: AUTOSAR Fundamentals Evolution of AUTOSAR – Motivations and Objectives AUTOSAR consortium – Stake holders – work Packages, AUTOSAR Partnership, Goals of the partnership, Organization of the partnership, AUTOSAR specification, AUTOSAR Current development status, BSW Conformance classes: ICC1, ICC2, ICC3, and Drawbacks of AUTOSAR.	8 hrs
Chapter No. 2: AUTOSAR layered Architecture AUTOSAR Basic software, Details on the various layers , Details on the stacks Virtual Function Bus (VFB) Concept Overview of AUTOSAR Methodology , Tools and Technologies for AUTOSAR AUTOSAR Application Software Component (SW-C) ,Types of SW-components AUTOSAR Run Time Environment (RTE): RTE Generation Process: Contract Phase, Generation Phase, MCAL, IO HW Abstraction Layer, Partial Networking, Multicore, J1939 Overview, AUTOSAR Ethernet, AUTOSAR E2E Overview , AUTOSAR XCP, Metamodel , From the model to the process , Software development process.	7 hrs
Unit - 2	
Chapter No. 3: Methodology of AUTOSAR and Communication in AUTOSAR CAN Communication, CAN FD, CANape, Application Layer and RTE, intra and inter ECU communication, Client-Server Communication, Sender-Receiver, Communication, CAN Driver, Communication Manager (ComM), Overview of Diagnostics Event and Communication Manager	10 hrs
Chapter No. 4: Overview about BSW constituents BSW Constituents: Memory layer, COM and Services layer, ECU abstraction, AUTOSAR, Operating system, Interfaces: Standard interface, AUTOSAR standardized interface, BSW-RTE interface,(AUTOSAR interface), BSW-ECU hardware interface, Complex device drivers and BSW module configuration, AUTOSAR Integration.	5 hrs
Unit - 3	
Chapter 5: MCAL and ECU abstraction Layer Microcontroller Drivers, Memory drivers: on-chip and off chip drivers, IO drivers(ADC, PWM, DIO), Communication drivers: CAN driver, LIN drivers, Flexrfay	5 hrs
Chapter 6: Service Layer	5 hrs

Diagnostic Event Manager, Function inhibits Manager, Diagnostic communication manager, Network management, Protocol data unit router, Diagnostic log and trace unit, COMM manager.	

Text Books (List of books as mentioned in the approved syllabus)

Ronald K. Jurgen, Infotainment systems, 2007, SAE International, 2007

Laboratory Title: **Project Work**	Lab. Code:**20EECW402**
Credit : 0-0-11 Total Hours: **22 hours/week**	Duration of exam: 2
Total Exam Marks: ISA : 50	ESA Marks: **50**

Application Areas are,

- Smart City
- Connected Cars
- Home Automation
- Health care
- Smart energy
- Automation of Agriculture

Guide lines for selection of a project:

- The project needs to encompass the concepts leant in a subject/s studied in the previous seven semesters, so that the student will learn to integrate, the knowledge base acquired to provide a solution to the defined problem statement of the project work.
- Student can select a project which leads to a product or model or prototype.
- Time plan: Effort to do the project should be between 120-150 Hrs per team, which includes self-study of an individual member (80-100 Hrs) and team work (40-50hrs).
- Learning overhead should be 20-25% of total project development time.

Criteria for group formation:

- 3-4 students in a team.
- Role of teammates: Team lead and members.

Allocation of Guides and Mentors for the projects:

Every Project batch will be allocated with one faculty.

Details of the project batches:

- Number of faculty members : 64
- Number of students:3-4 students in a team-46 Teams
- Internship Students:93

Role of a Guide

The primary responsibility of the guide is to help students to understand the meaning and need of various stages in the implementation of the project. At every stage of the project development, guide should help towards its successful completion as per the predefined standards.

<u>How student should carry out a project</u>:

- Define the problem
- Specify the requirements
- Specify the design in the understandable form (Block Diagram, Flowchart,Algorithm,etc)
- Analyze the design with hardware and software components saparately.
- Select appropriate simulation tool and development board for the design.
- Implement the design
- Optimize the design and generate the results
- Result representation and analysis
- Prepare a document and presentation.

<u>Report Writing</u>

- The format for report writing should be downloaded from ftp://10.3.0.3/projects
- The report needs to be shown to guide and committee for each review.

<u>Evaluation Scheme</u>

Internal semester assessment (ISA)

Evaluation is done based on the evaluation rubrics given in Table 1

- Project shall be reviewed and evaluated by the concerned Guide for 50% of the marks.
- Project shall be evaluated by the review committee for 50% of the marks.

Course Title: Research Experience for undergraduates(REU)	Course Code: 17EECE490
L-T-P: 0-0-6	Duration of SEE: 1hr
ESA Marks: 50	ISA Marks: 50

To enable the bright students to reach their fullest potential, several course offerings are made available. These courses are primarily aimed at stimulating the intellectual effort of students to reach higher goals. One of them is **Research Experience for Undergraduates (REU)**

Research Experience for Undergraduates (REU) is a 6 credit course designed to provide authentic research experience to undergraduate students. It helps them to experience and learn how to identify and define the problems and solve them, how to find and evaluate evidence, how to consider and assess competing interpretations, how to form and test their own analysis and interpretations and how to communicate their ideas and findings. This learning’s enable them to take part in the research missions in their future career beyond academic curriculum. This has resulted in large number of student publications in reputed journals and conferences.

Course Title: Institutional Research Project(IRP)	Course Code: 17EECE491
L-T-P: 0-0-6	Duration of SEE: 1hr
ESA Marks: 50	ISA Marks: 50

To enable the bright students to reach their fullest potential, several course offerings are made available. These courses are primarily aimed at stimulating the intellectual effort of students to reach higher goals. One of them is **Institutional Research Projects (IRP**)

Institutional Research Projects (IRP) is a 6 credit course where students get an opportunity to take part in Institutional Research projects funded by the University. IRP provides an exposure of solving a real time projects involving current technologies using KLE Tech ecosystem as live lab.

Course Title: Internship- Training	Course Code: 18EECI493
L-T-P: 0-0-6	Duration of SEE: 2hr
ESA Marks: 50	ISA Marks: 50

Engineering graduates unlike graduates from other fields require a strong industry connect during the course. This experience is provided through industry internships during VIII Semester of the program. Internships make students more competitive in the job market. During internship the student gains competency while working on live projects meeting all the deadlines related to project work. The students of the VIII semester are permitted to opt for full-time Industry Internship. Students having placement offers usually undergo internship at their respective industries, while others choose industry, based on their competency in consultation with the department.

The implementation details and impact of internships in the department are discussed below.

The internship has 2 mandatory components; i) InternshipTraining, and ii) Internship – Project.

- Internship Training: Industry offers training in learning tools/ framework / programming language / Industrial practices to carry out the Internship project.

- Internship-Project: Industry assigns a well-defined problem statement for the project and provides an industry mentor to execute the project. The University guide in consultation with Industry Guide reviews the project progress at regular intervals using Skype/ Webex or personal visit to the industry.

At the end of the Internship, student has to submit Internship Training Report & Internship Project report to the University. Contents of the Reports shall be decided in consultation with Industry Guide. Industry shall issue Internship Certificate to student-intern.

The expectations from most of the problem statements were either to develop a subsystem of a bigger system or development of a relatively smaller system itself. Students developed either a working prototype or proof of concept as part of their project work. Students worked on simulation projects as well.

Course Title: Internship- Project	Course Code: 20EECW494
L-T-P: 0-0-11	Duration of ESA: 2hr
ESA Marks: 50	ISA Marks: 50

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The expectations from most of the problem statements were either to develop a subsystem of a bigger system or development of a relatively smaller system itself. Students developed either a working prototype or proof of concept as part of their project work. Students worked on simulation projects as well.

Course Title: Start-up Internship Experience (SIE)	Course Code: 17EECE492
L-T-P: 0-0-6	Duration of SEE: 1hr
ESA Marks: 50	ISA Marks: 50

STUDENT INTERNSHIP EXPERIENE refers to work experience that is relevant to professional development prior to graduation. Industrial Training is an essential component in the development of the practical and professional skills required for an Engineer and an aid to prospective employment. It should also be noted that developing an awareness of general workplace behavior and interpersonal skills are important objectives of the Industrial Training experience. At the end of the Industrial Training,

students should be able to improve their knowledge and skills relevant to their areas of specialization and at the same time able to relate, apply and adapt relevant knowledge, concepts and theories within an industrial organization, practice and ethics. With this experience and exposure the students should be able to acquire knowledge and skills to compete in the job market.

Program: Digital Electronics		
Course Title: Principles and Practices of Engineering Education		**Course Code:** 15ECRC701
L-T-P: 2-0-1	**Credits: 3**	**Contact Hours: 3**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 40	**Examination Duration: 3 hrs**	

Unit	Hours
1. **Fundamental Principles of Teaching and Learning**	**8 Hours**
2. **Learning Styles and Theories**	**8 Hours**
3. **Instructional Design Models and Technology Enhanced Learning**	**8 Hours**
4. **Assessment and Evaluation**	**8 Hours**
5. **Engineering Learning Modules**	**8 Hours**

Program: Digital Electronics		
Course Title: Fault diagnoses and testing for VLSI circuits		**Course Code:** 15EDEC708
L-T-P: 4-0-0	**Credits: 4**	**Contact Hours: 4**
CIE Marks: 50	**SEE Marks: 50**	**Total Marks: 100**
Teaching Hours: 50	**Examination Duration: 3 hours**	

Unit	Hours
1. Threshold Logic: Introduction, Synthesis of threshold networks.	5 hrs
2. Reliable Design And Fault Diagnosis: Different types of Faults, Fault Detection in Combinational Circuits, Fault Location Experiments, Different approaches used in fault diagnosis of Combinational Circuits, Failure Tolerant Design, Quadded Logic.	15 hrs
3. Capabilities, Minimization and Transformation of Sequential Machines: Finite State Model (FSM) used in Machine design, Capabilities & Limitations of finite state machines, State equivalence and machine minimization, Simplification of incompletely specified machines.	10hrs
4. Structure of Sequential Machines: State Assignments Using Partitions, The Lattice of Closed Partitions, Reduction of the Output Dependency, Input Independence and Autonomous Clocks, Covers and Generation of Closed Partitions by State Splitting, Information Flow in Sequential Machines, Machine Decomposition.	10 hrs
5. State-Identification And Fault-Detection Fault detection / location Experiments, Machine Identification, Fault-Detection Experiments, Design of Diagnosable Machines, Second Algorithm for the Design of Fault-Detection Experiments, Fault-Detection Experiments for Machines, Which have no Distinguishing Sequences.	10 hrs

Text Books

1. Khohavi ZVI Switching and Finite Automata Theory, 2ed., TMH, 1999,

Reference Books:

2. Samuel Lee Digital Circuits & Logic Design, PHI, 1990

Program: Digital Electronics		
Course Title: Real Time Embedded System lab		**Course Code:** 15EDEP706
L-T-P: 0-0-1	**Credits: 1**	**Contact Hours: 2**
CIE Marks: 80	**SEE Marks: 20**	**Total Marks: 100**
Lab Hours: 20	**Examination Duration: 3 hours**	

Experiments

I Advanced Embedded Systems

1. Use any EDA (Electronic Design Automation) tool to learn the Embedded Hardware Design and for PCB design.

2. Familiarize the different entities for the circuit diagram design.

3. Familiarize with the layout design tool, building blocks, component placement, routings, design rule checking etc.

II Embedded Programming Concepts (RTOS)

4. Create „n" number of child threads. Each thread prints the message " I"m in thread number …" and sleeps for 50 ms and then quits. The main thread waits for complete execution of all the child threads and then quits. Compile and execute in Linux.

5. Implement the multithread application satisfying the following :

i.Two child threads are crated with normal priority.

ii.Thread 1 receives and prints its priority and sleeps for 50ms and then quits.

iii.Thread 2 prints the priority of the thread 1 and rises its priority to above normal and retrieves the new priority of thread 1, prints it and then quits.

iv The main thread waits for the child thread to complete its job and quits.

6. Implement the usage of anonymous pipe with 512 bytes for data sharing between parent and child processes using handle inheritance mechanism.

7. Test the program below using multithread application-

i.The main thread creates a child thread with default stack size and name Child_Thread".

ii. The main thread sends user defined messages and the message „WM_QUIT" randomly to the child thread.

iii. The child thread processes the message posted by the main thread and quits when it receives the „WM_QUIT" message.

iv. The main thread checks the termination of the child thread and quits when the child thread complete its execution.

v. The main thread continues sending the random messages to the child thread till the „WM_QUIT" message is sent to child thread.

vi. The messaging mechanism between the main thread and child thread is synchronous.

Program: Digital Electronics	
Course Title: Data Structure using C	**Course Code:** 17EDEC701

L-T-P: 0-0-1	**Credits: Audit**	**Contact Hours: 2**
ISA Marks: 80	**ESA Marks: 20**	**Total Marks: 100**
Teaching Hours: 25	**Examination Duration: -**	

Chapter 01:C language features Pointers revisited, Strings, Structures – Basics, Structures and functions, Arrays of structures, Pointers to structures, Self Referential Structures, Unions and bit fields, Files.	5 Hrs
Chapter 02:Stacks and Queues Definition, Representation and Applications of stack. Definitions, representation and applications of linear, circular, queues, multiple queues, priority queue. Recursion	5 Hrs
Chapter 03:Lists Linked lists, singly, doubly, circular lists, definitions, representations. Implementation of list operations, applications – polynomial addition, addition of long integers. Linked stacks, Linked Queues	5 Hrs
Chapter 04:Trees Binary trees – Definitions, traversals (recursive and iterative versions), Building and searching, Threaded Binary trees, Trees and their applications	5 Hrs
Exchange sorts, Selection and tree sorts, Merge and radix sorts	5 Hrs

Text Book

1. Aaron M. Tenenbaum, et al, Data Structures using C, II Edition, PHI, 2006
2. Horowitz, Sahani, Anderson-Feed, Fundamentals of Data Structures in C, II Edition, University, 2008

References

1. E Balaguruswamy, The ANSI C programming Language, II Edition, PHI, 2010
2. Yashavant Kanetkar, Data Structures through C, II Edition, BPB public, 2010
3. Richard F. Gilberg, Behrouz A. Forouzan , Data Structures: A Pseudocode Approach With C, II Edition, Course Tec, 2009

Lab:

1. Programs on Pointer concepts.
2. Programs on string handling functions, structures union And bit-files.
3. Programming on files
4. Programming on stacks data structures
5. Programs on implementation of different queue data structures.
6. Programs on implementation of different types of Linked lists
7. Programs on Implementation of trees
8. Programs to implement different sorting techniques.
9. Programming on graph
10. Programming on hashing tables
11. Design and implement stack queue data structures
12. Design and implement linked list data structures
13. project

Program: I Semester Master of Technology (Digital Electronics)			**Teaching Hours**
Course Title: Principles of Embedded Systems		**Course Code: 17EDEC703**	
L-T-P: 0-0-2	**Credits: 2**	**Contact Hours: 4 Hrs/week**	
ISA Marks: 80	**ESA Marks: 20**	**Total Marks: 100**	
Teaching Hours: 42 Hrs	**Examination Duration:**		

1. Introduction to embedded system: Introduction, Classification of Embedded System, Major Application Areas, Purpose of Embedded System. Characteristics and quality attributes of Embedded Systems, Design Metric and Optimizing the metrics.	**06 Hrs**
2. Typical Embedded Systems: Core of Embedded System-processor fundamentals, up vs uc, risc vs cisc, vonneumann vs Harvard, 8051 controller architecture and programmer model, Memory, Sensor and Actuators, Communication Network, Embedded Firmware	**08 Hrs**
3. Low Level programming Concepts: Addressing Modes, Instruction Set and Assembly Language programming(ALP), Developing, Building, and Debugging ALP's	**08 Hrs**
4. Middle Level Programming Concepts: Cross Compiler, Embedded C language implementation, programming, & debugging, Differences from ANSI-C, Memory Models, Use of directives, Functions, Parameter passing and return types	**02 Hrs**
5. On-Chip Peripherals Study, Programming, and Application: Ports: Input/Output, Timers & Counters, UART, Interrupts	**08 Hrs**
6. External Interfaces Study, Programming and Applications : LEDS, Switches(Momentary type, Toggle type), Seven Segment Display: (Normal mode, BCD mode, Internal Multiplexing & External Multiplexing), LCD (8bit, 4bit, Busy flag, custom character generation), Keypad Matrix, Stepper Motor, DC Motor	**10 Hrs**

Text Books

1. Introduction to Embedded Systems 1E by Shibu K V.
2. Kenneth J. Ayala ; "The 8051 Microcontroller Architecture, Programming & Applications" 2e, Penram International, 1996 / Thomson Learning 2005
3. Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D. McKinlay; "The 8051 Microcontroller and Embedded Systems – using assembly and C "- PHI, 2006 / Pearson, 2006

References

1. Embedded System Design: A Unified Hardware/Software Introduction – Frank Vahid, Tony Givargis, John Wiley & Sons, Inc.2002
2. Predko ; "Programming and Customizing the 8051 Microcontroller" –, TMH
3. Raj Kamal, "Microcontrollers: Architecture, Programming, Interfacing and System Design", Pearson Education, 2005

Program: Digital Electronics			**Teaching Hours**
Course Title: Fundamentals of signal processing		**Course Code: 17EDEC704**	
L-T-P: 3-0-1	**Credits: 4**	**Contact Hours: 5 Hrs/week**	
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**	
Teaching Hours: 40 Hrs	**Examination Duration: 3 hrs**		
Chapter No. 1. Introduction Definition of a signals and systems, classification of signals, basic operation on signals, elementary signals, Systems viewed as Interconnection of operation, properties of systems.			**08 Hrs**
Chapter No. 2. Time-Domain representation for LTI systems Convolution, Impulse response representation, convolution sum and convolution integral. Properties of impulse response representation.			**08 Hrs**

Chapter No. 3. Discrete Fourier Transforms Discrete Fourier Transforms (DFT): Frequency domain sampling and reconstruction of discrete time signals. DFT as a linear transformation, its relationship with other transforms. use of DFT in linear filtering, overlap-save and overlap-add method. Fast-Fourier-Transform (FFT) need for efficient computation of the DFT (i.e. FFT algorithms). Radix-2 FFT algorithm for the computation of DFT and IDFT: decimation-in-time and decimation-in-frequency algorithms. Composite FFT.	**08 Hrs**
Chapter No. 4. Design of digital filters Design of digital filters: Considerations and Characteristics of practical digital filters. Design of digital filters: symmetric and anti symmetric FIR filters, design of linear phase FIR filters using windowing method- Rectangular, Hamming, Hanning, Bartlet and Kaiser windows. Design of linear phase FIR filters using frequency sampling technique.	**08Hrs**
Chapter No. 5. Design of IIR filters from analog filters Design of IIR filters from analog filters: Approximation of derivative, Impulse invariance method, bilinear transformation. Characteristics of commonly used Analog Filters: Butterworth and Chebyshev filters. Frequency transformation in the digital domain	**08Hrs**

Text Books

1. Simon Haykin and Barry Van Veen, Signals and Systems, second, John Wiley & Sons, 2002
2. Proakis & Monalakis, Digital signal processing Principles Algorithms & Applications, 4th Edition, PHI, New Delhi, 2007

References

1. Alan V. Oppenheim, Alan S Willsky and S. Hamid Nawab, Signals and Systems, second, Pearson Education Asia, 1997

Implementation Assignments:

1. Implementation assignments are designed using Python. Ex:
   - Generate different elementary signals and perform mathematical operations on them.
   - Calculate N point DFT and find the cost of computation, justify the use of FFT algorithms to calculate DFT.
   - Design Filters (FIR/IIR) for given specifications.
2. Explore the feature of SDR to build signal processing applications like,
   - Noise cancellation
   - Audio file editing

Program: I Semester Master of Technology (Digital Electronics)			**Teaching Hours**
Course Title: Machine learning		**Course Code: 17EDEC705**	
L-T-P: 3-0-1	**Credits: 4**	**Contact Hours: 5 Hrs/week**	
ISA Marks: 50+100	**ESA Marks: 50**	**Total Marks: 200**	
Teaching Hours: 40 Hrs	**Examination Duration: 3 hrs**		
Chapter No. 1: Introduction Introduction What is Machine Learning? Applications of Machine Learning, Types of Machine Learning: Supervised, Unsupervised and Reinforcement learning, Dataset formats, Basic terminologies.			**05 Hrs**

Chapter No. 2: Supervised Learning Linear Regression, Logistic Regression Linear Regression: Single and Multiple variables, Sum of squares error function, The Gradient descent algorithm, Application, Logistic Regression, The cost function, Classification using logistic regression, one-vs-all classification using logistic regression, Regularization.	**10 Hrs**
Chapter No. 3: Supervised Learning: Neural Network Introduction to perception learning, Implementing simple gates XOR, AND, OR using neural network. Model representation, Gradient checking, Back propagation algorithm, Multi-class classification, Application- classifying digits, SVM.	**10 Hrs**
Chapter No. 4: Unsupervised Learning: Clustering Introduction, K means Clustering, Algorithm, Cost function, Application.	**05Hrs**
Chapter No. 5: Unsupervised Learning: Dimensionality reduction Dimensionality reduction, PCA- Principal Component Analysis. Applications, Clustering data and PCA.	**05Hrs**
Chapter No. 6: Machine Learning System Design Evaluating a hypothesis, Model selection, Bias and variance, error analysis, error metrics for skewed classes. Building a Model.	**05 Hrs**
Text Book (List of books as mentioned in the approved syllabus) 1. Tom Mitchell, Machine Learning, 1, McGraw-Hill. , 1997 2. Christopher Bishop, Pattern Recognition and Machine Learning, 1, Springer, 2007 **References** 1. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning : Data Mining, Inference and Prediction, 2, Springer, 2009	
Implementation Assignments: 1. Assignments are designed to explore the concepts like • Supervise and unsupervised learning, • Clustering, • Regression and estimation 2. Motivate students to take up open challenges like Kaggle, walmart, ect	

Program: I Semester Master of Technology (Digital Electronics)			**Teaching Hours**
Course Title: RISC Architectures		**Course Code: 17EDEC706**	
L-T-P: 3-0-1	**Credits: 4**	**Contact Hours: 3 Hrs/week**	
ISA Marks: 50+100	**ESA Marks: 50**	**Total Marks: 200**	
Teaching Hours: 46 Hrs	**Examination Duration:**		

1. The 32 bit RISC Architecture: The Acorn RISC machine, Architectural inheritance, Architecture of ARM7TDMI, ARM programmers model, ARM development tools, 3 stage pipeline ARM organization, ARM instruction execution.	**06 Hrs**
2. 32 bit Instruction set: Data processing instruction, Branch instruction, Load store instruction, Software interrupt instruction, Program status register instruction, Conditional execution, Example programs, 16bit Instruction set-The Thumb programmer model, ARM-Thumb interworking, other branch instructions, Data processing instructions, Single/Multiple register load store instruction, Stack operation, Software interrupt instructions, example programs.	**06 Hrs**
3. Exception Handling: Introduction, Interrupts, error conditions, processor exception sequence, the vector table, Exception handlers, Exception priorities, Procedures for handling exceptions.	**04 Hrs**
4. Memory Hierarchy Design: Cache basics, Miss rate and penalty, Cache Hierarchy, Memory Organizations, Memory Hierarchy.	**06 Hrs**
5. Pipelining: Linear pipeline processor, Nonlinear pipeline processor, Instruction pipeline design, Branch handling techniques, Arithmetic pipeline design, Computer arithmetic principles, Static arithmetic pipeline, Multifunctional arithmetic pipeline.	**08 Hrs**
6. Cortex M4 : Functional description, programmer's model, memory protection unit, nested vectored interrupt controller.	**06 Hrs**
7. Multi-Core Architectures : Introduction to Intel Architecture, How an Intel Architecture System works, Basic Components of the Intel Core 2 Duo Processor: The CPU, Memory Controller, I/O Controller.	**07 Hrs**
8. Current Trends in Intel Architectures and Applications : Seminar on current trends in Intel Architectures	**03 Hrs**

Text Books

1. "ARM System- on-Chip Architecture" by 'Steve Furber', LPE, Second Edition.
2. "ARM Assembly Language fundamentals and Techniques" by William Hohl, CRC press, 2009.
3. D. A. Patterson and J. L. Hennessey "Computer Organization and Design", Morgan , Kaufmann,2002
4. H. Jonathan Chao and Bin Liu, "High performance switches & routers", Wiley Interscience, 2007.
5. Kai Hwang, " Advanced Computer Architecture – TMH – 1993
6. Web resources for Example Architectures of INTEL and Texas Instruments: http:/ /download.intel.com/design/intarch/papers/321087.pdf

References

1. Kai Hwang, Faye A. Briggs, Computers Architecture and Parallel Processing – MGH – 1985
2. David E Culler, Jaswinder Pal Singh, Anoop Gupta "Parallel Computer Architecture", Harcourt Asia Pte Ltd 2000
3. Stalling W." Computer Organization and Architecture- Designing for performance" PHI,2005
4. D. Sima,T. Fountain, P.Kasuk," Advanced Computer Architecture-A Design Space Approach" Addisson Wesley,1997.
5. M. J. Flynn,"Computer Architecture, Pipelined And Parallel Processing", Narosa Publications, 1998.

List of Experiments:

1. Write an ALP to verify data transfer w.r.t memory to achieve following
   i. 8 bit data transfer
   ii. 16 bit data transfer
   iii. 32 bit data transfer
2. Write an ALP for Tables and lists to do following:
   i. Add an entry to a list
   ii. Remove an element from the queue
3. Write an ALP to pass parameters to a subroutine.
   i. Ascending order
   ii. Descending order
4. Write a 'C' program & demonstrate an interfacing of Alphanumeric LCD 2X16 panel to LPC2148Microcontroller
5. Write a 'C' program & demonstrate concept of Interrupts interface to LPC2148 Microcontroller.
6. Write a 'C' program & demonstrate an interfacing of DAC to LPC2148 Microcontroller.
7. Write a 'C' program & demonstrate an interfacing of UART to LPC2148 Microcontroller.
8. Write a 'C' program & demonstrate an interfacing of ADC to LPC2148 Microcontroller.
9. Write a 'C' program & demonstrate an interfacing of RTC to LPC2148 and read time, date and year.
10. Write a 'C' program & demonstrate interface I2C to LPC2148
11. Develop a code for college bell system. (Use the following interfaces LCD, RTC and Buzzer).

Reference Books

1. "ARM System- on-Chip Architecture" by 'Steve Furber", LPE, Second Edition.
2. "Embedded Systems- Architecture, Programming and Design" by Raj Kamal, TMH
3. Dr. K.V.K.K. Prasad, "Embedded/Real-time systems: concepts, Design & Programming", published by dreamtech press.

Manual

1. LPC2148 datasheet by NXP.
2. LPC2148 board manual by ALS, Bangalore.

Program: Digital Electronics			**Teaching Hours**
Course Title: Electronic System Design		**Course Code: 17EDEC707**	
L-T-P: 0-0-3	**Credits: 3**	**Contact Hours:6 Hrs/week**	

ISA Marks: 100	**ESA Marks:**	**Total Marks: 100**	
Teaching Hours: 25 Hrs	**Examination Duration: --**		

To level specifications, Block level specifications, Timing of micro architecture, Verification and test plan, Schematic capture	05 Hrs
Simulation, Advanced simulation, Signal Integrity	05 Hrs
PCB layout- Floor planning, component pre planning, PCB printing- 2 layer	05 Hrs
Functionality and performance check, Failure analysis, Validation and system integration	05 Hrs
System Analysis	05 Hrs

References

1. A. S Sedra and KC Smith, Microelectronic circuits, Oxford, 1998.
2. G.L. Ginsberg, Printed Circuit Design, McGraw Hill, 1991.

Program: Digital Electronics		
Course Title: Automotive Electronics		**Course Code:** 17EDEC708
L-T-P: 3-0-1	**Credits: 4**	**Contact Hours: 5**
ISA Marks: 50+100	**ESA Marks: 50**	**Total Marks: 200**
Teaching Hours: 40	**Examination Duration: 3 hrs**	

Chapter No. 1. Automotive Fundamentals Overview Introduction to Automotive Industry and Modern Automotive Systems Vehicle classifications and specifications need for electronics in automobiles, Application areas of electronics in the automobiles Four Stroke Cycle, Engine Control, Ignition System, Spark plug, Spark pulse generation, Ignition Timing, Drive Train, Transmission, Brakes, Steering System.	8Hrs
Chapter No. 2. Sensors and Actuators Oxygen (O2/EGO) Sensors, Throttle Position Sensor (TPS), Engine Crankshaft Angular Position (CKP) Sensor, Magnetic Reluctance Position Sensor, Engine Speed Sensor, Ignition Timing Sensor, Hall effect Position Sensor, Optical Crankshaft Position Sensor, Manifold Absolute Pressure (MAP) Sensor Strain gauge, Engine Coolant Temperature (ECT) Sensor, Knock Sensor, Throttle angle sensor, Fuel Injector Actuator, Ignition Actuator	7Hrs
Chapter No. 3. Electronic Engine Control Engine parameters, variables, Engine Performance terms, Electronic Fuel Control System, Electronic Ignition control, Idle sped control, EGR Control	5Hrs
Chapter No. 4. Vehicle Motion Control and Safety Systems Cruise Control, Antilock Brake System (ABS), Electronic Steering Control, Power Steering, Traction Control, Electronic Stability Program.	6Hrs
Chapter No:5. Automotive communication protocols Overview of Automotive communication protocols : CAN, LIN .	3Hrs
Chapter No. 6. Advanced Driver Assistance Systems (ADAS) Lane Departure Warning, Collision Warning, Automatic Cruise Control, Pedestrian Protection, Headlights Control, Connected Cars technology and trends towards Autonomous vehicles.	5Hrs
Chapter No. 7. Automotive safety standards ISO26262 and Diagnostics	

Functional Safety: Need for safety standard-ISO 26262, safety concept, safety process for product life cycle, safety by design, validation. Fundamentals of Diagnostics: Basic wiring system and Multiplex wiring system, Preliminary checks and adjustments, Self-diagnostic system. Fault finding and corrective measures, OBD & off board diagnostic.	6Hrs

Text books:

1. Denton.T – Automobile Electrical and Electronic Systems, Edward Arnold publication, 1995.

References:

1. William T.M – Automotive Electronic Systems, Heiemann Ltd., London ,1978.
2. Nicholas Navet – Automotive Embedded System Handbook, CRC Press, 2009.
3. BOSCH Automotive Handbook, Wiley Publications, 8th Edition, 2011.
4. Co-Verification of hardware & software for ARM SoC Design – Jason.R.Andrews, Newnes Publications, 2004.
5. Hardware Software co-design of embedded systems, F.Balarin, Kluwer Academic Oublishers, 1987.

Lab:

1. Demonstration of cut section modules: Engine, Transmission , Steering, Braking, Suspension - Automobile dept.
2. Electronic engine control system: Injection and Ignition control system Transmission trainer modules
3. Modeling an engine Vehicle model simulation with Simulink using PI CONTROLLER
4. Basic gate logic simulation and modeling using Simulink and realization on the hardware platform.
5. Seat belt warning system simulation and modeling using Simulink and realization on the hardware platform. Vehicle speed control based on the gear input simulation and modeling using Simulink and realization on the hardware platform.
6. Throttle control modeling and simulation using Simulink and realization on the hardware platform.
7. Accelerator pedal interfacing software modeling and simulation using Simulink and realization on the hardware platform.
8. Develop matlab code for stepper motor control and convert it to Simulink model and port it to embedded hardware

KLE TECH. KLE Technological University Creating Value Leveraging Knowledge	School of Electronics & Communication Engineering **PG – Digital Electronics**

Course Code: **17EDEC710**	Course Title: **Multimedia and Signal Processing**		Teaching Hrs: **40 Hrs**
L-T-P: **3-0-1**	Credits: **4**		Contact Hrs: **5 Hrs/week**
ISA Marks: **50+100**	Exam Duration: **3Hrs**	ESA Marks: **50**	Total Marks: 2**00**

1	**Introduction to Multimedia:** Multimedia and Hyper media, WWW, overview of multimedia software tools.	**02Hrs**
2	**Graphics and Image representation:** Graphics / Image data types, Popular file formats.	**02Hrs**
3	**Fundamental concepts in video:** Types of video signals, analog video, digital video.	**06Hrs**
4	**Basics of digital audio:** Digitization of sound, MIDI, Quantization and transmission of audio.	**05Hrs**
5	**Lossless compression algorithms:** Introduction, run-length coding, variable length coding, dictionary based coding, arithmetic coding, lossless image compression.	**05Hrs**
6	**Lossy compression algorithms:** Introduction, distortion measures, quantization, transform coding, wavelet based coding, wavelet packets, embedded zero tree of wavelet coefficients.	**06Hrs**
7	**Image compression standards:** The JPEG standard, The JPEG2000 standard, The JPEG-LS standard, Bi level image compression standard.	**06Hrs**
8	**Basics video compression techniques:** Overview, video compression based on motion compensation, H.261 .	**08Hrs**

Text books

1. Ze-Nian Li & Mark S Drew**, "**Fundamentals of multimedia**"**, Pearson Education, 2004.

References books

1. Ralf Steinmetz & Kalra Nahrstedt , "Multimedia: Computing, Communication & Applications", Pearson Education, 2004

2. K R Rao, Zoran S Bojkovic, Dragord A Milovanvic, Pearson education, "Multimedia communication systems: Techniques, Standards, & Networks",. Second Indian reprint, 2004.

Course Code: **17EDEE701**	Course Title: **Image and Video Processing**		Teaching Hrs: **40 Hrs**
L-T-P: **2-0-1**	Credits: **3**		Contact Hrs: **4 Hrs/week**
ISA Marks: **50+100**	Exam Duration: **3Hrs**	ESA Marks: **50**	Total Marks: **100**

1	**Introduction**: 2D systems, Mathematical Preliminaries- FT, Z-transform, Optical and Modulation Transfer Functions (OTF and MTF). Matrix theory, Image perception: Light, Luminance, Brightness, Contrast, MTF of the visual system, Visibility function, Monochrome Vision Models, Fidelity criteria, Color Representation, Color Vision Models, Temporal Properties of Vision.	2 hrs
2	**Image sampling and Quantization:** 2D Sampling theory, Quantization, Optimal Quantizer, Compander and Visual Quantization.	2 hrs
3	**Image Transforms:** 2D orthogonal and unitary transforms, DFT, DCT, Harr, KLT	4hrs
4	**Image Enhancement**: Histograms Modeling, Spatial operations, Transform operations, Multispectral Image Enhancement,	4hrs
5	**Image Filtering and Restoration:** Image Observation Models, Inverse and Weiner filtering , Frequency Domain Filters. Smoothing Splines and Interpolation.	4hrs
6	**Basics of Video:** Analog Video, Digital Video	2 hrs
7	**Two dimensional motion estimation:** Optical flow methods**,** Block based methods, Bayesian methods**.**	7 hrs

Text books

1. Jain, A.K., Fundamentals of Digital Image Processing, 3rd Edision, Pearson Education (Asia) 2013
2. A. Murat Tekalp, Digital Video processing Pearson Education (Asia) Pte. Ltd.
3. Li and, Z. Drew, M.S. Fundamentals of Multimedia, Pearson Education (Asia) Pte. Ltd,. 2010.

References books

1. Gonzalez, Rafael C., Woods, Richard E. and Eddins Steven L., Digital Image Processing Using Matlab, Pearson Education (Asia) Pvt. Ltd.,
2. Al. Bovik, Essential guide to Video Processing, Academic Press

Program: III Semester Master of Technology (Digital Electronics)			Teaching Hours
Course Title: Embedded Software Design		Course Code: 17EDEC801	
L-T-P: 0-0-3	Credits: 3	Contact Hours: 6 Hrs/week	
ISA Marks: 80	ESA Marks: 20	Total Marks: 100	
Teaching Hours: 40 Hrs	Examination Duration:		
1. Introduction To Real-Time Operating Systems: Introduction to OS, Introduction to real time embedded system- real time systems, characteristics of real time systems, and the future of embedded systems. Introduction to RTOS, key characteristics of RTOS, its kernel, components in RTOS kernel, objects, scheduler, services, context switch, Scheduling types: Preemptive priority-based scheduling, Round-robin and preemptive scheduling.			**08 Hrs**
2. Tasks, Semaphores and Message Queues:: A task, its structure, A typical finite state machine, Steps showing the how FSM works. A semaphore, its structure, binary semaphore, mutual exclusion (mutex) semaphore, Synchronization between two tasks and multiple tasks, Single shared-resource-access synchronization, Recursive shared-resource-access synchronization. A message queue, its structure, Message copying and memory use for sending and receiving messages, Sending messages in FIFO or LIFO order, broadcasting messages.			**08 Hrs**
3. Typical RTOSs: Study of VX works, RT Linux and Android OS and comparisons. Real time programming using RTX/free RTOS. Applications and Common Design Problems: Embedded RTOS for Image Processing & Control Systems, and common problems encountered in these applications.			**04 Hrs**
4. Introduction to embedded linux: Embedded Linux overview: Development-Kernel architectures and device driver model-Embedded development issues-Tool chains in Embedded Linux-GNU Tool Chain (GCC,GDB, MAKE, GPROF & GCONV)- Linux Boot process			**02 Hrs**
5. Boot sequence-System loading, sys linux, Lilo, grub-Root file system-Binaries required for system operation-Shared and static Libraries overview-Writing applications in user space-GUI environments for embedded Linux system			**02 Hrs**
6. File system in Linux: File system Hierarchy-File system Navigation -Managing the File system –Extended file systems-INODE-Group Descriptor-Directories-Virtual File systems-Performing File system Maintenance - Locating Files –Registering the File systems-Mounting and Un-mounting –Buffer cache-/proc file systems-Device special files			**08 Hrs**
7. Program design and Analysis : Components of Embedded system: State machines; stream oriented programming and circular buffers, queues. Models of programs: data flow graph and control flow graphs, Assembly, linking and loading. Basic compilation techniques: Statement translation, procedures, data structures. Program optimization: Expression simplification, dead code elimination, procedure inlining, loop transformations, register allocation, scheduling, instruction selection, interpreters and JIT compilers. Program level performance analysis, software performance optimization, program level energy and power analysis, analysis and optimization of program size. Program validation and testing: Clear box testing, black box testing, evaluating function tests.			**08 Hrs**

Text Books

1. Qing Li with Caroline Yao, "Real-Time Concepts for Embedded Systems", Published by CMP Books,2011
2. Dr. K.V.K.K. Prasad, "Embedded/Real-time systems: concepts, Design & Programming", published by dreamtech press .
3. "Embedded Systems- Architecture, Programming and Design" by Raj Kamal, TMH

References

1. Philip.A.Laplante, "Real Time System Design and Analysis", Prentice Hall of India, 3rd Edition, April 2004.
2. "Programming embedded systems" in C and C++ Micheal Barr orielly

List of Experiments:

1. Write a 'C' program & demonstrate concept of Task Scheduling.
2. Write a 'C' program & demonstrate concept of Semaphore.
3. Write a 'C' program & demonstrate concept of Mailbox.
4. Write a 'C' program & demonstrate concept of S/W Interrupts.
5. Write a 'C' program & demonstrate concept of interrupts.
6. Write a 'C' program & demonstrate concept of Inter Task Communication.

Reference Books

1. Dr. K.V.K.K. Prasad, "Embedded/Real-time systems: concepts, Design & Programming", published by dreamtech press.

Manual

1. LPC2148 datasheet by NXP.

LPC2148 board manual by ALS, Bangalore.

Program: Digital Electronics		
Course Title: Automotive Communication		Course Code: 17EDEC802
L-T-P: 3-0-0	Credits: 3	Contact Hrs: 3
CIA Marks: 50	SEE Marks: 50	Total Marks: 100
Teaching Hrs: 40	Exam Duration: 3 hrs	

Content	**Hrs**
Chapter No. 1: Controller Area Network Introduction to CAN, Basic Concepts, Message Transfer, Frame Types, Message Validation, Error Handling, Fault Confinement, Bit Timing Requirements, Increasing Can Oscillator Tolerance, Protocol Modifications.	15 hrs
Chapter No. 2: Local Interconnect Network Overview of LIN protocol, LIN Workflow ,LIN Physical Layer ,LIN Communication, Synchronization of the LIN nodes, LIN Message & Scheduling, Message Types, Status & Network Management, Introduction to LIN slave diagnostics , Introduction to LIN slave configuration.	5 hrs
Chapter No. 3: Flexray Communication protocol Introduction to Fleray, Basic Concepts, Message Transfer, Static and dynamic data transmission, Flexray BUS, FlexRay controller states, Frame Types, Message Validation, Error Handling, Fault Confinement, Bit Timing Requirements, Fault tolerant and time triggered services implemented in hardware.	5 hrs

Chapter No. 4: Media oriented system transport protocol Technology background, MOST25, MOST50, MOST150, MOST topology, different masters in MOST network, control channel, synchronous channel, asynchronous channel, MOST application frame work, addressing scheme, frame formats,	5 hrs
Chapter No. Chapter 5: Keyword 2000 protocol Overview of KWP protocol, KWP Workflow , Physical topology ,message structure, frame format,	5 hrs
Chapter No. Chapter 6: SENT, I2C, SPI and UART Overview about SENT , I2C, SPI and UART, frame formats, application of I2C, SPI, SENT and UART in automotive.	5 hrs
Text Books (List of books as mentioned in the approved syllabus) Ronald K. Jurgen, Infotainment systems, 2007, SAE International, 2007	

Program: III Semester Master of Technology (Digital Electronics)			**Teaching Hours**
Course Title: Internet of Things		**Course Code: 17EDEE801**	
L-T-P: 2-0-1	**Credits: 3**	**Contact Hours: 5 Hrs/week**	
ISA Marks: 50+100	**ESA Marks: 50**	**Total Marks: 200**	
Teaching Hours: 25 Hrs	**Examination Duration:**		

1	**Introduction to Internet of Things (IoT)** Definition & Characteristics of IoT, Things in IoT, IoT protocols, IoT functional blocks, communication models and APIs.	**04 hrs**
2	**IoT Architecture** Enabling technologies: Sensors, Zigbee, Bluetooth, IoT ecosystem, Data Link protocols: IEEE 802.15.4e, IEEE 802.11.ah, DASH7, Low Power Wide Area Network (LoRaWAN).	**04 hrs**
3	**Network protocols** Routing Protocol for Low-Power and Lossy Networks (RPL), cognitive RPL (CORPL), Channel-Aware Routing Protocol (CARP), Low power Wireless Personal Area Networks (LoWPAN).	**04 hrs**
4	**Application and Security protocols** Message Queue Telemetry Transport (MQTT), MQTT for Sensor Networks, Secure MQTT, Advanced Message Queuing Protocol (AMQP), Constrained Application Protocol (CoAP), OPC UA, 6LoWPAN), Routing Protocol for Low-Power and Lossy Networks (RPL).	**04 hrs**
5	**IoT Platforms Design Methodology** IoT Design Methodology, Case Study on IoT System for Weather Monitoring etc., Basic building blocks of an IoT device, Raspberry Pi, interface (serial, SPI, I2C), IoT Operating Systems: Contiki, RIOT.	**04 hrs**
6	**Programming with Raspberry Pi** XML, JSON, SOAP and REST-based approach, WebSocket protocol.	**04 hrs**
7	**IoT prototyping** Business models, example applications: Case studies on Home automation, Cities, Environment, Energy, Agriculture, Health with emphasis on data analytics and security.	**06 hrs**
Text Books:		

1. Arshdeep Bahga, Vijay Madisetti “Internet of Things (A Hands-on-Approach)” Universities Press- 2014.
2. Olivier Hersent, David Boswarthick, Omar Elloumi, “The Internet of Things: Key Applications and Protocols” John Wiley & Sons – 2012.

Reference Books:

1. Subhas Chandra Mukhopadhyay “Internet of Things Challenges and Opportunities” Springer- 2014.

Lab:

1. Programming with Raspberry Pi
2. Cloud service interface for data storage and retrieval
3. Performance analysis of Data link protocols, routing and application protocols
4. Open Ended Experiment with focus on data analytics and security

Course Code: 17EDEE802	Course Title: AUTOSAR	
L-T-P : 2-0-1	Credits: 3	Contact Hrs: 3 Hours
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 40		Exam Duration: 3

Content	**Hrs**
Unit - 1	
Chapter No. 1: AUTOSAR Fundamentals Evolution of AUTOSAR – Motivations and Objectives AUTOSAR consortium – Stake holders – work Packages, AUTOSAR Partnership, Goals of the partnership, Organization of the partnership, AUTOSAR specification, AUTOSAR Current development status, BSW Conformance classes: ICC1, ICC2, ICC3, and Drawbacks of AUTOSAR.	8 hrs
Chapter No. 2: AUTOSAR layered Architecture AUTOSAR Basic software, Details on the various layers , Details on the stacks Virtual Function Bus (VFB) Concept Overview of AUTOSAR Methodology , Tools and Technologies for AUTOSAR AUTOSAR Application Software Component (SW-C) ,Types of SW-components AUTOSAR Run Time Environment (RTE): RTE Generation Process: Contract Phase, Generation Phase, MCAL, IO HW Abstraction Layer, Partial Networking, Multicore, J1939 Overview, AUTOSAR Ethernet, AUTOSAR E2E Overview , AUTOSAR XCP, Metamodel , From the model to the process , Software development process.	7 hrs
Unit - 2	
Chapter No. 3: Methodology of AUTOSAR and Communication in AUTOSAR CAN Communication, CAN FD, CAN in Automation, CANape, Application Layer and RTE, intra and inter ECU communication, Client-Server Communication, Sender-Receiver, Communication, CAN Driver, Communication Manager (ComM), Overview of Diagnostics Event and Communication Manager	10 hrs
Chapter No. 4: BSW Development and Integration BSW Constituents: Memory layer, COM and Services layer, ECU abstraction, AUTOSAR, Operating system, Interfaces: Standard interface, AUTOSAR standardized interface, BSW-RTE interface,(AUTOSAR interface), BSW-ECU hardware interface, Complex device drivers and BSW module configuration, AUTOSAR Integration.	5 hrs
Unit - 3	

Chapter No. Chapter 5: Infotainment Systems in Automobiles Infotainment Systems Fundamentals: Radio, Multimedia, and Navigation: Introduction to In Vehicle Infotainment (IVI) systems, Use of operating systems in IVI , GENIVI Alliance, Tuner: AM/FM, XM/Sirrus, DAB/DMB, Software Defined Radio; Concepts of HD, radio, Ensemble, Traffic Announcements, Spread Spectrum, d. Multimedia: Types of Media; Music, Video, Podcasts, etc. Media management; Playback, Track Control, Metadata, Playlists, Categories, Trick play, Audio/Video Source Management, Navigation: Points of Interests, Routes, Waypoints, Dead Reckoning position, Traffic Info, GLONASS, GNSS, RTK, GPS, and SBAS/GBAS,INS f. Media types: CD, DVD, CDDA, USB, SDCARD, Media Formats:MP3, WMV, RealAudio/Video, QTP, Architecture – Design Patterns - Proxies, Adaptors, Interfaces, Singleton, Factory method	5 hrs
Chapter No. Chapter 6: Communication Systems in Automobiles Automotive & Consumer Electronic Communication Systems: Introduction to Bluetooth – Pairing, HFP, A2DP, PAN, PBAP, DUN, Concepts of MOST network, DLNA, AVB, Concepts of TCP/IP, Ethernet, WiFi, WiFi Direct, MyWiFi and CAN, Mirror link, Tethering	5 hrs
Text Book (List of books as mentioned in the approved syllabus) 1. Ribbens, Understanding of Automotive electronics, 6th Edition, Elsevier, 2003 2. Denton.T, Automobile Electrical and Electronic Systems, Elsevier, 3rd Edition, 2004 3. Denton.T, Advanced automotive fault diagnosis, 2000 **References** 1. Ronald K Jurgen, Automotive Electronics Handbook, 2nd Edition, McGraw-Hill, 1999 2. James D Halderman, Automotive electricity and Electronics, PHI Publication, 2000 3. Allan Bonnick, Automotive Computer Controlled Systems Diagnostic Tools and Techniques, Elsevier Science, 2001 4. Nicholas Navet , Automotive Embedded System Handbook , 2009	

Program: Digital Electronics			**Teaching Hours**
Course Title: Advanced Computer Architecture & Programming		**Course Code: 17EDEC801**	
L-T-P: 2-0-1	**Credits: 3**	**Contact Hours: 4 Hrs/week**	
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**	
Teaching Hours: 40 Hrs	**Examination Duration: 3 hrs**		
Chapter 1: Instructions: Representing Instructions in the Computer, ARM Addressing for 32-Bit Immediates and more complex addressing modes, Parallelism and Instructions: Synchronization, Translating and Starting a Program.			**05**
Chapter 2: Arithmetic for Computers Addition and Subtraction, Multiplication, Division, Floating Point, Parallelism and Computer Architecture: Associativity.			**05**
Chapter 3: The Processor: Introduction, Logic Design Conventions, Building a Datapath , A Simple Implementation Scheme, An overview of pipelining, Pipelined datapath and control, Data Hazards: Forwarding versus Stalling, Control hazards, Exceptions , Parallelism and advanced instruction level parallelism, Real Stuff: AMD opteron pipeline, Advance Topic: an introduction to describe and model a pipeline and more pipelining			**10**

illustrations.	
Chapter 4: Large and Fast: Exploiting Memory Hierarchy Introduction, The Basics of Caches , Measuring and Improving Cache Performance, Virtual Memory A Common Framework for Memory Hierarchies, Virtual machines, using a finite state machine to control a simple cache, Parallelism and memory hierarchy: cache coherence ,Advanced material: Implementing cache controllers, Real Stuff: AMD Opteron & Intel Nehalem Memory hierarchies	**10**
Chapter 5: Storage, Networks, and Other Peripherals Introduction , Dependability, Reliability and Availability, Disk Storage, Flash storage, Connecting Processors, Memory, and I/O Devices, Interfacing I/O Devices to the Processor, Memory and Operating System, I/O Performance Measures: Examples from Disk and File Systems, Designing an I/O System, Parallelism and I/O: Redundant arrays of inexpensive disks, Real Stuff: Sun firwe x4150 server, Advanced topics: Networks	**10**
Chapter 6: Multicores, Multiprocessors and Clusters Introduction, Difficulty of creating parallel processing programs, Shared memory multiprocessors Clusters and other message passing multiprocessors,Hardware multithreading,SISD, MIMD, SIMD, SPMD, and vector,Introduction to graphics processing units,Introduction to multiprocessor network topologies, Multiprocessor benchmarks, Roofline : A simple performance model, Real Stuff: Benchmarking four multicores using the roofline model.	**10**

Text Books:

1. Computer Organization and Design, The hardware/Software interface, ARM edition– David A. Patterson, John L.Hennessy. 4th edition,MK publishers,2009

Reference Books:

1. Computer Architecture and Organization- John P. Hayes, 3rd edition, McGraw-Hill, 1998

Program: Digital Electronics		
Course Title: AUTOSAR and Infotainment Systems		Course Code: **17EDEC802**
L-T-P : 2-0-1	Credits: 3	Contact Hrs: 4
CIA Marks: 50	SEE Marks: 50	Total Marks: 100
Teaching Hrs: 24	Exam Duration: 3 hrs	

Chapter No. 1: AUTOSAR Fundamentals Evolution of AUTOSAR – Motivations and Objectives AUTOSAR consortium – Stake holders – work Packages, AUTOSAR Partnership, Goals of the partnership, Organization of the partnership, AUTOSAR specification, AUTOSAR Current development status, BSW Conformance classes: ICC1, ICC2, ICC3, and Drawbacks of AUTOSAR.	4 hrs
Chapter No. 2: AUTOSAR layered Architecture AUTOSAR Basic software, Details on the various layers , Details on the stacks Virtual Function Bus (VFB) Concept Overview of AUTOSAR Methodology , Tools and Technologies for AUTOSAR AUTOSAR Application Software Component (SW-C) ,Types of SW-components AUTOSAR Run Time Environment (RTE): RTE Generation Process: Contract Phase, Generation Phase, MCAL, IO HW Abstraction Layer, Partial Networking, Multicore, J1939 Overview, AUTOSAR Ethernet, AUTOSAR E2E Overview , AUTOSAR XCP, Metamodel , From the model to the process , Software development process.	4 hrs

Unit - 2	
Chapter No. 3: Methodology of AUTOSAR and Communication in AUTOSAR CAN Communication, Application Layer and RTE, intra and inter ECU communication, Client-Server Communication, Sender-Receiver, Communication, CAN Driver, Communication Manager (ComM), Overview of Diagnostics Event and Communication Manager	4 hrs
Chapter No. 4: BSW Development and Integration BSW Constituents: Memory layer, COM and Services layer, ECU abstraction, AUTOSAR, Operating system, Interfaces: Standard interface, AUTOSAR standardized interface, BSW-RTE interface,(AUTOSAR interface), BSW-ECU hardware interface, Complex device drivers and BSW module configuration, AUTOSAR Integration.	4 hrs
Chapter No. Chapter 5: Infotainment Systems in Automobiles Infotainment Systems Fundamentals: Radio, Multimedia, and Navigation: Introduction to In Vehicle Infotainment (IVI) systems, Use of operating systems in IVI , GENIVI Alliance, Tuner: AM/FM, XM/Sirrus, DAB/DMB, Software Defined Radio; Concepts of HD, radio, Ensemble, Traffic Announcements, Spread Spectrum, d. Multimedia: Types of Media; Music, Video, Podcasts, etc. Media management; Playback, Track Control, Metadata, Playlists, Categories, Trick play, Audio/Video Source Management, Navigation: Points of Interests, Routes, Waypoints, Dead Reckoning position, Traffic Info, GLONASS, GNSS, RTK, GPS, and SBAS/GBAS,INS f. Media types: CD, DVD, CDDA, USB, SDCARD, Media Formats:MP3, WMV, RealAudio/Video, QTP, Architecture – Design Patterns - Proxies, Adaptors, Interfaces, Singleton, Factory method	4 hrs
Chapter No. Chapter 6: Communication Systems in Automobiles Automotive & Consumer Electronic Communication Systems: Introduction to Bluetooth – Pairing, HFP, A2DP, PAN, PBAP, DUN, Concepts of MOST network, DLNA, AVB, Concepts of TCP/IP, Ethernet, WiFi, WiFi Direct, MyWiFi and CAN, Mirror link, Tethering	4 hrs
Text Books 1. Ronald K. Jurgen, Infotainment systems, 2007, SAE International, 2007	

Program: Digital Electronics		
Course Title: Principles and Practices of Engineering Education		**Course Code:** 15ECRC701
L-T-P: 2-0-1	**Credits: 3**	**Contact Hours: 3**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 40	**Examination Duration: 3 hrs**	

1. **Fundamental Principles of Teaching and Learning**	**8 Hours**
2. **Learning Styles and Theories**	**8 Hours**
3. **Instructional Design Models and Technology Enhanced Learning**	**8 Hours**
4. **Assessment and Evaluation**	**8 Hours**
5. **Engineering Learning Modules**	**8 Hours**

Program: Digital Electronics		
Course Title: Data Structure using C		**Course Code:** 17EVEC701
L-T-P: 0-0-1	**Credits: Audit**	**Contact Hours: 2**
ISA Marks: 80	**ESA Marks: 20**	**Total Marks: 100**
Teaching Hours: 25	**Examination Duration: -**	

Chapter 01:C language features Pointers revisited, Strings, Structures – Basics, Structures and functions, Arrays of structures, Pointers to structures, Self Referential Structures, Unions and bit fields, Files.	5 Hrs
Chapter 02:Stacks and Queues Definition, Representation and Applications of stack. Definitions, representation and applications of linear, circular, queues, multiple queues, priority queue. Recursion	5 Hrs
Chapter 03:Lists Linked lists, singly, doubly, circular lists, definitions, representations. Implementation of list operations, applications – polynomial addition, addition of long integers. Linked stacks, Linked Queues	5 Hrs
Chapter 04:Trees Binary trees – Definitions, traversals (recursive and iterative versions), Building and searching, Threaded Binary trees, Trees and their applications	5 Hrs
Exchange sorts, Selection and tree sorts, Merge and radix sorts	5 Hrs
Text Book 1. Aaron M. Tenenbaum, et al, Data Structures using C, II Edition, PHI, 2006 2. Horowitz, Sahani, Anderson-Feed, Fundamentals of Data Structures in C, II Edition, University, 2008 **References** 1. E Balaguruswamy, The ANSI C programming Language, II Edition, PHI, 2010 2. Yashavant Kanetkar, Data Structures through C, II Edition, BPB public, 2010 3. Richard F. Gilberg, Behrouz A. Forouzan , Data Structures: A Pseudocode Approach With C, II Edition, Course Tec, 2009	
Lab: **1.** Programs on Pointer concepts. **2.** Programs on string handling functions, structures union And bit-files.	

3. Programming on files **4.** Programming on stacks data structures **5.** Programs on implementation of different queue data structures. **6.** Programs on implementation of different types of Linked lists **7.** Programs on Implementation of trees **8.** Programs to implement different sorting techniques. **9.** Programming on graph **10.** Programming on hashing tables **11.** Design and implement stack queue data structures **12.** Design and implement linked list data structures **13.** project	

Program: I Semester Master of Technology (Digital Electronics)			**Teaching Hours**
Course Title: Principles of Embedded Systems		**Course Code: 17EVEC703**	
L-T-P: 0-0-2	**Credits: 2**	**Contact Hours: 4 Hrs/week**	
ISA Marks: 80	**ESA Marks: 20**	**Total Marks: 100**	
Teaching Hours: 42 Hrs	**Examination Duration:**		
1. Introduction to embedded system: Introduction, Classification of Embedded System, Major Application Areas, Purpose of Embedded System. Characteristics and quality attributes of Embedded Systems, Design Metric and Optimizing the metrics.			**06 Hrs**
2. Typical Embedded Systems: Core of Embedded System-processor fundamentals, up vs uc, risc vs cisc, vonneumann vs Harvard, 8051 controller architecture and programmer model, Memory, Sensor and Actuators, Communication Network, Embedded Firmware			**08 Hrs**
3. Low Level programming Concepts: Addressing Modes, Instruction Set and Assembly Language programming(ALP), Developing, Building, and Debugging ALP's			**08 Hrs**
4. Middle Level Programming Concepts: Cross Compiler, Embedded C language implementation, programming, & debugging, Differences from ANSI-C, Memory Models, Use of directives, Functions, Parameter passing and return types			**02 Hrs**
5. On-Chip Peripherals Study, Programming, and Application: Ports: Input/Output, Timers & Counters, UART, Interrupts			**08 Hrs**
6. External Interfaces Study, Programming and Applications : LEDS, Switches(Momentary type, Toggle type), Seven Segment Display: (Normal mode, BCD mode, Internal Multiplexing & External Multiplexing), LCD (8bit, 4bit, Busy flag, custom character generation), Keypad Matrix, Stepper Motor, DC Motor			**10 Hrs**

Text Books

1. Introduction to Embedded Systems 1E by Shibu K V.
2. Kenneth J. Ayala ; "The 8051 Microcontroller Architecture, Programming & Applications" 2e, Penram International, 1996 / Thomson Learning 2005
3. Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D. McKinlay; "The 8051 Microcontroller and Embedded Systems – using assembly and C "- PHI, 2006 / Pearson, 2006

References

1. Embedded System Design: A Unified Hardware/Software Introduction – Frank Vahid, Tony Givargis, John Wiley & Sons, Inc.2002
2. Predko ; "Programming and Customizing the 8051 Microcontroller" –, TMH
3. Raj Kamal, "Microcontrollers: Architecture, Programming, Interfacing and System Design", Pearson Education, 2005

Program: I Semester Master of Technology (Digital Electronics)			**Teaching Hours**
Course Title: RISC Architectures		**Course Code: 17EVEC705**	
L-T-P: 3-0-1	**Credits: 4**	**Contact Hours: 3 Hrs/week**	
ISA Marks: 50+100	**ESA Marks: 50**	**Total Marks: 200**	
Teaching Hours: 46 Hrs	**Examination Duration:**		
1. The 32 bit RISC Architecture: The Acorn RISC machine, Architectural inheritance, Architecture of ARM7TDMI, ARM programmers model, ARM development tools, 3 stage pipeline ARM organization, ARM instruction execution.			**06 Hrs**
2. 32 bit Instruction set: Data processing instruction, Branch instruction, Load store instruction, Software interrupt instruction, Program status register instruction, Conditional execution, Example programs, 16bit Instruction set- The Thumb programmer model, ARM-Thumb interworking, other branch instructions, Data processing instructions, Single/Multiple register load store instruction, Stack operation, Software interrupt instructions, example programs.			**06 Hrs**
3. Exception Handling: Introduction, Interrupts, error conditions, processor exception sequence, the vector table, Exception handlers, Exception priorities, Procedures for handling exceptions.			**04 Hrs**
4. Memory Hierarchy Design: Cache basics, Miss rate and penalty, Cache Hierarchy, Memory Organizations, Memory Hierarchy.			**06 Hrs**
5. Pipelining: Linear pipeline processor, Nonlinear pipeline processor, Instruction pipeline design, Branch handling techniques, Arithmetic pipeline design, Computer arithmetic principles, Static arithmetic pipeline, Multifunctional arithmetic pipeline.			**08 Hrs**
6. Cortex M4 : Functional description, programmer's model, memory protection unit, nested vectored interrupt controller.			**06 Hrs**
7. Multi-Core Architectures : Introduction to Intel Architecture, How an Intel Architecture System works, Basic Components of the Intel Core 2 Duo Processor: The CPU, Memory Controller, I/O Controller.			**07 Hrs**
8. Current Trends in Intel Architectures and Applications : Seminar on current trends in Intel Architectures			**03 Hrs**

Text Books

1. "ARM System- on-Chip Architecture" by 'Steve Furber', LPE, Second Edition.
2. "ARM Assembly Language fundamentals and Techniques" by William Hohl, CRC press, 2009.
3. D. A. Patterson and J. L. Hennessey "Computer Organization and Design", Morgan , Kaufmann,2002
4. H. Jonathan Chao and Bin Liu, "High performance switches & routers", Wiley Interscience, 2007.
5. Kai Hwang, " Advanced Computer Architecture – TMH – 1993
6. Web resources for Example Architectures of INTEL and Texas Instruments:
   http:/ /download.intel.com/design/intarch/papers/321087.pdf

References

1. Kai Hwang, Faye A. Briggs, Computers Architecture and Parallel Processing – MGH – 1985
2. David E Culler, Jaswinder Pal Singh, Anoop Gupta "Parallel Computer Architecture", Harcourt Asia Pte Ltd 2000
3. Stalling W." Computer Organization and Architecture- Designing for performance" PHI,2005
4. D. Sima,T. Fountain, P.Kasuk," Advanced Computer Architecture-A Design Space Approach" Addisson Wesley,1997.
5. M. J. Flynn,"Computer Architecture, Pipelined And Parallel Processing", Narosa Publications, 1998.

List of Experiments:

1. Write an ALP to verify data transfer w.r.t memory to achieve following
   i. 8 bit data transfer
   ii. 16 bit data transfer
   iii. 32 bit data transfer
2. Write an ALP for Tables and lists to do following:
   i. Add an entry to a list
   ii. Remove an element from the queue
3. Write an ALP to pass parameters to a subroutine.
   i. Ascending order
   ii. Descending order
4. Write a 'C' program & demonstrate an interfacing of Alphanumeric LCD 2X16 panel to LPC2148Microcontroller
5. Write a 'C' program & demonstrate concept of Interrupts interface to LPC2148 Microcontroller.
6. Write a 'C' program & demonstrate an interfacing of DAC to LPC2148 Microcontroller.
7. Write a 'C' program & demonstrate an interfacing of UART to LPC2148 Microcontroller.
8. Write a 'C' program & demonstrate an interfacing of ADC to LPC2148 Microcontroller.
9. Write a 'C' program & demonstrate an interfacing of RTC to LPC2148 and read time, date and year.
10. Write a 'C' program & demonstrate interface I2C to LPC2148
11. Develop a code for college bell system. (Use the following interfaces LCD, RTC and Buzzer).

Reference Books

1. "ARM System- on-Chip Architecture" by 'Steve Furber", LPE, Second Edition.
2. "Embedded Systems- Architecture, Programming and Design" by Raj Kamal, TMH
3. Dr. K.V.K.K. Prasad, "Embedded/Real-time systems: concepts, Design & Programming", published by dreamtech press.

Manual

1. LPC2148 datasheet by NXP.
2. LPC2148 board manual by ALS, Bangalore.

Program: Digital Electronics			**Teaching Hours**
Course Title: Electronic System Design		**Course Code: 17EVEC707**	
L-T-P: 0-0-3	**Credits: 3**	**Contact Hours:6 Hrs/week**	
ISA Marks: 100	**ESA Marks:**	**Total Marks: 100**	
Teaching Hours: 25 Hrs	**Examination Duration: --**		
To level specifications, Block level specifications, Timing of micro architecture, Verification and test plan, Schematic capture			05 Hrs
Simulation, Advanced simulation, Signal Integrity			05 Hrs
PCB layout- Floor planning, component pre planning, PCB printing- 2 layer			05 Hrs
Functionality and performance check, Failure analysis, Validation and system integration			05 Hrs
System Analysis			05 Hrs

References

1. A. S Sedra and KC Smith, Microelectronic circuits, Oxford, 1998.
2. G.L. Ginsberg, Printed Circuit Design, McGraw Hill, 1991.

Program: Digital Electronics			
Course Title: Automotive Electronics		**Course Code:** 17EVEC708	
L-T-P: 3-0-1	**Credits: 4**	**Contact Hours: 5**	
ISA Marks: 50+100	**ESA Marks: 50**	**Total Marks: 200**	
Teaching Hours: 40	**Examination Duration: 3 hrs**		
Chapter No. 1. Automotive Fundamentals Overview Introduction to Automotive Industry and Modern Automotive Systems Vehicle classifications and specifications need for electronics in automobiles, Application areas of electronics in the automobiles Four Stroke Cycle, Engine Control, Ignition System, Spark plug, Spark pulse generation, Ignition Timing, Drive Train, Transmission, Brakes, Steering System.			8Hrs
Chapter No. 2. Sensors and Actuators Oxygen (O2/EGO) Sensors, Throttle Position Sensor (TPS), Engine Crankshaft Angular Position (CKP) Sensor, Magnetic Reluctance Position Sensor, Engine Speed Sensor, Ignition Timing Sensor, Hall effect Position Sensor, Optical Crankshaft Position Sensor, Manifold Absolute Pressure (MAP) Sensor Strain gauge, Engine Coolant Temperature (ECT) Sensor, Knock Sensor, Throttle angle sensor, Fuel Injector Actuator, Ignition Actuator			7Hrs
Chapter No. 3. Electronic Engine Control Engine parameters, variables, Engine Performance terms, Electronic Fuel Control System, Electronic Ignition control, Idle sped control, EGR Control			5Hrs
Chapter No. 4. Vehicle Motion Control and Safety Systems Cruise Control, Antilock Brake System (ABS), Electronic Steering Control, Power Steering, Traction Control, Electronic Stability Program.			6Hrs
Chapter No:5. Automotive communication protocols			3Hrs

Overview of Automotive communication protocols : CAN, LIN .	
Chapter No. 6. Advanced Driver Assistance Systems (ADAS) Lane Departure Warning, Collision Warning, Automatic Cruise Control, Pedestrian Protection, Headlights Control, Connected Cars technology and trends towards Autonomous vehicles.	5Hrs
Chapter No. 7. Automotive safety standards ISO26262 and Diagnostics Functional Safety: Need for safety standard-ISO 26262, safety concept, safety process for product life cycle, safety by design, validation. Fundamentals of Diagnostics: Basic wiring system and Multiplex wiring system, Preliminary checks and adjustments, Self-diagnostic system. Fault finding and corrective measures, OBD & off board diagnostic.	6Hrs

Text books:

1. Denton.T – Automobile Electrical and Electronic Systems, Edward Arnold publication, 1995.

References:

1. William T.M – Automotive Electronic Systems, Heiemann Ltd., London ,1978.
2. Nicholas Navet – Automotive Embedded System Handbook, CRC Press, 2009.
3. BOSCH Automotive Handbook, Wiley Publications, 8th Edition, 2011.
4. Co-Verification of hardware & software for ARM SoC Design – Jason.R.Andrews, Newnes Publications, 2004.
5. Hardware Software co-design of embedded systems, F.Balarin, Kluwer Academic Oublishers, 1987.

Lab:

1. Demonstration of cut section modules: Engine, Transmission , Steering, Braking, Suspension - Automobile dept.
2. Electronic engine control system: Injection and Ignition control system Transmission trainer modules
3. Modeling an engine Vehicle model simulation with Simulink using PI CONTROLLER
4. Basic gate logic simulation and modeling using Simulink and realization on the hardware platform.
5. Seat belt warning system simulation and modeling using Simulink and realization on the hardware platform. Vehicle speed control based on the gear input simulation and modeling using Simulink and realization on the hardware platform.
6. Throttle control modeling and simulation using Simulink and realization on the hardware platform.
7. Accelerator pedal interfacing software modeling and simulation using Simulink and realization on the hardware platform.
8. Develop matlab code for stepper motor control and convert it to Simulink model and port it to embedded hardware

Program: II Semester Master of Technology (VLSI Design & Embedded Systems)			**Teaching Hours**
Course Title: Real Time Embedded System		**Course Code: 17EVEC709**	
L-T-P: 3-0-1	**Credits: 4**	**Contact Hours: 3 Hrs/week**	
ISA Marks: 50+100	**ESA Marks: 50**	**Total Marks: 200**	
Teaching Hours: 45 Hrs	**Examination Duration:**		
UNIT I			

1. Building blocks: Real Time System, Types, Real Time Computing, Design Issue, Sample Systems, Hardware Requirements- Processor in a system, System Memories, System I/O, De-bouncing, Other Hardware Devices (A/D, D/A, USART, Watchdog Timers, Interrupt Controllers). Device Drivers, Interrupt Servicing Mechanism & Interrupt Latency.	**12 Hrs**
2. Advanced Processors: Automotive Grade Processors: AEC-Q100 qualification, Qorivva 32-bit Microcontrollers, MPC577XK for ADAS, AURIX from Infineon, Tricore Architecture, Renasas RL78/D1x (Automotive Only)	**10 Hrs**
UNIT II	
3. Real Time Operating System: Interrupt driven systems, foreground/background systems, full featured rtos, POSIX, buffering data, mailboxes, critical regions, semaphores, event flags & signals, deadlock, process stack management, dynamic allocation.	**04 Hrs**
4. Case Studies: Mucos/ VX Works Functions – System level, task service, time delay, memory allocation, semaphore, mailbox, queue. Example systems: Coding for Automatic chocolate vending machine using MUCOS & Coding for sending application layer byte streams on a TCP/IP Network using Vx Works.	**06 Hrs**
UNIT III	
5. Process of Embedded System Development: Development process, requirements engineering, design, implementation, integration & testing, packaging, configuration management, managing embedded system development, embedded system fiascos.	**08 Hrs**
6. Current trends, ethical & environmental issues The students shall give seminars on current trends in the field of RTES, ethical, & environmental issues.	**05 Hrs**

Text Books

1. Philip. A. Laplante, “Real-Time Systems Design and Analysis- an Engineer’s Handbook”- Second Edition, PHI Publications.
2. Rajkamal, “Embedded Systems: Architecture, Programming and Design”, Tata McGraw Hill, New Delhi, 2003.
3. Dr. K.V.K K Prasad, “Embedded Real Time Systems: Concepts Design and Programming”, Dreamtech Press New Delhi, 2003.

References

1. Joseph Yiu, “The Definitive guide to ARM CORTEX –M3 & CORTEX-M4 Processors”, Elsevier, Newnes, 2014.
2. Steve Furber “ARM System –on – Chip Architecture” Second Edition, Pearson Education
3. David E. Simon, “An Embedded software primer”, Pearson Education, 1999..
4. David A. Evesham, “Developing real time systems – A practical introduction”, Galgotia Publications, 1990
5. William Hohl, “ARM Assembly Language Fundamentals & Techniques”, CRC Press
6. C. M. Krishna, “Real Time Systems” MGH, 1997
7. Jane W.S. Liu, “Real-Time Systems”, Pearson Education Inc., 2000

Course Code: 17EVEC710	Course Title: **Advanced Digital Logic Design**
L-T-P: 1-0-3	Credits: 4
ISA Marks: 50+100	ESA Marks: 50
Teaching Hrs: 40	

Chapter No. 1. Digital Integrated Circuits Moore's law, Technology Scaling, Die size growth, Frequency, Power dissipation, Challenges in digital design, Design metrics, Cost of Integrated circuits, ASIC , Evolution of SoC ASIC Flow Vs SoC Flow, SoC Design Challenges. Introduction to CMOS Technology, PMOS & NMOS Operation, CMOS Operation principles, Characteristic curves of CMOS, CMOS Inverter and characteristic curves, Delays in inverters, Buffer Design, Power dissipation in CMOS, CMOS Logic, Stick diagrams and Layout diagrams. Setup time, Hold Time, Timing Concepts.	10 hrs
Chapter No. 2. Digital Building Blocks Basic Gates, Universal Gates, nand & nor Implementations. Decoder, encoder, code converters, Priority encoder, multiplexer, demultiplexer, Comparators, Parity check schemes, Multiplexer, De-multiplexer, Pass Transistor Logic, application of multiplexer as a multi-purpose logical element. Asynchronous and synchronous up-down counters, Shift registers. FSM Design, Mealy and Moore Modelling, Adder & Multiplier concepts, Memory Concept	10 hrs
Chapter No. 3. Logic Design Using Verilog Evolution & importance of HDL, Introduction to Verilog, Levels of Abstraction, Typical Design Flow, Lexical Conventions, Data Types Modules, Nets, Values, Data Types, Comments, arrays in Verilog, Expressions, Operators, Operands, Arrays, memories, Strings , Delays , parameterized designs Procedural blocks, Blocking and Non-Blocking Assignment, looping, flow Control, Task, Function, Synchronization, Event Simulation. Need for Verification, Basic test bench generation and Simulation	12 hrs
Chapter No. 4. Principles of RTL Design Verilog Coding Concepts, Verilog coding guide lines: Combinational, Sequential, FSM. General Guidelines, Synthesizable Verilog Constructs, Sensitivity List, Verilog Events, RTL Design Challenges, Clock Domain Crossing. Verilog modelling of combinational logic and sequential logic	8 hrs
Chapter No. 5. Design and simulation of Architectural building blocks Basic Building blocks design using Verilog HDL: Arithmetic Components – Adder, Subtractor, and Multiplier design, Data Integrity – Parity Generation circuits, Control logic – Arbitration, FSM Design – overlapping and non-overlapping Mealy and Moore state machine design	10 hrs

Reference Books:

1. Digital Design by Morris Mano M, 4th Edition
2. Verilog HDL: A Guide to Digital Design and Synthesis by Samir Palnitkar, 2nd Edition
3. Principles of VLSI RTL Design: A Practical Guide by Sapan Garg, 2011 Tools: 1. NC Verilog, NC Sim, CVER + GTKWave, VCSMX, Modelsim for Verilog 2. Microwind for layout.

Course Code: 17EVEC711	Course Title: Testing & IC Characterization	
L-T-P: 3-0-1	**Credits: 4**	**Contact Hrs: 5 hrs/week**
ISA Marks: 50+100	**ESA Marks: 50**	**Total Marks: 200**
Teaching Hrs: 40		**Exam Duration: 03 hrs**

Content	Hrs
CHAPTER NO. 1. VERIFICATION CONCEPTS Concepts of verification, importance of verification, Stimulus vs Verification, functional verification, test bench generation, functional verification approaches, typical verification flow, stimulus generation, direct testing, Coverage: Code and Functional coverage, coverage plan.	10 hrs
CHAPTER NO. 2. SYSTEM VERILOG – LANGUAGE CONSTRUCTS System Verilog constructs - Data types: two-state data, strings, arrays: queues, dynamic and associative arrays, Structs, enumerated types. Program blocks, module, interfaces, clocking blocks, modports.	10 hrs
CHAPTER NO. 3. SYSTEM VERILOG – CLASSES & RANDOMIZATION SV Classes: Language evolution, Classes and objects, Class Variables and Methods, Class instantiation, Inheritance, and encapsulation, Polymorphism. Randomization: Directed Vs Random Testing. Randomization: Constraint Driven Randomization.	12 hrs
CHAPTER NO. 4. SYSTEM VERILOG – ASSERTIONS & COVERAGE Assertions: Introduction to Assertion based verification, Immediate and concurrent assertions. Coverage driven verification : Motivation, Types of coverage, Cover Group, Cover Point, Cross Coverage, Concepts of Binning and event sampling.	8 hrs
CHAPTER NO. 5. BUILDING TESTBENCH LAYERED TESTBENCH ARCHITECTURE. INTRODUCTION TO UNIVERSAL VERIFICATION METHODOLOGY, OVERVIEW OF UVM BASE CLASSES AND SIMULATION PHASES IN UVM AND UVM MACROS. UNIFIED MESSAGING IN UVM, UVM ENVIRONMENT STRUCTURE, CONNECTING DUT- VIRTUAL INTERFACE	10 hrs

REFERENCES:

1. SYSTEM VERILOG LRM
2. CHRIS SPEAR, GREGORY J TUMBUSH - SYSTEMVERILOG FOR VERIFICATION - A GUIDE TO LEARNING THE TESTBENCH LANGUAGE FEATURES - SPRINGER, 2012
3. STEP-BY-STEP FUNCTIONAL VERIFICATION WITH SYSTEMVERILOG AND OVM BY SASAN IMAN SIMANTIS INC. SANTA CLARA, CA SPRING 2008 TOOLS: 1. NC VERILOG, NC SIM, VCSMX FOR SYSTEM.

Course Code: 17EVEE703	Course Title: **Standard Cell Design and Layout**	
L-T-P: 2-0-1	Credits: 3	Contact Hrs:
ISA Marks: 50+100	ESA Marks: 50	Total Marks: 200
Teaching Hrs: 50		Exam Duration: 3 hrs

Chapter No. 1. Introduction IC design flows. Use of standard cell elements vs. custom design and Gate array paradigms. Introduction to memory types and construction of memory elements.	15 hrs
Chapter No. 2. Standard cell library composition and usage Types of standard cell elements. Logical and functional elements, primitives and complex macros. Sequential elements and register files. (Flip flop and latch design). Data path elements. Library size vs. usage in standard flows. Drive strength and cell families. Layout of library elements – single height, double height cells. Power Management cells.	17hrs
Chapter No. 3. Standard cell characterization Usage of standard cells by various tools. Information needed at each stage of design flow. Characterization parameters, setup and runs across PVT corners. Library representation formats. (Gate level simulation, synthesis, timing, layout, timing, LVS, DRC)	18 hrs
References: Standard cell and memory library documentation by Vendors 90nm EDK library	

Program: VLSI Design & Embedded Systems		
Course Title: Low Power VLSI Circuits		**Course Code:** 17EVEE704
L-T-P: 2-0-1	**Credits: 4**	**Contact Hours:4**
ISA Marks: 50+100	**ESA Marks: 50**	**Total Marks: 200**
Teaching Hours: 40	**Examination Duration: 3 hours**	

1: Introduction to low power VLSI design: Need for Low Power VLSI Chips, sources of power dissipation. Device and Technology impact on Low Power, dynamic power dissipation in CMOS. Power Estimation.	6Hrs
2: Power analysis: Simulation Power Analysis, Spice circuits simulator, gate level logic simulator, Probabilistic power analysis	5Hrs
3: A new CMOS driver model for transient analysis and power dissipation analysis, low power design of off-chip drivers and transmission lines: a branch and bound approach.	5Hrs
4: Different levels of power optimization Low Power Design; circuit Level, logic Level, Low Power Architecture.	7Hrs
5: Floor plan design with low power considerations, optimal drivers of high-speed low power ics, retiming sequential circuits for low power	5Hrs
6: Clock Distribution: Low Power Clock distribution, single driver versus distributed buffers. Power management: Power & performance management,switching activity reduction, parallel architecture.	4Hrs
7:Algorithmic level methodologies for power reduction: Algorithm and architectural level methodologies- algorithmic level analysis & optimization, architecture level estimation and synthesis, Current trends	8Hrs
Text Books	

1. Gary K. Yeap, "Practical Low Power Digital VLSI Design", KAP, 2002.
2. Rabaey, Pedram, "Low power design methodologies" Kluwer Academic, 1997.

Reference Books:

1. A. Chandrakasan and R. Brodersen, "Low Power CMOS Design".
2. Sung - Mo Kang & Yosuf Leblebici, "CMOS Digital Integrated Circuits: Analysis and Design", TMH, 2003 (Third Edition).
3. Laung-Terng Wang, Charles E. Stroud, Nur A. Touba, "System-on-chip Test Architectures", 2008.
4. Kaushik Roy, Sharat Prasad, "Low-Power CMOS VLSI Circuit Design" Wiley, 2000.

Program: VLSI Design & Embedded Systems		
Course Title: Analog and Mixed mode VLSI Circuits		**Course Code: 17EVEE705**
L-T-P: 2-0-1	**Credits: 3**	**Contact Hours: 6**
ISA Marks: 50	**ESA Marks: 50**	
Teaching Hours: 50	**Examination Duration: 3 hours**	**Total Marks: 100**

1.	Introduction to CMOS analog circuits, MOS transistor DC and AC small signal parameters from large signal model, Common source amplifier with resistive load, diode load and current source load, Source follower, Common gate amplifier, Cascode amplifier, Frequency response of amplifiers.	12 hrs
2.	Current source/sink/mirror, Matching, Wilson current source, Widlar current source and Regulated Cascode current source, Differential amplifier.	08 hrs
3.	Op-Amp: CMOS Op-Amp, Compensation of Op-Amp,Design of two stage Op-Amp.	06 hrs
4.	Basic Current reference, and Voltage (Bandgap) reference circuits, OPAMP based references, Current mode bandgap reference.	06 hrs
5.	Bidirectional analog switch, Sample and Hold circuit, Basic Comparator architecture, non-idealities (offset error, bandwidth consideration), Dynamic comparator, Sense amplifier, Current Mode Logic(Buffer and Latch)	08 hrs
6.	Data Converter Fundamentals, DAC architectures and ADC architectures	10 hrs

Text Books

1. Phillip. E. Allen, Douglas R. Holberg, "CMOS Analog circuit Design" Oxford University Press, 2002.
2. Baker, Li, Boyce, "CMOS: Circuit Design, Layout and Simulation", Prentice Hall of India, 2000

Reference Books

1. N. Weste and K. Eshranghian, Principles of CMOS VLSI Design, Addison Wesley. 1985.
2. J. Rabaey, Digital Integrated Circuits: A Design Perspective, Prentice Hall India, 1997
3. B Razavi 'Design of Analog CMOS Integrated Circuits' First Edition McGraw Hill 2001

Lab:

1. Design and implement Common source MOS amplifier with resistive load, diode load and current source load.
2. Design and implement a Cascode amplifier.
3. Design and implement a Simple current mirror
4. Design and implement a Differential amplifier
5. Design and implement a Operational amplifier
6. Design and implement a basic comparator
7. Design and implement a R-2R DAC

Program: III Semester Master of Technology (VLSI Design & Embedded Systems)			Teaching Hours
Course Title: Embedded Software Design		Course Code: 17EVEC801	
L-T-P: 0-0-3	Credits: 3	Contact Hours: 6 Hrs/week	
ISA Marks: 80	ESA Marks: 20	Total Marks: 100	
Teaching Hours: 40 Hrs	Examination Duration:		
1. Introduction To Real-Time Operating Systems: Introduction to OS, Introduction to real time embedded system- real time systems, characteristics of real time systems, and the future of embedded systems. Introduction to RTOS, key characteristics of RTOS, its kernel, components in RTOS kernel, objects, scheduler, services, context switch, Scheduling types: Preemptive priority-based scheduling, Round-robin and preemptive scheduling.			**08 Hrs**
2. Tasks, Semaphores and Message Queues:: A task, its structure, A typical finite state machine, Steps showing the how FSM works. A semaphore, its structure, binary semaphore, mutual exclusion (mutex) semaphore, Synchronization between two tasks and multiple tasks, Single shared-resource-access synchronization, Recursive shared-resource-access synchronization. A message queue, its structure, Message copying and memory use for sending and receiving messages, Sending messages in FIFO or LIFO order, broadcasting messages.			**08 Hrs**
3. Typical RTOSs: Study of VX works, RT Linux and Android OS and comparisons. Real time programming using RTX/free RTOS. Applications and Common Design Problems: Embedded RTOS for Image Processing & Control Systems, and common problems encountered in these applications.			**04 Hrs**
4. Introduction to embedded linux: Embedded Linux overview: Development-Kernel architectures and device driver model-Embedded development issues-Tool chains in Embedded Linux-GNU Tool Chain (GCC,GDB, MAKE, GPROF & GCONV)- Linux Boot process			**02 Hrs**
5. Boot sequence-System loading, sys linux, Lilo, grub-Root file system-Binaries required for system operation-Shared and static Libraries overview-Writing applications in user space-GUI environments for embedded Linux system			**02 Hrs**
6. File system in Linux: File system Hierarchy-File system Navigation -Managing the File system –Extended file systems-INODE-Group Descriptor-Directories-Virtual File systems-Performing File system Maintenance -Locating Files –Registering the File systems-Mounting and Un-mounting –Buffer cache-/proc file systems-Device special files			**08 Hrs**
7. Program design and Analysis : Components of Embedded system: State machines; stream oriented programming and circular buffers, queues. Models of programs: data flow graph and control flow graphs, Assembly, linking and loading. Basic compilation techniques: Statement translation, procedures, data structures. Program optimization: Expression simplification, dead code elimination, procedure inlining, loop transformations, register allocation, scheduling, instruction selection, interpreters and JIT compilers. Program level performance analysis, software performance optimization, program level energy and power analysis, analysis and optimization of program size. Program validation and testing: Clear box testing, black box testing, evaluating function tests.			**08 Hrs**

Text Books

1. Qing Li with Caroline Yao, "Real-Time Concepts for Embedded Systems", Published by CMP Books,2011
2. Dr. K.V.K.K. Prasad, "Embedded/Real-time systems: concepts, Design & Programming", published by dreamtech press .
3. "Embedded Systems- Architecture, Programming and Design" by Raj Kamal, TMH

References

1. Philip.A.Laplante, "Real Time System Design and Analysis", Prentice Hall of India, 3rd Edition, April 2004.
2. "Programming embedded systems" in C and C++ Micheal Barr orielly

List of Experiments:

1. Write a 'C' program & demonstrate concept of Task Scheduling.
2. Write a 'C' program & demonstrate concept of Semaphore.
3. Write a 'C' program & demonstrate concept of Mailbox.
4. Write a 'C' program & demonstrate concept of S/W Interrupts.
5. Write a 'C' program & demonstrate concept of interrupts.
6. Write a 'C' program & demonstrate concept of Inter Task Communication.

Reference Books

1. Dr. K.V.K.K. Prasad, "Embedded/Real-time systems: concepts, Design & Programming", published by dreamtech press.

Manual

1. LPC2148 datasheet by NXP.

LPC2148 board manual by ALS, Bangalore.

Course Code: 17EVEC802	Course Title: **Advanced Digital logic Verification**	
L-T-P: 1-0-3	Credits: 4	Contact Hrs: 6hrs/week
ISA Marks: 50+100	ESA Marks: 50	Total Marks: 200
Teaching Hrs: 50		Exam Duration: 3 hrs

Chapter No. 1. Verification Concepts Concepts of verification, importance of verification, Stimulus vs Verification, functional verification, test bench generation, functional verification approaches, typical verification flow, stimulus generation, direct testing, Coverage: Code and Functional coverage, coverage plan.	10 hrs
Chapter No. 2. System Verilog – Language Constructs System Verilog constructs - Data types: two-state data, strings, arrays: queues, dynamic and associative arrays, Structs, enumerated types. Program blocks, module, interfaces, clocking blocks, modports.	10 hrs
Chapter No. 3. System Verilog – Classes & Randomization SV Classes: Language evolution, Classes and objects, Class Variables and Methods, Class instantiation, Inheritance, and encapsulation, Polymorphism. Randomization: Directed Vs Random Testing. Randomization: Constraint Driven Randomization.	12 hrs
Chapter No. 4. System Verilog – Assertions & Coverage Assertions: Introduction to Assertion based verification, Immediate and concurrent assertions. Coverage driven verification : Motivation, Types of coverage, Cover Group, Cover Point, Cross Coverage, Concepts of Binning and event sampling.	8 hrs
Chapter No. 5. Building Testbench Layered testbench architecture. Introduction to Universal Verification Methodology, Overview of UVM	10 hrs

Base Classes and simulation phases in UVM and UVM macros. Unified messaging in UVM, UVM environment structure, Connecting DUT- Virtual Interface	
References: 1. System Verilog LRM 2. Chris Spear, Gregory J Tumbush - SystemVerilog for verification - a guide to learning the testbench language features - Springer, 2012 **3.** Step-by-Step Functional Verification with SystemVerilog and OVM by Sasan Iman SiMantis Inc. Santa Clara, CA Spring 2008 Tools: 1. NC Verilog, NC Sim, VCSMX for System.	

Program: III Semester Master of Technology (VLSI Design & Embedded Systems)			**Teaching Hours**
Course Title: Internet of Things		**Course Code: 17EVEE801**	
L-T-P: 2-0-1	**Credits: 3**	**Contact Hours: 5 Hrs/week**	
ISA Marks: 50+100	**ESA Marks: 50**	**Total Marks: 200**	
Teaching Hours: 25 Hrs	**Examination Duration:**		

1	**Introduction to Internet of Things (IoT)** Definition & Characteristics of IoT, Things in IoT, IoT protocols, IoT functional blocks, communication models and APIs.	**04 hrs**
2	**IoT Architecture** Enabling technologies: Sensors, Zigbee, Bluetooth, IoT ecosystem, Data Link protocols: IEEE 802.15.4e, IEEE 802.11.ah, DASH7, Low Power Wide Area Network (LoRaWAN).	**04 hrs**
3	**Network protocols** Routing Protocol for Low-Power and Lossy Networks (RPL), cognitive RPL (CORPL), Channel-Aware Routing Protocol (CARP), Low power Wireless Personal Area Networks (LoWPAN).	**04 hrs**
4	**Application and Security protocols** Message Queue Telemetry Transport (MQTT), MQTT for Sensor Networks, Secure MQTT, Advanced Message Queuing Protocol (AMQP), Constrained Application Protocol (CoAP), OPC UA, 6LoWPAN), Routing Protocol for Low-Power and Lossy Networks (RPL).	**04 hrs**
5	**IoT Platforms Design Methodology** IoT Design Methodology, Case Study on IoT System for Weather Monitoring etc., Basic building blocks of an IoT device, Raspberry Pi, interface (serial, SPI, I2C), IoT Operating Systems: Contiki, RIOT.	**04 hrs**
6	**Programming with Raspberry Pi** XML, JSON, SOAP and REST-based approach, WebSocket protocol.	**04 hrs**
7	**IoT prototyping** Business models, example applications: Case studies on Home automation, Cities, Environment, Energy, Agriculture, Health with emphasis on data analytics and security.	**06 hrs**
Text Books: 1. Arshdeep Bahga, Vijay Madisetti “Internet of Things (A Hands-on-Approach)” Universities Press- 2014. 2. Olivier Hersent, David Boswarthick, Omar Elloumi, “The Internet of Things: Key Applications and Protocols”		

John Wiley & Sons – 2012.

Reference Books:

1. Subhas Chandra Mukhopadhyay "Internet of Things Challenges and Opportunities" Springer- 2014.

Lab:

1. Programming with Raspberry Pi
2. Cloud service interface for data storage and retrieval
3. Performance analysis of Data link protocols, routing and application protocols
4. Open Ended Experiment with focus on data analytics and security

Course Code: 17EVEE802	Course Title: AUTOSAR	
L-T-P : 2-0-1	Credits: 3	Contact Hrs: 3 Hours
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 40		Exam Duration: 3

Content	Hrs
Unit - 1	
Chapter No. 1: AUTOSAR Fundamentals Evolution of AUTOSAR – Motivations and Objectives AUTOSAR consortium – Stake holders – work Packages, AUTOSAR Partnership, Goals of the partnership, Organization of the partnership, AUTOSAR specification, AUTOSAR Current development status, BSW Conformance classes: ICC1, ICC2, ICC3, and Drawbacks of AUTOSAR.	8 hrs
Chapter No. 2: AUTOSAR layered Architecture AUTOSAR Basic software, Details on the various layers , Details on the stacks Virtual Function Bus (VFB) Concept Overview of AUTOSAR Methodology , Tools and Technologies for AUTOSAR AUTOSAR Application Software Component (SW-C) ,Types of SW-components AUTOSAR Run Time Environment (RTE): RTE Generation Process: Contract Phase, Generation Phase, MCAL, IO HW Abstraction Layer, Partial Networking, Multicore, J1939 Overview, AUTOSAR Ethernet, AUTOSAR E2E Overview , AUTOSAR XCP, Metamodel , From the model to the process , Software development process.	7 hrs
Unit - 2	
Chapter No. 3: Methodology of AUTOSAR and Communication in AUTOSAR CAN Communication, CAN FD, CAN in Automation, CANape, Application Layer and RTE, intra and inter ECU communication, Client-Server Communication, Sender-Receiver, Communication, CAN Driver, Communication Manager (ComM), Overview of Diagnostics Event and Communication Manager	10 hrs
Chapter No. 4: BSW Development and Integration BSW Constituents: Memory layer, COM and Services layer, ECU abstraction, AUTOSAR, Operating system, Interfaces: Standard interface, AUTOSAR standardized interface, BSW-RTE interface,(AUTOSAR interface), BSW-ECU hardware interface, Complex device drivers and BSW module configuration, AUTOSAR Integration.	5 hrs
Unit - 3	
Chapter No. Chapter 5: Infotainment Systems in Automobiles Infotainment Systems Fundamentals: Radio, Multimedia, and Navigation: Introduction to In Vehicle Infotainment (IVI) systems, Use of operating systems in IVI , GENIVI Alliance, Tuner: AM/FM, XM/Sirrus, DAB/DMB, Software Defined Radio; Concepts of HD, radio, Ensemble, Traffic Announcements, Spread Spectrum, d. Multimedia: Types of Media; Music, Video, Podcasts, etc.	5 hrs

Media management; Playback, Track Control, Metadata, Playlists, Categories, Trick play, Audio/Video Source Management, Navigation: Points of Interests, Routes, Waypoints, Dead Reckoning position, Traffic Info, GLONASS, GNSS, RTK, GPS, and SBAS/GBAS,INS f. Media types: CD, DVD, CDDA, USB, SDCARD, Media Formats:MP3, WMV, RealAudio/Video, QTP, Architecture – Design Patterns - Proxies, Adaptors, Interfaces, Singleton, Factory method	
Chapter No. Chapter 6: Communication Systems in Automobiles Automotive & Consumer Electronic Communication Systems: Introduction to Bluetooth – Pairing, HFP, A2DP, PAN, PBAP, DUN, Concepts of MOST network, DLNA, AVB, Concepts of TCP/IP, Ethernet, WiFi, WiFi Direct, MyWiFi and CAN, Mirror link, Tethering	5 hrs
Text Book (List of books as mentioned in the approved syllabus) 1. Ribbens, Understanding of Automotive electronics, 6th Edition, Elsevier, 2003 2. Denton.T, Automobile Electrical and Electronic Systems, Elsevier, 3rd Edition, 2004 3. Denton.T, Advanced automotive fault diagnosis, 2000 **References** 1. Ronald K Jurgen, Automotive Electronics Handbook, 2nd Edition, McGraw-Hill, 1999 2. James D Halderman, Automotive electricity and Electronics, PHI Publication, 2000 3. Allan Bonnick, Automotive Computer Controlled Systems Diagnostic Tools and Techniques, Elsevier Science, 2001 4. Nicholas Navet , Automotive Embedded System Handbook , 2009	

Course Code: 17EVEE803	Course Title: ASIC Design	
L-T-P: 2-0-1	Credits: 4	Contact Hrs: 50
ISA Marks: 50+100	ESA Marks: 50	Total Marks: 200
Teaching Hrs: 50		Exam Duration: 3 hrs

Content	Hrs
Chapter No. 1. Introduction to ASIC ASIC types, design flow, economics of ASIC	8 hrs
Chapter No. 2. ASIC design library and Logic cell Transistor as register, transistor parasitic capacitance, Logic Effort, Data Path Elements, Adders, Multiplier, Sequential logic cells, I/O cell.	10 hrs
Chapter No. 3. Logic Synthesis and Simulation Logic synthesis, FSM synthesis, structural simulation, static timing analysis, delay models	10 hrs
Chapter No. 4. ASIC Construction Floor planning and placement and routing Physical Design, System Partitioning, Estimating ASIC size, partitioning methods.	10 hrs
Chapter No. 5. Floor planning and placement and routing Floor planning tools, I/O and power planning, clock planning, placement algorithms, iterative placement improvement, Time driven placement methods. Physical Design flow global Routing, Local Routing, Detail Routing, Special Routing, Circuit Extraction and DRC.	12 hrs
Text Books: 1. M.J.S .Smith, - “Application - Specific Integrated Circuits” – Pearson Education, 2003. 2. Randall L Geiger, Phillip E. Allen, “Noel K.Strader, VLSI Design Techniques for Analog and Digital Circuits”, McGraw Hill International Company, 1990.	

References:

1. Jose E.France, Yannis Tsividis, “Design of Analog-Digital VLSI Circuits for Telecommunication and signal processing”, Prentice Hall, 1994.
2. Andrew Brown, - “VLSI Circuits and Systems in Silicon”, McGraw Hill, 1991.
3. S.D. Brown, R.J. Francis, J. Rox, Z.G. Uranesic, “Field Programmable Gate Arrays”- Kluwer Academic Publishers, 1992.
4. Mohammed Ismail and Terri Fiez, “Analog VLSI Signal and Information Processing “, McGraw Hill, 1994.
5. S. Y. Kung, H. J. Whilo House, T. Kailath, “VLSI and Modern Signal Processing”, Prentice Hall, 1985.

Program: Digital Electronics			**Teaching Hours**
Course Title: Machine learning		**Course Code: 17EVEC705**	
L-T-P: 3-0-1	**Credits: 4**	**Contact Hours: 5 Hrs/week**	
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**	
Teaching Hours: 40 Hrs	**Examination Duration: 3 hrs**		
Chapter No. 1: Introduction Introduction What is Machine Learning? Applications of Machine Learning, Types of Machine Learning: Supervised, Unsupervised and Reinforcement learning, Dataset formats, Basic terminologies.			**05 Hrs**
Chapter No. 2: Supervised Learning Linear Regression, Logistic Regression Linear Regression: Single and Multiple variables, Sum of squares error function, The Gradient descent algorithm, Application, Logistic Regression, The cost function, Classification using logistic regression, one-vs-all classification using logistic regression, Regularization.			**10 Hrs**
Chapter No. 3: Supervised Learning: Neural Network Introduction to perception learning, Implementing simple gates XOR, AND, OR using neural network. Model representation, Gradient checking, Back propagation algorithm, Multi-class classification, Application- classifying digits, SVM.			**10 Hrs**
Chapter No. 4: Unsupervised Learning: Clustering Introduction, K means Clustering, Algorithm, Cost function, Application.			**05Hrs**
Chapter No. 5: Unsupervised Learning: Dimensionality reduction Dimensionality reduction, PCA- Principal Component Analysis. Applications, Clustering data and PCA.			**05Hrs**
Chapter No. 6: Machine Learning System Design Evaluating a hypothesis, Model selection, Bias and variance, error analysis, error metrics for skewed classes. Building a Model.			**05 Hrs**

Text Book (List of books as mentioned in the approved syllabus)

1. Tom Mitchell, Machine Learning, 1, McGraw-Hill. , 1997
2. Christopher Bishop, Pattern Recognition and Machine Learning, 1, Springer, 2007

References

1. Video lectures by : Andrew Ng, Co-founder, Coursera; Adjunct Professor, Stanford University; formerly head of Baidu AI Group/Google Brain https://www.coursera.org/learn/machine-learning#
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning : Data Mining, Inference and Prediction, 2, Springer, 2009

Implementation Assignments:

1. Assignments are designed to explore the concepts like
   - Supervise and unsupervised learning,
   - Clustering,
   - Regression and estimation
2. Motivate students to take up open challenges like Kaggle, walmart, ect
3. To explore different Machine Learning Tools/ Libraries.

Program: Digital Electronics		
Course Title: Advanced Computer Architecture		**Course Code:** 17EVEC801
L-T-P-SS: 4-0-0	**Credits: 4**	**Contact Hours: 4**
CIE Marks: 50	**SEE Marks: 50**	**Self Study : --**
Teaching Hours: 50	**Examination Duration: 3 hours**	**Total Marks: 100**

1. Parallel Computers Models: Introduction. State of Computing and classification of parallel Computers, Multiprocessors and multi computers. Multivector and SIMD Computers.	7 hrs
2. Program properties*:* Conditions of Parallelism Data & resource Dependences, H/W & S/W parallelism, Program partitioning, Scheduling Grain size & latency, program flow Mechanisms.	6 hrs
3. System Interconnect Architecture: Network Properties and routing, Static & dynamic interconnection networks, Multiprocessor system interconnects, Hierarchical bus systems, Crossbar switch, Multipart memory, Multistage & combining network.	5 hrs
4. Advanced processors : Advanced processor technology, instruction-set architectures, CISC scalar processors, RISC scalar processors, Superscalar processors, VLIW architectures, VLIW architectures.	6 hrs
5. Pipelining: Linear pipeline processor, Nonlinear pipeline processor, Instruction pipeline design, Branch handling techniques, Arithmetic pipeline design, Computer arithmetic principles, Static arithmetic pipeline, Multifunctional arithmetic pipeline	8 hrs
6. Memory Hierarchy Design: Cache basics, Miss rate and penalty, Cache Hierarchy, Memory Organizations, Memory Hierarchy	6 hrs
7. Multiprocessor Architecture and Programming: Symmetric shared memory architectures, Distributed shared memory architectures, Models of memory consistency, Cache coherence protocols (MSI, MESI and MOESI), Scalable cache coherence	6 hrs
8. Scalable & multithreaded architecture : Latency Hiding Techniques, Principles of multithreading, Scalable multithreadeded architectures	2 hrs
9. Introduction to Intel architectures Intel core Duo processor, CPU, Memory controller, I/O Controller	4 hrs

Text Books

1. Kai Hwang, Faye A. Briggs, "Computers Architecture and Parallel Processing" MGH – 1985
2. Kai Hwang, " Advanced Computer Architecture – TMH – 1993
3. D. Sima,T. Fountain, P.Kasuk," Advanced Computer Architecture-A Design Space Approach" Addisson Wesley,1997.
4. M. J. Flynn,"Computer Architecture, Pipelined And Parallel Processing", Narosa Publications,1998

Reference Books:

1. Neil D. A. Patterson and J. L. Hennessey "Computer Organization and Design", Morgan , Kaufmann,2002

2. Stalling W. ”Computer Organization and Architecture- Designing for performance” ,PHI,2005.
3. D.E. Culler and J.P.Singh “ Parallel Computer Architechure”, Harcourt Asia PTE Ltd,2000

Program: VLSI Design & Embedded Systems		
Course Title: Automotive Electronics		**Course Code:** 19EVEC701
L-T-P: 3-0-1	**Credits: 4**	**Contact Hours: 5**
ISA Marks: 50+100	**ESA Marks: 50**	**Total Marks: 200**
Teaching Hours: 40	**Examination Duration: 3 hrs**	

Chapter No. 1. Automotive Fundamentals Overview Introduction to Automotive Industry and Modern Automotive Systems Vehicle classifications and specifications need for electronics in automobiles, Application areas of electronics in the automobiles Four Stroke Cycle, Engine Control, Ignition System, Spark plug, Spark pulse generation, Ignition Timing, Drive Train, Transmission, Brakes, Steering System.	8Hrs
Chapter No. 2. Sensors and Actuators Oxygen (O2/EGO) Sensors, Throttle Position Sensor (TPS), Engine Crankshaft Angular Position (CKP) Sensor, Magnetic Reluctance Position Sensor, Engine Speed Sensor, Ignition Timing Sensor, Hall effect Position Sensor, Optical Crankshaft Position Sensor, Manifold Absolute Pressure (MAP) Sensor Strain gauge, Engine Coolant Temperature (ECT) Sensor, Knock Sensor, Throttle angle sensor, Fuel Injector Actuator, Ignition Actuator	7Hrs
Chapter No. 3. Electronic Engine Control Engine parameters, variables, Engine Performance terms, Electronic Fuel Control System, Electronic Ignition control, Idle sped control, EGR Control	5Hrs
Chapter No. 4. Vehicle Motion Control and Safety Systems Cruise Control, Antilock Brake System (ABS), Electronic Steering Control, Power Steering, Traction Control, Electronic Stability Program.	6Hrs
Chapter No:5. Automotive communication protocols Overview of Automotive communication protocols : CAN, LIN .	3Hrs
Chapter No. 6. Advanced Driver Assistance Systems (ADAS) Lane Departure Warning, Collision Warning, Automatic Cruise Control, Pedestrian Protection, Headlights Control, Connected Cars technology and trends towards Autonomous vehicles.	5Hrs
Chapter No. 7. Automotive safety standards ISO26262 and Diagnostics Functional Safety: Need for safety standard-ISO 26262, safety concept, safety process for product life cycle, safety by design, validation. Fundamentals of Diagnostics: Basic wiring system and Multiplex wiring system, Preliminary checks and adjustments, Self-diagnostic system. Fault finding and corrective measures, OBD & off board diagnostic.	6Hrs

Text books:

2. Denton.T – Automobile Electrical and Electronic Systems, Edward Arnold publication, 1995.

References:

6. William T.M – Automotive Electronic Systems, Heiemann Ltd., London ,1978.
7. Nicholas Navet – Automotive Embedded System Handbook, CRC Press, 2009.
8. BOSCH Automotive Handbook, Wiley Publications, 8th Edition, 2011.
9. Co-Verification of hardware & software for ARM SoC Design – Jason.R.Andrews, Newnes Publications, 2004.
10. Hardware Software co-design of embedded systems, F.Balarin, Kluwer Academic Oublishers,

1987.
Lab: 9. Demonstration of cut section modules: Engine, Transmission , Steering, Braking, Suspension - Automobile dept. 10. Electronic engine control system: Injection and Ignition control system Transmission trainer modules 11. Modeling an engine Vehicle model simulation with Simulink using PI CONTROLLER 12. Basic gate logic simulation and modeling using Simulink and realization on the hardware platform. 13. Seat belt warning system simulation and modeling using Simulink and realization on the hardware platform. Vehicle speed control based on the gear input simulation and modeling using Simulink and realization on the hardware platform. 14. Throttle control modeling and simulation using Simulink and realization on the hardware platform. 15. Accelerator pedal interfacing software modeling and simulation using Simulink and realization on the hardware platform. 16. Develop matlab code for stepper motor control and convert it to Simulink model and port it to embedded hardware

Program: VLSI Design & Embedded Systems		
Course Title: AUTOSAR and Infotainment		Course Code: **19EVEE707**
L-T-P : 2-0-1	Credits: 3	Contact Hrs: 4
CIA Marks: 50	SEE Marks: 50	Total Marks: 100
Teaching Hrs: 24	Exam Duration: 3 hrs	

Chapter No. 1: AUTOSAR Fundamentals Evolution of AUTOSAR – Motivations and Objectives AUTOSAR consortium – Stake holders – work Packages, AUTOSAR Partnership, Goals of the partnership, Organization of the partnership, AUTOSAR specification, AUTOSAR Current development status, BSW Conformance classes: ICC1, ICC2, ICC3, and Drawbacks of AUTOSAR.	4 hrs
Chapter No. 2: AUTOSAR layered Architecture AUTOSAR Basic software, Details on the various layers , Details on the stacks Virtual Function Bus (VFB) Concept Overview of AUTOSAR Methodology , Tools and Technologies for AUTOSAR AUTOSAR Application Software Component (SW-C) ,Types of SW-components AUTOSAR Run Time Environment (RTE): RTE Generation Process: Contract Phase, Generation Phase, MCAL, IO HW Abstraction Layer, Partial Networking, Multicore, J1939 Overview, AUTOSAR Ethernet, AUTOSAR E2E Overview , AUTOSAR XCP, Metamodel , From the model to the process , Software development process.	4 hrs
Unit - 2	
Chapter No. 3: Methodology of AUTOSAR and Communication in AUTOSAR CAN Communication, Application Layer and RTE, intra and inter ECU communication, Client-Server Communication, Sender-Receiver, Communication, CAN Driver, Communication Manager (ComM), Overview of Diagnostics Event and Communication Manager	4 hrs
Chapter No. 4: BSW Development and Integration BSW Constituents: Memory layer, COM and Services layer, ECU abstraction, AUTOSAR, Operating system, Interfaces: Standard interface, AUTOSAR standardized interface, BSW-RTE interface,(AUTOSAR interface), BSW-ECU hardware interface, Complex device drivers and BSW module configuration, AUTOSAR Integration.	4 hrs
Chapter No. Chapter 5: Infotainment Systems in Automobiles	4 hrs

Infotainment Systems Fundamentals: Radio, Multimedia, and Navigation: Introduction to In Vehicle Infotainment (IVI) systems, Use of operating systems in IVI , GENIVI Alliance, Tuner: AM/FM, XM/Sirrus, DAB/DMB, Software Defined Radio; Concepts of HD, radio, Ensemble, Traffic Announcements, Spread Spectrum, d. Multimedia: Types of Media; Music, Video, Podcasts, etc. Media management; Playback, Track Control, Metadata, Playlists, Categories, Trick play, Audio/Video Source Management, Navigation: Points of Interests, Routes, Waypoints, Dead Reckoning position, Traffic Info, GLONASS, GNSS, RTK, GPS, and SBAS/GBAS,INS f. Media types: CD, DVD, CDDA, USB, SDCARD, Media Formats:MP3, WMV, RealAudio/Video, QTP, Architecture – Design Patterns - Proxies, Adaptors, Interfaces, Singleton, Factory method	
Chapter No. Chapter 6: Communication Systems in Automobiles Automotive & Consumer Electronic Communication Systems: Introduction to Bluetooth – Pairing, HFP, A2DP, PAN, PBAP, DUN, Concepts of MOST network, DLNA, AVB, Concepts of TCP/IP, Ethernet, WiFi, WiFi Direct, MyWiFi and CAN, Mirror link, Tethering	4 hrs
Text Books (List of books as mentioned in the approved syllabus) Ronald K. Jurgen, Infotainment systems, 2007, SAE International, 2007	

Syllabus of All Courses

Course Code: 15EMEF201 **Course Title: Mechanics of Materials**

L-T-P: 3-1-0	Credits: 4	Contact Hrs: 5
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 50		Exam Duration: 3 hrs

Unit – 1

1. Stresses and Strains 10 hrs

Normal and shear stress, Bearing stress, Strain, deformation, Stress-strain diagram, Hooke's law, working stress and factor of safety, Analysis of bars of constant and varying sections, Principle of super position, Saint-Venant's principle, Stresses in composite section, Volumetric strain, Elastic Constants, Statically Indeterminate structures, Thermal stresses.

2. Torsion and Buckling 6 hrs

Torsion of circular shafts, Torsional equation, Power transmitted by solid and hollow circular shafts.

Buckling: Elastic Instability, Critical load, Euler's equation for columns with different end conditions, Rankine's formula.

Unit – 2

3. Shear Force and Bending Moment in Beams 6 hrs

Types of beams, Supports and Loads, Shear force and bending moment diagrams for simply supported, overhanging and cantilever beams subjected to point loads, uniformly distributed load, uniformly varying load and couple.

4. Stresses in Beams 5 hrs

Bending stress, Flexure formula, Section modulus, Bending stresses in beams of different cross sections, Economic Sections. Shear stresses in beams, Shear stress across rectangular, I and T sections.

6. Deflection of Beams 5 hrs

Deflection and slope of a beam, Differential equation of the elastic curve, Equations for deflection, slope and moment, Double integration and Macaulay's method, Deflection and slope for simply supported, overhanging and cantilever beams subjected to point loads, uniformly distributed load and couple.

Unit – 3

7. Compound stresses 4 hrs

State of stress at a point, Transformation of plane stress, Principal planes and Principal stresses, Analytical method for determining principal stresses, maximum shear stress and their planes, Mohr's circle for plane stress.

8. Thin and Thick Cylinders 4 hrs

Thin walled pressure vessels, Cylindrical vessels; hoop stress, longitudinal stress and maximum shear stress, change in dimensions of cylinder (diameter, length and volume). Spherical vessels, Thick cylinders subjected to internal and external pressures (Lame's equation)

Text Book (List of books as mentioned in the approved syllabus)

1. Andrew Pytel and Jaan Kiusalaas, Mechanics of Materials, Third Indian Reprint, CENGAGE Le, 2009
2. Hibbeler R.C, Mechanics of Materials, Eighth Edition, Prentice H, 2011

References

1. Nash, W.A, Strength of Material, Fourth Edition, Schaum Outline Series, 2007
2. James M Gere. Mechanics of materials sixth edition THOMSON India edition.2007

Course Code: 15EMEC201		**Course Title: Manufacturing Processes**
L-T-P: 4-0-0	Credits: 4	Contact Hrs: 4
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 50		Exam Duration: 3 hrs

Unit – 1

1. Introduction to Manufacturing Processes 2 Hrs

Definition of manufacturing, Manufacturing sectors and their significance to the economy of a country, Classification of production processes and systems, Criteria for selection of a process for production

2. Casting and Special Casting Processes 12 Hrs

Casting: Introduction, Green sand moulding, Pattern & core making: Pattern types, allowances and materials, Core & core making methods, Moulding methods and machines, Principles of gating, risers and gating ratio. Special Casting Processes: CO_2 moulding, Shell moulding, Investment casting, Die casting and Centrifugal casting processes. Melting Furnaces and Defects in Castings: Crucible furnaces, Electric arc furnaces, Induction furnaces. Defects in castings, Cleaning and fettling operations, Testing methods

3. Fabrication processes 6 Hrs

Classification of joining processes, Soldering, Brazing, Mechanical fastening, Welding, Preparation of base metal and joint. Arc welding, Gas welding, TIG, MIG, FCAW, Thermit welding, Spot, seam and projection welding, Ultrasonic welding, Electron beam welding and Laser welding

Unit – 2

4. Machine Tool Operations 8 Hrs

Principles of metal cutting, Introduction to Lathes, Drilling and Milling machines; Constructional features, Operations, Machining time calculations.

Grinding, Super finishing, Honing and Lapping methods; Constructional features, Operations and types

5. CNC Machine Tool 6 Hrs

Need for CNC machines, Fundamentals of numerical control, Classification of numerical control, NC controllers, and constructional details of CNC machines. Manual part programming

6. Mechanics of Machining 6 Hrs

Geometry of cutting tools, Cutting tool materials, Mechanism of chip formation, Merchant's circle diagram, Velocity and force relationships, Cutting fluids, Thermal aspects of machining, Types of tool wear & wear mechanisms, Tool life, Machinability & its criteria

Unit – 3

7. Forming processes 5 Hrs

Bulk deformation processes: Forging, Rolling, Extrusion and Drawing. Sheet metal working processes. Selection of equipments

8. Advanced Manufacturing Processes 5 Hrs

Non-traditional Machining Processes: Mechanical, Thermal, Electrochemical and Chemical machining processes.

Micro-machining and Additive manufacturing

Text books

1. Kalpakjian S., and Schmid S.R., Manufacturing Engineering & Technology, 7th edition, Pearson Education, 2014.
2. Mikell P. Groover, Fundamentals of Modern Manufacturing, 5th edition, John Wiley & Sons, 2012.

Reference books

1. Rosenthal, P., Heine L., Principles of Metal Casting, Tata McGraw Hill, 1997.
2. John A. Schey, Introduction to Manufacturing Processes, 3rd edition, Tata McGraw Hill, 1999.
3. Juneja B. L. and Sekhon G. S., Fundamentals of Metal Cutting and Machine Tools, 3rd edition, New Age International Limited, 2008.
4. Mikell P. Groover, Automation, Production Systems, and Computer-Integrated Manufacturing, 4th edition, Prentice Hall, 2014.
5. Pandey P. C. and Shan H. S., Modern Machining Processes, 1st edition, Tata McGraw Hill, 2013.
6. Rao P. N., Manufacturing Technology: Volume-1, 3rd edition, Tata McGraw Hill, 2008.
7. Rao P. N., Manufacturing Technology: Volume-2, 3rd edition, Tata McGraw Hill, 2013.

Course Code: 15EMEC204		**Course Title: Machines & Mechanisms**
L-T-P: 4-0-0	Credits: 4	Contact Hrs: 4
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 50		Exam Duration: 3 hrs

Unit I

Chapter 1: Kinematics Fundamentals: 10 Hrs

Links, pairs, Mechanisms, machines, structure, and Inversions. Identifying types of links, pairs, Drawing Kinematic Diagram and finding mobility of linkages Numericals on mobility, Inversions of Four bar mechanism, single slider crank mechanism, double slider crank mechanism. Steering gear mechanism and Ackerman gear mechanism Hook's joint analysis with examples, Crank and slotted lever mechanism and whit worth quick return mechanism analysis, Intermediate motion mechanism

Chapter 2: Kinematic Analysis 10 Hrs

Locating instantaneous centers for different mechanisms, Numericals. Velocity and acceleration analysis of links. velocity and acceleration analysis of 4 bar mechanisms and slider crank mechanisms.
Velocity and acceleration analysis of quick return motion mechanisms Numericals
Velocity analysis and Acceleration analysis of four bar mechanism and engine mechanism by complex algebra. Numericals

Unit II

Chapter 3: Static and Dynamic analysis of Mechanisms 8 Hrs

Static force analysis of 4 bars mechanisms. Static force analysis of slider cranks mechanisms. Numericals
Inertia forces and torque, inertia forces on engine mechanism, TMD for different machines, Fluctuation of energy, Flywheel. Numericals

Chapter 4: Kinematic analysis of Gear and Gear Trains 6 Hrs

Classification and terminology of gears Involutometry, backlash in gears Law of gearing, velocity of siding, length of path of contact, arc of contact, Contact ratio Numericals.
Epicyclic gear train with numericals

Chapter 5: Balancing of masses 6 Hrs

Necessity of balancing, Static and Dynamic balancing, Balancing of revolving mass in single and multiple planes, Balancing of several masses in single planes, Balancing of several masses in multiple planes, Balancing of reciprocating masses, Balancing of multi cylinder inline engine. Numericals

Unit – III

Chapter 6: Belts and Chain drives 6 Hrs

Velocity ratio, effect of belt thickness and slip, Power transmitted by belt driving tension, centrifugal tension and initial tension, Belts. Numericals Classification of chains, length of chains, initial tension, creep. Numericals

Chapter 7: Cams and Gyroscope 4 Hrs

Introduction, classification of followers and cams. Displacement diagrams for roller follower with SHM and analysis, displacement diagrams for followers with UV&R and analysis. Numericals
Gyroscopic couple and precessional motion, effect of gyroscopic couple on airplane and Naval Ship during steering and Rolling.

Reference Book:

1. Machines and Mechanisms by Myzcka.
2. Theory of Machines and Mechanisms 4th Edition, by John Uicker , Gordon Ennock , Joseph Shigley
3. Design of Machinery by Robert L. Norton.
4. Theory of machines by S S Rattan.

Course Code: 15EMEF202 **Course Title: Engineering Materials**

L-T-P: 4-0-0	Credits: 4	Contact Hrs: 4
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 50		Exam Duration: 3 hrs

Unit – 1

Chapter 1: Introduction: 05 Hrs

An overview of materials science and engineering, classes of engineering materials, functional and advanced materials, Materials history and character, Design-limiting properties, Material property charts, Matching materials to design, Selection strategy- translation, screening, ranking and documentation.

Chapter 2: Structures of Metals and ceramics: 05 Hrs

Macro-Micro-Nano: The scale of structures, Crystal Structures- BCC, FCC, HCP structures; coordination number, atomic packing factor, Imperfections in solids and their roles in affecting the behavior of materials., Plastic deformation of single crystal by slip and twinning, dislocation theory.

Chapter 3: Mechanical Behavior of materials: 10 Hrs

Stress-strain diagrams to show ductile and brittle behavior of materials, linear and non linear elastic behavior of materials, mechanical properties in elastic and plastic range, Effect of strain rate and temperature on tensile properties, **Fatigue**: Types of fatigue loading with example, mechanism of fatigue, fatigue properties, fatigue testing and SN diagram; **Creep**: Description of phenomenon with examples, stages of creep, creep properties, stress relaxation; **Fracture**: Failure of engineering materials.

Unit – 2

Chapter 4: Solidification and phase diagrams: Mechanism of solidification, Homogeneous and heterogeneous nucleation, crystal growth, cast metal structures, Solid solutions, Hume Rothery rules, substitutional and interstitial solid solutions, intermediate phases, Gibbs phase rule, construction of equilibrium diagrams, equilibrium diagrams involving complete and partial solubility, lever rule, Iron carbon equilibrium diagram, description of phases, solidification of steels and cast irons, invariant reactions, Numericals. 07 Hrs

Chapter 5: Ferrous and Non ferrous materials: 06 Hrs

Properties, composition and uses of cast irons and steels, AISI and BIS designation of steels. Aluminum, Magnesium and Titanium alloys.

Chapter 6: Heat treatment of metals: 07 Hrs

Objectives, Annealing and its types, normalizing, hardening, tempering, austempering, martempering, hardenability, surface hardening methods like carburizing, cyaniding, nitriding, flame hardening and induction hardening; Age hardening of Aluminum -Copper alloys. Time-temperature-transformation (TTT) curves, continuous cooling curves.

Unit – 3

Chapter 7: Ceramic and Polymer Materials: 05 Hrs

An overview of ceramic materials, mechanical and thermal properties of ceramics, An overview of polymeric materials, thermoplastics and thermosets, elastomers, engineering applications of ceramic and polymer materials.

Chapter 8: Advanced materials: 05 Hrs

The need for advanced materials; Composite materials- classification, types of matrix materials and reinforcements, fundamentals of production of FRP's and MMC's, applications of composites, Smart materials, Nano materials and Exotic alloys.

Text Books:

1. Engineering Materials: An Introduction to Properties, Applications and Design- Michael Ashby and D R H Jones.
2. The Science and Engineering of Materials – Donald Askeland and Pradeep Phule, Thompson Learning.
3. Materials Science and Engineering – William Callister, John Wiley & Sons. Inc.

Course Code: 15EMEP201 | **Course Title: Production Technology Lab**

L-T-P: 0-0-1 | Credits: 1 | Contact Hrs: 2

ISA Marks: 80 | ESA Marks: 20 | Total Marks: 100

Exam Duration: 2 hrs

Content

1 Machining practices involving machining time calculations and estimation of machining costs for the jobs for turning, milling, drilling, grinding. (3 slots)

2 Simulation of CNC programming on machining processes. (2 slots)

3 CNC programming practices on machining processes. (2 slots)

4 Machinability studies in turning, milling, drilling. (3 slots)

5 Design, Modeling and Analysis of Bulk deformation and Sheet Metal forming processes. (2 slots)

Text books

1. Kalpakjian S., and Schmid S.R., Manufacturing Engineering & Technology, 7th edition, Pearson Education, 2014.
2. Mikell P. Groover, Fundamentals of Modern Manufacturing, 5th edition, John Wiley & Sons, 2012.

Reference books

1. John A. Schey, Introduction to Manufacturing Processes, 3rd edition, Tata McGraw Hill, 1999.
2. Juneja B. L. and Sekhon G. S., Fundamentals of Metal Cutting and Machine Tools, 3rd edition, New Age International Limited, 2008.
3. Mikell P. Groover, Automation, Production Systems, and Computer-Integrated Manufacturing, 4th edition, Prentice Hall, 2014.
4. Pandey P. C. and Shan H. S., Modern Machining Processes, 1st edition, Tata McGraw Hill, 2013.

Course Code: 15EMEP204 **Course Title: Machines & Mechanisms Lab**

L-T-P: 0-0-1	Credits: 1	Contact Hrs: 2
ISA Marks: 80	ESA Marks: 20	Total Marks: 100
		Exam Duration: 2 hrs

Sl No	Content	Type
1	Converting a machine in to its Kinematic model	Structured enquiry
2	Velocity and Acceleration of complex mechanisms	Structured enquiry
3	Analysis of Gear and Gear trains	Structured enquiry
4	Design of cam profile	Exercise
5	Balancing of rotating masses	Exercise
6	Balancing of reciprocating masses	Exercise
7	Belt Drive	Structured enquiry
8	Dynamic force analysis	Structured enquiry
9	Develop the mechanism for the given objective	Open Ended problem

Reference Book:

1. MSC ADAMS Manual.
2. Machines and Mechanisms by Myzcka.
3. Theory of Machines and Mechanisms 4th Edition, by John Uicker , Gordon ennock ,Joseph Shigley
4. Design of Machinery by Robert L. Norton.
5. Theory of machines by S S Rattan

Course Code: 15EMEP202 **Course Title: Engineering Materials Lab**

L-T-P: 0-0-1	Credits: 1	Contact Hrs: 2
ISA Marks: 80	ESA Marks: 20	Total Marks: 100
		Exam Duration: 2 hrs

Expt. No.	Brief description about the experiment	No. of Lab. Slots
01	Introduction to the Laboratory-Overview of Destructive and Non Destructive Testing methods. (Awareness about the ASM hand books and ASTM standards)	01
02	Non destructive test experiments a. Ultrasonic flaw detection. b. Magnetic particle inspection. c. Dye penetration testing, To study the defects of castings and welded specimens.	01
03 04	Evaluation of the tensile strength, Compression strength, Shear strength, Bending/ Torsion strength and Impact strength. Ex: Should be able to Describe the differences between the tensile behavior of the metal sample and that of polymer sample, considering that the student performs the test on two different materials family.	01 01
05	To study wear characteristics of ferrous, non-ferrous and composite materials for different loading. Computation of wear parameters: wear rate, wear resistance, specific wear rate, frictional force, coefficient of friction, wear coefficient.	01
06	To study the microstructure of the ferrous and nonferrous alloy and to perform grain size analysis and volume fraction analysis. • Familiarization with the procedure for preparation of a material specimen for microscopic examination. • Familiarization with compound optical microscopes and metallography. • Examination of surface characteristics of engineering materials. • Grain size determination of metals and analysis.	01
07	To analyze given SEM Micrographs (Microstructure and fracture surface morphology) and conclude on the structure and mode of fracture. (Familiarization with the advanced characterization of metals by Scanning electron microscopy).	01
08	Computer Modeling of Stress Concentration, Crack Opening and Crack Propagation Understand the occurrence of stress concentration at geometrical discontinuities. Determine the stress concentration factor at a geometrical discontinuity.	01
09	Design an experiment to investigate the spring characteristics of any given spring.	02
10	Synthesize a novel composite material which is reinforced with a natural fiber in a polymer matrix and perform the mechanical characterization for investigation of mechanical properties, which is desirable for specified engineering applications. Perform a parametric analysis which affects the mechanical properties of prepared composites using a statistical approach and find the correlation of those parameters with properties of composites.	02

Course Code: 15EMEP203 **Course Title: Engineering Design Practice**

L-T-P: 0-1.5-1.5	Credits: 3	Contact Hrs: 6
ISA Marks: 80	ESA Marks: 20	Total Marks: 100
		Exam Duration: 3 hrs

Part - A

1. **Introduction to Engineering Design Process**
Introduction to engineers design, Generic design process, good design and bad design, types of design process, managing project and professionalism

2. **Need analysis and problem definition**
Need Analysis- Why-Why analysis, VOC- Interaction with stake holders- Customers, experts etc. (through well-defined questionnaires), and Market analysis- How to Conduct a Market Analysis, Relevant Information Resource, Intellectual property rights (Patents, Copyrights etc.)

3. **Functional analysis**
Identifying functions, Functional Decomposition, Function Structure -Procedure to Establish Functional Structures, Methods- Black box & transparent box, reverse engineering

4. **Design specifications**
VoE: Establishing product specifications - QFD Method, Human Factors in design and Safety Considerations

5. **Conceptualization**
Brainstorming, Develop Concepts from Function- Morphological analysis, Expanding design space, applying metrics to objectives: Selecting the preferred design

6. **Evaluating design alternatives/ alternative concepts**
Sketch Assembly of Alternatives, Conceptual design evaluation and decisions- Decision Matrix- Pugh method

7. **Detailed design & costing**
Product Drawings, Bill of Materials, Prototyping techniques
Cost estimating in design- Cost Classifications, Cost Estimate Methods, Product Pricing

8. **Concept testing& Documentation**
Purpose of concept test, choose survey population/format, and communicate the concept to measure customer response, interpret the results and document

Part – B

Content	Hrs
Part – B1(2D Drafting)	
1. Orthographic Projections – Sectional [MANUAL drawings] Conversion of pictorial views into orthographic projections, Sectional views such as half section, full section, local section, removed section and offset section.[1st and 3rd angle projection]	08 Hours / 4 sessions
2. Thread forms and Threaded Fasteners: [MANUAL drawings] **Thread forms:** Thread terminology, thread profiles, [ISO Metric, BSW, Square and Acme, Sellers thread, American Standard thread]. **Fasteners:** Hexagonal headed bolt and nut with washer (assembly), square headed bolt and nut with washer (assembly).	08 Hours / 4 sessions
3. 2D Assembly Drawings: Part and Assembly Drawings, Generating bill of materials for assembly. [Creating sectional views of parts and assembly of protected type flanged coupling, machine vice, screw jack etc.]	10 Hours / 5 sessions
Part – B2(3D Modeling)	
4. Introduction to 3D Modeling and different work benches: Sketcher Workbench: Demonstration of sketch tools, modifying tools, geometrical constraints and dimensional constraints.	4 Hours / 2 sessions
5. Part Modeling: Shape toolbar for adding materials, shape toolbar for removing materials, modifying tools, types of views etc.,	10Hours / 5 sessions
6. Assembly: Component placement, Placement types (Surface, Axis, and Planes), Feature settings etc.	4 Hours / 2 sessions
7. Drawing: Drawing properties, Adding drawing models, View types, Scale factors, Section apply, View display	4 Hours / 2 sessions

Text Book/Reference Books:

1. YosefHaik, Engineering Design process, 2004, Cengage Learning India Pvt. Ltd
2. Clive L. Dym& Patrick Little, Engineering design, 3rd edition, John Wiley and Sons
3. Engineering Design Principles Ken Herst, Elsevier Publication, 2010, Indian Edition
4. Product Design and Development – Karl T Ulrich & Steven D Eppinger, Tata McGraw Hill 3rd Edition 2004

Course Code: 15EMEC202		**Course Title: Engineering Thermodynamics**
L-T-P: 3-0-0	Credits: 3	Contact Hrs: 3
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 40		Exam Duration: 3 hrs

Unit – 1

Chapter No. 1. Introduction 5 hrs

Basic concepts, Zeroth law, 1st law of thermodynamics applied to non flow system and flow system

Chapter No. 2. Second Law of Thermodynamics 10 hrs

Devices converting heat to work; (a) in a thermodynamic cycle, (b) in a mechanical cycle. Thermal reservoir. Direct heat engine; schematic representation and efficiency. Devices converting work to heat in a thermodynamic cycle; reversed heat engine, schematic representation, coefficient of performance. Classical statements of second law of thermodynamics, PMM I and PMM II, factors that make a process irreversible, reversible heat engines, Carnot cycle, Carnot theorem, thermodynamic temperature scale. Entropy, a property of a system, Clausius theorem and Clausius inequality, Principle of increase of entropy, calculation of entropy change during various processes, Tds relations, Exergy and Aenergy, Exergy analysis

Unit – 2

Chapter No. 3. Gas and Vapour Power Cycles 9 hrs

Gas power cycles: Otto, Diesel, Dual cycles, expression for mean effective pressure and cycle efficiency, comparison of Otto, Diesel and Dual cycles. Vapour power cycle: Carnot cycle, work done and cycle efficiency, draw backs, ideal and actual Rankine cycle, network done, cycle efficiency and work ratio, regenerative cycle and reheat cycle

Chapter No. 4. Internal Combustion Engines and their Testing 6 hrs

Introduction to I C engines, Thermodynamic testing of internal combustion engines, measurement of air supplied, fuel supplied to the engines, measurement of power and efficiencies, preparation of heat balance sheet

Unit – 3

Chapter No. 5. Combustion thermodynamics 5 hrs

Stoichiometric air for combustion of fuels, excess air, combustion equations, air - fuel ratio, combustion efficiency, analysis of products of combustion, volumetric and gravimetric basis, enthalpy of formation, enthalpy and internal energy of combustion, adiabatic flame temperature. Energy and environment.

Chapter No. 6. Refrigeration 5 hrs

Vapour compression refrigeration system; description, analysis, refrigerating effect, capacity, power required, units of refrigeration, COP. Refrigerants and their desirable properties. Air cycle refrigeration; reversed Carnot cycle, reversed Brayton cycle. Vapour absorption refrigeration system. Steam jet refrigeration. Cryogenics and applications. Psychrometry: Atmospheric air and psychometric properties; Dry bulb temperature, wet bulb temperature, dew point temperature; partial pressures, specific and relative humidity and the relation between the two. Enthalpy and adiabatic saturation temperature

Text Book (List of books as mentioned in the approved syllabus)

1. Michael J Moran & Howard N Shapiro, Fundamentals of engineering thermodynamics, 6th, Wiley Stud, 2007

Cenegal Y. A. and Boles M. A, Thermodynamics an Engineering approach, 7th, Tata McGraw Hill, 2011

Course Code: 15EMEC203		**Course Title: Fundamentals of Machine Design**
L-T-P: 3-1-0	Credits: 4	Contact Hrs: 5
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 50		Exam Duration: 3 hrs

Unit – 1

1 Introduction to Machine Design 4 Hrs

Machine Design, Basic Procedure of Machine Design, Design of Machine elements, Traditional design methods, Design synthesis, Use of Standards in Design, Selection of prepared sizes, Aesthetic considerations in design, Ergonomic considerations in design, Concurrent Engineering.

2 Design against Static Load 6 Hrs

Modes of failure, factor of safety, eccentric axial loading, design of machine parts, Stress Concentration, Stress Concentration Factors, Reduction of Stress Concentration. Theories of Elastic failure, Maximum Principal Stress Theory, Maximum Shear Stress Theory, Distortion-Energy Theory, Selection and use of failure Theories.

3 Design against Reversing load 5 Hrs

Fluctuating Stresses, Fatigue Failure, Endurance Limit, Low cycle and High Cycle Fatigue, Notch Sensitivity, Endurance Limit- Approximate Estimation, Reversed Stresses-Design for Finite and Infinite Life

Unit II

4 Design against Fluctuating load 3 Hrs

Cumulative Damage in Fatigue, Soderberg and Goodman equations. Fatigue design under combined stresses. Impact Stresses.

5 Design of Belt Drives 5 Hrs

Introduction to Belt drives, Materials for Belts, Flat belt drives, Length of open/ cross belt drives, Velocity ratio, centre distance, ratio of driving tensions in flat belts, centrifugal tension, power transmitted by flat belt drives, design procedure for belt drives.

6 Shafts and Keys 8 Hrs

Transmission Shafts, Shaft Design on Strength Basis, Shaft Design on Torsional rigidity Basis, ASME Code for shaft design, Design of Shafts subjected to combined bending and twisting. Keys ,Saddle and Sunk keys, Design of square and flat Key.

Unit III

7 Temporary Joints 4 Hrs

Bolted joint –simple analysis, eccentric load perpendicular to axis of bolt, eccentric load parallel to axis of bolt

8 Permanent Joints 5 Hrs

Welded Joints, Strength of Butt Welds, Strength of Parallel fillet Welds, Strength of Transverse Fillet Welds, Eccentric Loaded welded joints, Riveted Joints, Types of riveted joints, Types of failures, Design of butt and lap joints for Boilers.

Tutorials

Session 01: Load Determination
Session 02: Problems on Design against Static Load
Session 03: Problems on Design against Static Load (contd.)
Session 04: Problems on Design against Static Load (contd.)
Session 05: Problems on Design against Reversing Load
Session 06: Problems on Design against Reversing Load (contd.)
Session 07: Problems on Design against Fluctuating Load
Session 08: Problems on Design of Belt Drives
Session 09: Problems on Shafts and Keys

Session 10: Problems on Shafts and Keys (contd.)
Session 11: Problems on Temporary Joints
Session 12: Problems on Permanent Joints
Session 13: Problems on Permanent Joints (contd.)

Text Book (List of books as mentioned in the approved syllabus)

1. V.B. Bhandari, Design of Machine Elements, Third Edition, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2010

References

1. T. Krishna Rao, Design of Machine Elements (Volume I), Second Edition, I K International Publishing House Pvt. Ltd., New Delhi, 2011
2. Farazdak Haideri, Mechanical Engineering Design (Volume I), Second Edition, Nirali Prakashan, Pune, 2000

Design Data Hand Book:

Design Data Hand Book by K. Mahadevan and Balaveera Reddy, CBS Publication

Course Code: 15EMEC205		**Course Title: Instrumentation & Control Engineering**
L-T-P: 4-0-0	Credits: 4	Contact Hrs: 4
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 50		Exam Duration: 3 hrs

Unit – 1

1 INTRODUCTION: 4 Hrs

Generalized configurations and functional descriptions of measuring instruments, performance characteristics of instruments, instrument categorization, measurement quantities and control.

2 FORCE, TORQUE, AND SHAFT POWER MEASUREMENT: 8 Hrs

Basic methods of force measurement, characteristics of elastic force transducers, bonded-strain-gage transducers, differential-transformer transducers, piezoelectric transducers, and variable-reluctance/fm-oscillator, elastic force meters, load cells, torsion meters, dynamometers, gyroscopic force and torque measurement.

3 PRESSURE, VIBRATION AND SOUND MEASUREMENT: 8 Hrs

Basic methods of pressure measurement, deadweight gages and manometers, elastic transducers, dynamic testing of pressure-measuring systems, principles of seismic instruments – vibrometer and accelerometer using this principle, sound measurement.

Unit – 2

4 MATHEMATICAL MODEL: 8 Hrs

Concept of automatic controls, open and closed loop systems, concepts of feedback, requirement of an ideal control system. Mechanical system (both translation and rotational), Electrical system, D. C. Motors, Hydraulic systems (liquid level and fluid power systems), Thermal systems.

5 SYSTEM RESPONSE: 6 Hrs

First order subjected to step and ramp input, second order system response to step input, concepts of time constant and its importance in speed of response. Mathematical concept of stability-Routh Hurwitz Criterion

6 CONTROL ACTION: 6 Hrs

Types of controllers – proportional, integral, proportional integral, proportional integral differential controllers, system compensations.

Unit – 3

7 FREQUENCY RESPONSE TECHNIQUES: 5 Hrs

Definition of root loci, Rules for rapid plotting, constructing of root loci, Stability analysis. Problems solving using software.

Bode attenuation diagrams, stability analysis using Bode diagrams, simplified Bode diagrams. Problems solving using software.

8 INTRODUCTION TO STATE VARIABLE CHARACTERISTICS OF LINEAR SYSTEMS: 5 Hrs

Introduction to the state concepts, state equation of linear continuous data system. Matrix representation of state equations

Text Book:

1. Ernest O. Doebelin, ‘Measurement Systems’, McGraw-Hill Publication.
2. Dr.D.S.Kumar, ‘Measurements Systems: Applications & Design’, Anuradha Agencies.
3. B.C.Nakara & K.K.Choudhary, ‘Instrumentation, measurement & analysis’, Tata McGraw-Hill Publication.
4. Richard C Dorf and Robert H. Bishop, ‘Modern Control Systems’, Addison Wesley.
5. Control systems’ by I. J. Nagarath & M. Gopal, New age International publishers.

References:

1. FR K Jain, ‘Mechanical and Industrial Measurements’, Khanna Publishers.
2. A. K. Ghosh, ‘ Introduction to Instrumentation and Control’, PHI Learning Pvt. Ltd.
3. B.C. Kuo, F. Golnaraghi, ‘Control Systems’, John Wiley & Sons.
4. Norman S. Nise, ‘Control. Systems’, John Wiley & Sons
5. Eronini Umez, ‘System Dynamics & control’ , Thomson Learning.
6. M. Gopal, ‘Control Systems Principles and Design’, Tata McGraw-Hill Publication.

Course Code: 15EMEC206 **Course Title: Mechatronics**

L-T-P: 3-0-0	Credits: 3	Contact Hrs: 3
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 40		Exam Duration: 3 hrs

Unit – 1

1 Introduction to Mechatronics: Definition & overview of Mechatronics, Key elements, Mechatronics Design approach, Mechatronics and sustainability, examples of mechatronic systems.	6 Hrs
2. Sensors : Proximity Sensor; Displacement/Distance-Potentiometer, encoder, resolver, LVDT, PZT, ultrasonic, Light Sensor; Force-load cell; Temp etc	4 Hrs
3 Signal conditioning: Overview of BJT, MOSFET, SCR, TRIAC, IGBT, Optoisolators; Review of analog(OP-Amp based) and digital(ADC, DAC, MUX) signal conditioning; Signal Filters (Analog/Digital, Active/Passive); Application of Bridge Circuits- strain measurement; Data Acquisition System(DAQ); virtual instruments.	5 Hrs

Unit – 2

4 Microcontroller Introduction to Memory Hierarchy; Address/Data lines; microprocessor and microcontroller ; Introduction to open Hardware Architecture(Arduino/Rasberipy); Basic programming; interfacing Digital I/O, PWM and Analog inputs. Introduction to communication protocols-RS232, I2C, Ethernet Etc.	9 Hrs
5 Programmable logic controller(PLC): Introduction to PLC and it's Architecture; PLC I/O; examples of applications; Ladder diagrams, logic functions, latching; Programming on industrial applications like conveyor belt control, water/oil level controller, sequencing of 3 motors, washing machine sequencing, automatic bottle filling system etc.	6 Hrs

Unit – 3

6 Actuators and its applications: Review of electrical actuators like relay, solenoid etc; Resolver, DC & AC motors, DC & AC servo motors; power drives, IPM; VFD; Servo drives-AC, DC	5 Hrs
7 Machine Vision System&3D printing: Introduction to Machine Vision; Image Acquisition; Image Processing; Visual Navigation; Introduction to 3D printing Hardware and Software.	5 Hrs

Text Books:

1. Devdas Shetty, Rechard A. Kolk, Mechatronics System Design, Cengage Learning – 2nd edition 2011 .
2. W. Bolton, 'Programmable Logic Controllers', Elsevier – 4th edition 2006.

Reference for Mechatronics:

1. David Bradley · David W. Russell, Mechatronics in Action: Case Studies in Mechatronics – Applications and Education, Springer 2010
2. Robert H Bishop, Mechatronics -an Introduction, Taylor & Francis Group 2006
3. W. Bolton, Mechatronics, Pearson Education Asia – 2nd edition 2001
4. Jacob Fraden, Handbook of Modern Sensor, Springer Science Business Media -Fourth Edition 2010
5. http://www.arduino.cc
6. Garry Dunning, 'Introduction to Programmable Logic Controllers' Thomson

Course Code: 15EMEP205 **Course Title: Mechatronics & Control Engineering Lab**

L-T-P: 0-0-2	Credits: 2	Contact Hrs: 4
ISA Marks: 80	ESA Marks: 20	Total Marks: 100
		Exam Duration: 2 hrs

Part1

1. Introduction to FG, DSO – Measurement of frequency, Voltage etc.
2. Active Analog Filters (Op-Amp) & Passive Filter
3. Arduino Basics and Programming
4. Interfacing Pot, Switch, LED and
5. LabVIEW_ DAQ : pot, Switch and LED
6. Interfacing LM35, Ultrasonic, LCD
7. DC motor Speed & Direction and keypad
8. Stepper , BLDC motor control and RC servo(pot feedback)
9. DC motor speed Control (with Potentiometer/encoder)
10. Vfd Drives – Induction motor speed control(Demo)
11. PLC – Basics : Logic gates execution , On delay and Off delay timers, Sequencing of 3 motors using CoDeSys software.

Part 2

1. Introduction to MATLAB/ Simulink/ Python
2. MATLAB based application- 1^{st} , 2^{nd} & higher order sym response
3. System response with additional poles, zeros- MATLAB
4. Python based application – Telescopic position control
5. LabVIEW based control- root locus, bode.
6. Compensator Design Via Root locus supported by MATLAB
7. Compensator design with Op-Amp
8. **Demonstration** - Inverted pendulum control, VTL, PID temperature controller.
9. PLC control applications: Automatic water level controller, Bottle filling plant fluid control
10. PLC control applications: Automatic conveyor belt controller, Lift Sequencing/DC motor Control

- **Books/References:**
    - Refer to theory
- **Manuals:**
    - Mechatronics and Control Lab Manual prepared by Lab-incharge.
- **Others:**
    - Course material provided by National Instruments
    - Data Sheets of IC's/ Components.

Course Code: 15EMEC301 **Course Title: Fluid Mechanics and Hydraulic Machines**

L-T-P: 4-0-0	Credits: 4	Contact Hrs: 4 hrs/week
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 50		Exam Duration: 3 hrs

Unit – 1

2. Fluid Continuum 8 hrs

Introduction, A brief history of fluid mechanics, Classification of fluid flows, Systems and control volume, Properties of fluids, Pascal's law, Hydrostatic laws, Manometry, Fluid forces on submerged plane and curved surfaces, Buoyancy and stability.

3. Fluid Kinematics and Fluid Dynamics 10 hrs

Lagrangian and Eulerian description, Flow patterns – stream lines and stream tubes, path lines, streak lines, Time lines, Differential analysis of fluid flow – Conservation of mass – Continuity equation, Velocity potential function and Stream function, Rotational and Irrotational flows. Bernoulli's equation, General energy equation, Linear momentum equation and its application to pipe bends.

Unit – 2

3. Fluid flow measurement 8 hrs

Pitot and pitot static probe, Obstruction flow meters – orifice, venturi and notches, Laminar flow in pipes, Energy losses – major and minor losses, Darcy- Weisbach equation, Chezy's formula, Energy and hydraulic gradient line.

4. Laminar flow and Viscous effects 9 hrs

Introduction, Reynold's number, Laminar flow through circular pipes (Hagen poiseulle's equation), Parallel flow over flat plate, Couette flow. Boundary layer and separation phenomenon.

Dimensional analysis: Rayleigh's method and Buckingham's π theorem, Model testing.

Unit – 3

5. Hydraulic Pumps 8 hrs

Centrifugal pumps – Work done, Heads and efficiencies, Priming, specific speed, NPSH, Cavitations, Multistage centrifugal pumps.

Reciprocating pumps: Working principle, discharge, work done and power, slip, Air vessels.

6. Hydraulic Turbines 7 hrs

Classification, Heads and efficiencies of turbines, Pelton, Francis and Kaplan turbines, Velocity triangles and work done, specific speed, Unit quantities, Draft tube, Characteristic curves.

Text Book:

1. Yunus A Cengel, John M Cimbala: Fluid Mechanics – Fundamentals and Applications, 3rd Edn, McGraw-Hill Publications, 2014.

References:

1. White F M: Fluid Mechanics, 5th Edn, McGraw Hill International Publication, 2003.
2. Dr.R.K. Bansal: Fluid Mechanics and Hydraulic Machines, 9th Edn, Laxmi Publications, 2010.

Course Code: 15EMEC302 **Course Title: Metrology and Quality Engineering**

L-T-P: 4-0-0	Credits: 4	Contact Hrs: 4 hrs/week
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 50		Exam Duration: 3 hrs

Unit – I

Chapter 1: Fundamentals of Metrology Objectives of metrology, Standards of physical quantities (mass, length, time, temperature, force, Velocity, density) types of standards, line and end standard, Slip gauges, Angle Gauges, Linear and Angular Measurements, Performance characteristics of measuring instruments, Calibration of instruments, The Process of Measurement, Significance of measurement process , Methods of measurement, generalized measurement system, errors in measurement, gauges, comparators (mechanical and optical), Numericals	06 hrs
Chapter 2: Dimensional Metrology Measurement of screw thread parameters, Terminology of screw threads, types of threads , Toolmakers microscope, profile projector, Gear terminology, Measurement of gear parameters. Gear tooth vernier , Introduction to Surface Texture, Terminology as per Indian standard, Methods of measurement of surface finish, Working of Tomlinson surface meter, Taylor-Hobson Talysurf, Analysis of surface traces (RMS value, CLA value).	07 hrs
Chapter 3: Limits, Fits and Gauges Introduction, limits, tolerance, and fits, types of fits, allowance. Hole basis and shaft basis systems, Indian standard system for limits and fits (IS 919-2709), types of gauges, Taylor's principle and gauge design. Numericals Introduction to GD&T Terminology, Maximum Material control (MMC) & Least Material Control (LMC), Form and orientation tolerances in detail with application examples, Interpretation of drawings with GD & T and exercises,	07 hrs

Unit – II

Chapter 4: Advanced Metrology **CMM** Coordinate Measuring Machine: Co-ordinate metrology, CMM configurations, hardware components, Software, Probe sensors, Displacement devices, applications **Laser Metrology**: Free electron laser – optical alignment, measurement of distance – interferometry, reversible counting, refractive index correction, reversible counting, refractive index correction, surface topography and optical component testing,	07 hrs
Chapter 5: Analysis of Experimental Data Causes and Types of Experimental Errors, Error Analysis on a Common sense Basis, Uncertainty Analysis and Propagation of Uncertainty, Evaluation of Uncertainties for Complicated Data Reduction, Statistical Analysis of Experimental Data, Probability Distributions, The Gaussian or Normal Error Distribution, Comparison of Data with Normal Distribution, The Chi-Square Test of Goodness of Fit, Method of Least Squares, The Correlation Coefficient, Multivariable Regression, Standard Deviation of the Mean, Students t-Distribution	07 hrs
Chapter 6: Quality Engineering Quality concepts, Dimensions of quality, Inspection, Objectives of Inspection Difference between Inspection & Quality Control,7 QC tools, Statistical methods for quality control and improvement Basic Principles of control charts, control charts for variables, process capability and six sigma	07 hrs

Unit – III

Chapter 7: Control charts for attributes and acceptance sampling Control chart for fraction non-conforming, variable sample size, Number of defective chart, Control chart for Non conformities (defects) and Control chart for defects Average number of nonconformities. Types of sampling plans, operating characteristic (OC) curves	05 hrs
Chapter 8: TQM	05 hrs

Basic approach, TQM framework, TQM principles-Leadership, Employee involvement, Empowerment, Team and Teamwork, Quality circles ,Continuous process improvement – PDCA cycle, 5S, Kaizen – Supplier partnership – Partnering, TQM techniques- Bench marking, FMEA, QFD, TPM

Text Books:

1. Beckwith Marangoni and Lienhard, Mechanical Measurements, Pearson Education
2. Doebelin E.O., Measurements Systems, Applications and Design, McGraw –Hill 1990
3. Montgomery D. C., Introduction to Statistical Quality Control, John Wiley & Sons, Inc

Reference Books:

1. Holman J P, Experimental Methods for Engineers, McGraw-Hill. Eighth edition.
2. I.C. Gupta, Engineering Metrology, Dhanpat Rai Publications, Delhi.
3. Dotson C. Cengage, Fundamentals of Dimensional Metrology.
4. Bosch J A, Giddings and Lewis Dayton, Marcel Dekker. Co-ordinate Measuring Machines and Systems
5. Grant and Leavenworth, Statistical Quality Control, McGraw Hill

Course Code: **15EMEC303**		**Course Title: Introduction to Finite Element Methods**
L-T-P: 3-0-0	Credits: 3	Contact Hrs: 3 hrs/week
ISA Marks:50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 40		Exam Duration: 3 hrs

Unit - 1

1. Introduction to FEM: FEM paradigm : History, present/future, Research, Application, stress at a point, stress components on arbitrary plane, Equilibrium equations, compatibility equations, Generalized Hook's law, Plane stress and plain strain, principle of minimum potential energy and virtual work, RR method and Galerkin's methods, FEM steps, Advantages , disadvantages and limitations.	07 hrs
2 Interpolation Functions For General Element Formulation : Discreatisation process, types of elements, size of elements, location of node, node numbering scheme and mesh requirements in finite element method, polynomial form of interpolation functions, convergence requirements, Pascal triangle, shape functions (1D, 2D, LST, CST, Quad, Higher order elements), Stiffness matrix and its properties.	08 hrs

Unit - 2

3. Basic FEA: Illustrate the concept of linear static analysis, Non-linear analysis: Material, Geometry and Contact nonlinearity, Linear buckling analysis, Dynamic analysis, and Thermal analysis using practical applications.	10 hrs
4. Advanced FEA: Optimization - Shape/Material, Crash/Impact/Drop test analysis, Fatigue analysis: Stress based and Strain based approach, Modeling & Analysis of Composite (Coupons, Laminates, particulate form). Iso-parametric and Axi-symmetric elements.	07 hrs

Unit - 3

5. Post processing techniques: Validate and interpret the results, Average and Un-average stresses, Special tricks for post processing, Design modification, CAE Reports	04 hrs
6. Experimental Validation and Data Acquisition: Strain gauge, Photo elasticity, Load cells, Torque Sensors/Transducers, Dynamic tests, Acceleration test, Fatigue life measurement, Natural Frequency measurements.	04 hrs

Text Book

1. K. H. Huebner, D. L. Dewhirst, D. E. Smith and T. G. Byrom, The Finite Element Method for Engineers, 4th edition, Wiley, New York, 2001.
2. T. R. Chandraputala and A. D. Belegundu, Introduction to Finite Elements in Engineering, Third Edition, Prentice Hall of India, 2004.
3. Nitin Ghokale, Practical finite element analysis, Finite to infinite, 2008.

Reference Book:

1. N. S. Ottosen and H. Petersson, Introduction to the Finite Element Method,. Prentice-Hall, Englewood Cliffs, 1992.

Course Code: 15EMEC304		**Course Title: Design of Machine Elements**
L-T-P: 3-1-0	Credits: 4	Contact Hrs: 5
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 40+24		Exam Duration: 3 hrs

Unit – 1

Chapter 1: Spur Gears 08 hrs

Mechanical Drives, Gear Drives, Classification of Gears, Selection of Type of Gears, Terminology of Spur Gear, Standard Systems of Gear Tooth, Force Analysis, Gear Tooth Failures, Selection of Material, Number of Teeth, Face Width, Beam Strength of Gear Tooth, Permissible Bending Stress, Effective Load on Gear Tooth, Estimation of Module Based on Beam Strength, Wear Strength of Gear Tooth, Estimation of Module Based on Wear Strength

Chapter 2: Helical and Bevel Gears 07 hrs

Helical Gears, Terminology of Helical Gears, Virtual Number of Teeth, Tooth Proportions, Force Analysis, Beam Strength of Helical Gears, Effective Load on Gear Tooth, Wear Strength of Helical Gears. Bevel Gears, Terminology of Bevel Gears, Force Analysis, Beam Strength of Bevel Gears, Wear Strength of Bevel Gears, Effective Load on Gear Tooth.

Unit – 2

Chapter 3: Springs 08 hrs

Types of springs, Terminology of Helical spring, styles of ends, stress and deflection equations, series and parallel connections, spring materials, Design of helical springs, spring design –trial and error method, design against fluctuating load, optimum design of helical spring, surge in spring, multi-leaf springs, nipping of leaf springs.

Chapter 4 Clutches and Brakes 07 hrs

Clutches, Torque Transmitting Capacity, Multi-disk Clutches, Friction Materials, Block Brake and Disc Brakes

Unit – 3

Chapter 5: Rolling Contact Bearings 05 hrs

Bearings, Types of Rolling Contact Bearings, Selection of Bearing Type, Static Load Carrying Capacity, Dynamic Load Carrying Capacity, Equivalent Bearing Load, Load-Life Relationship, Selection of Bearing Life, Load Factor, Selection of Bearing From Manufacturer's Catalogue, Bearing failure – Causes and Remedies.

05 hrs

Chapter 6: Sliding Contact Bearings

Basic Modes of Lubrication, Viscosity, Measurement of Viscosity, Viscosity Index, Petroff's Equation, Mckee's Investigation, Bearing Design- Selection of Parameters, Comparison of Rolling and sliding Contact Bearings, Bearing failure – Causes and Remedies

Text Book:

1. Robert L. Norton, Machine Design , An integrated Approach, , Pearson Education, 2004
2. V.B. Bhandari, Design of Machine Elements:, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2nd Edition 2007.

References:

1. S.K. Somani, Machine Design: Hall, Holowenko, Laughlin (Schaum's Outlines series) Tata McGraw Hill Publishing Company Ltd., New Delhi, Special Indian Edition, 2008.

Design Data Hand Books:

1. K. Mahadevan and Balaveera Reddy, Design Data Hand Book, CBS Publication

Course Code: 15EMEP301 **Course Title: Metrology and Quality Engineering Lab**

L-T-P: 0-0-1	Credits: 1	Contact Hrs: 2 hrs/week
ISA Marks: 80	ESA Marks: 20	Total Marks: 100
Teaching Hrs: 24		Exam Duration: 2 hrs

Expt. No.	Brief description about the experiment	No. of Lab. Slots
01	Introduction to the Laboratory-Overview of standards of measurement for Linear and angular dimensions.	01
02	Analysis of performance characteristics of measuring instruments using Hypothesis testing.	01
03	Analysis of Repeatability and Reproducibility using gauge R& R test.	01
04	Measurement of Screw thread and Gear parameters, surface roughness	01
05	Machine Tool Alignment Test (Lathe, Drilling, Milling).	01
07	Measurement of Dimensions and GD&T parameters of given components using CMM (Coordinate Measuring Machine).	01
08	Reverse engineering of the given component by extraction of 2-Dimensions of the given part using 3D scanner.	02
09	Testing the goodness of fit for the given quality characteristics by Chi Square test	01
10	Construction of control chart for variables and Analysis of process capability for the different components manufacturing.	01
11	Construction and Analysis of control charts for defectives.	01
12	Open ended experiment- Error analysis , Gauge Design	01

Reference books:

1. Hume K.J.& Sharp G.H, ”Practical metrology”, ELBS &Macdonald
2. Montogomery D. C., Introduction to statistical Quality control, John wiley and sons.
3. Juran J.M. & F.M. Gryna, Quality Planning & Analysis, TMH

Course Code: 15EMEP302		**Course Title: Computer Aided Engineering Lab**
L-T-P: 0-0-1	Credits: 1	Contact Hrs: 2 hrs/week
ISA Marks: 80	ESA Marks: 20	Total Marks: 100
Teaching Hrs: 24		Exam Duration: 2 hrs

LAB Details:

Category: Demonstration		**No. of Lab. Sessions per batch (estimate)**
1	Scientific Research Exposure (Research Education): Methods to search/extract Journal papers (Reputed journal paper), Referring papers, Drafting a paper. Introduction to ANSYS Workbench and familiarity. Real time Current/future field issues : Problem Identification	**03**

Category: Exercises

Expt./Job No.	**Experiment/job Details**	**No. of Lab. Sessions per batch (estimate)**
1.	Static Structural analysis a) Uniform bar, b) Bracket, c) Machine Components	01
2.	Non-Linear Structural Analysis a) Geometric Nonlinearity b) Material Nonlinearity c) Contact Nonlinearity	01
3.	Dynamic Analysis (Modal/Harmonic/Transient Analysis) a) Beam (Different Boundary Conditions) b) Machine components	01
4.	Linear Buckling a) Columns & Struts (Different Boundary Conditions) b) Machine Component	01
5.	Thermal Analysis a) Fins b) Heat Exchangers c) Machine component	01
6.	Fatigue Analysis & Fatigue life Prediction a) Plate with hole or Bracket b) Machine components such as Shafts, Bearing etc.	01
7.	Drop Test & Impact Analysis a) Mobile drop test b) TV, Refrigerator etc.	01
8.	Optimization	01
9.	Composite Analysis - Laminate/Dispersed Coupon model	01

Category: Structured Enquiry

Execute all the FEM Analysis modules which are dealt under the lab exercise.
Identify the component (Sub-assembly need have Minimum 3 to 4 components)
Start from scratch

- Measure the dimensions of component
- Generate the Solid Modeling of components with overall assembly (In any of the CAD Software)
- Import the model in neutral form to ANSYS Workbench
- Collection of data relevant to Material Properties
- Understand the physics of the problem (Working Principle with load's and boundary conditions)

- Interpretation of Results with conclusion.

Category: Open ended

Identify field issue pertaining to any component/product in today's industry.

1. Collect the information/literature on earlier worked project through external/internal search (Journal Paper/Patent/reports)
2. Comprehend the physics of the problem with working principle.
3. Prepare the abstract and apply to a national/international conference
4. Identify material properties, boundary conditions and load steps.
5. Carryout the analysis as per the FEA steps.
6. Provide engineering solutions to the identified sub assembly (deformation and stresses, material change, weight reduction, increasing load bearing capacity, fatigue life calculation, prediction of endurance limit of component and damage factor).
7. Prepare the draft on the worked out problem and apply to a national/international conference

Materials and Resources Required:

1. Books/References: Nitin Ghokale, Practical finite element analysis
2. Manuals: Sham Tickoo, ANSYS for Engineers and Designers.

Course Code: 15EMEP303 | **Course Title: Automation Lab**

L-T-P: 0-0-2	Credits: 2	Contact Hrs: 4 hrs/week
ISA Marks: 80	ESA Marks: 20	Total Marks: 100
Teaching Hrs: 48		Exam Duration: 2 hrs

Chapter No. 1. Automation Using Hydraulic Systems 08 hrs

Introduction to Fluid Power, Advantages and application of Fluid Power, Types of Fluid Power System, Properties and Types of Fluids. Pascal's Law, Continuity Equations, Structure of Hydraulic Control System. The Source of Hydraulic Power: Pumps Pumping Theory, Pump Classification, Gear Pumps, Vane Pumps, Piston Pumps, Pump Selection, Hydraulic Actuators and Motors. Control Components In Hydraulic Systems: Symbolic representation as per ISO 1219 and ISO 5599. Directional Control Valves – Symbolic representation, Constructional features, pressure control valves, flow control valves. **Hydraulic Circuit Design (Simulation of circuits in Automation studio):** Control of single and double – acting Hydraulic Cylinder, regenerative circuit, pump unloading circuit, Double pump Hydraulic system, Counter Balance Valve application, Hydraulic cylinder sequencing circuits, cylinder synchronizing circuits, speed control of hydraulic cylinder, accumulator circuits.

Chapter No. 2. Automation using Pneumatic Systems 05 hrs

Choice of working medium, characteristics of compressed air. Structure of Pneumatic control system. Linear cylinders, Simple Pneumatic Control: Direct and indirect actuation pneumatic cylinders, use of memory valve. Flow control valves and speed control of cylinders supply air throttling and exhaust air throttling, use of quick exhaust valve. Signal processing elements: Use of Logic gates – OR and AND gates pneumatic applications.

Chapter No. 3. Automation Using Electronic Systems 05 hrs

Control of hydraulic and pneumatic elements through PLC, Programmable automation controllers(PAC)

Chapter No. 4. Robot programming & Control 05 hrs

Introduction to robotics, robot anatomy, work volume, robot drive systems, control systems and dynamic performance, precision of movements, end effectors Robot physical configuration and basic robot motions, Types of manipulators- constructional features, servo and non-servo manipulators.

Text Book

1. Mikell.O. Groover , Automation, Production system and Computer Integrated Manufacturing, 2nd, PHI, 2002
2. Anthony Esposito, Fluid power with applications, 5th, Pearson Ed, 2000
3. Mikell P. Groover& Mitchell Weiss, Industrial Robotics, 2nd, Mc Graw H, 2003
4. William Bolton, Programmable Logic Controllers, 4th, Newnes, 2006

References

1. S R Majumdar, Hydraulic systems, Principles and Maintenance, 5th, TMH, 2002
2. S R Majumdar, Pneumatic Systems, 2nd, TMH, 1995
3. Labrotaory manual prepared by inhouse team.

Laboratory:

Sl. No	Name of Experiments	Duration
1	Characteristic Curve of Variable Displacement Hydraulic Pump	1/2
2	Carryout pressure intensification of a single-rod cylinder	1/2
3	Carryout Meter-in and Meter-out circuits using Single-rod cylinder and 4/2 DCV	1/2
4	Center Configuration of 4/3 DCV	1/2
5	Application of Regenerative Circuit	1
6	Direct control of Double Acting Cylinder	1/2
7	Indirect control of Double Acting Cylinder	1/2
8	Speed Control of Single Acting Cylinder	1/2
9	Position Dependent Control of a Double Acting Cylinder with Mechanical Limit	1/2

	Switches	
10	Design of PLC system to control single acting cylinder, double acting cylinder, meter-in, meter-out and regenerative action.	1
11	To control extension/retraction with or without delay using ladder logic	1
12	Design of PLC system for, i. Clamping and punching operation (punching press machine) ii. Clamping and movement of tailstock (CNC machine)	1
13	To build and simulate arc/spot welding process in robotic environment	1
14	To build and simulate pick and place mechanism in robotic environment	1

Course Code: 15EMEC305		**Course Title: Heat & Mass Transfer**
L-T-P: 3-0-0	Credits: 3	Contact Hrs: 3 hrs/week
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 40		Exam Duration: 3 hrs

Unit –I

Chapter 1.Introductory concepts and definitions: Modes of heat transfer: Basic laws governing conduction, convection, and radiation heat transfer; Thermal conductivity; convective heat transfer coefficient; radiation heat transfer combined heat transfer mechanism, — 06 hrs

Mass transfer; Definition and terms used in mass transfer analysis, Fick's first law of diffusion. Boundary conditions of 1st , 2nd and 3rd kind Conduction: General 3D- heat conduction equation in Cartesian coordinate, discussion on 3-D conduction in cylindrical and spherical coordinates (No derivation). 1-D conduction through plane and composite walls. Overall heat transfer coefficient. Mathematical formulation

Chapter 2 One dimensional Steady State Conduction: Heat flow and temperature distribution in plane wall. Critical thickness of insulation, Thermal resistance concept. Steady state conduction in slab, cylinder and spheres with heat generation. Heat transfer in extended surfaces of uniform cross-section without heat generation [No Derivations]Fin efficiency and effectiveness. Numericals — 05 hrs

Chapter 3.One-dimensional transient conduction: Conduction in solids with negligible internal temperature gradient (Lumped system analysis), Use of Transient temperature charts (Heisler's charts) for transient conduction in slab, long cylinder and sphere Numerical Problems — 04 hrs

Unit – II

Chapter 4. Concepts and basic relations in boundary layers: — 05 hrs

Flow over a body velocity boundary layer, general expressions for drag coefficient and drag force, thermal boundary layer. general expression for local heat transfer coefficient; Average heat transfer coefficient; Nusselt number. Flow inside a duct, Numerical problems based on empirical relation given in data handbook.

Free or Natural Convection: Dimensional analysis for free convection- significance of Grasshoff number, correlations for free convection over vertical, horizontal and inclined flat plates, vertical and horizontal cylinders and spheres

Chapter 5. Forced Convection: Dimensional analysis for forced convection, significance of Reynolds, Prandtl, Nusselt and Stanton numbers. Correlations for hydrodynamically and thermally developed duct flows, Correlations for flow over flat plate, cylinder and sphere. — 05 hrs

Chapter 6.Heat Exchangers: Classification of heat exchangers; overall heat transfer coefficient, fouling and fouling factor; LMTD, Effectiveness-NTU methods of analysis of heat exchangers. Numerical problems — 05 hrs

Unit – III

Chapter 7. Condensation and Boiling: Types of condensation (discussion only) Nusselt's theory for laminar condensation on a vertical flat surface [No Derivation]; use of correlations for condensation. Regimes of pool boiling pool boiling correlations [Theory]. — 05 hrs

Chapter 8. Radiation heat transfer: Thermal radiation; definitions of various terms used in radiation heat transfer; Stefan-Boltzman law, Kirchoff's law, Planck's law and Wein's displacement law. Radiation heat exchange between two parallel infinite black surfaces, between two parallel infinite gray surfaces, intensity of radiation and solid angle; Lambert's law; radiation heat exchange between two finite surfaces configuration factor or view factor. Numerical problems — 05 hrs

Text Book

1. Nicati Ozisik **-** Heat transfer-A basic approach, Tata Mc Graw Hill, 2002
2. M.Tirumaleshwar – Fundamentals of Heat & Mass Transfer, Pearson education 2009

References

1. Yunus A. Cengel - Heat transfer, a practical approach, Tata Mc Graw Hill, 4th Edn, 2011
2. Frank Kreith, Raj M. Manglik, Mark S. Bohn, Principles of heat transfer, Cengage Learning, 7th Edn. 2011
3. Frank P. Incropera and David P. Dewitt- Fundamentals of Heat and mass transfer, John Wiley, 6th Edn., 2011
4. P.K. Nag - Heat and Mass transfer, Tata Mc Graw Hill, 3rd Edn.,2002

Course Code: 15EMEC307		**Course Title: I C Engines**
L-T-P: 2-0-0	Credits: 2	Contact Hrs: 2 hrs/week
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 26		Exam Duration: 3 hrs

Unit – 1

Chapter 1: Introduction to I C Engines: 7 hrs

Internal Combustion Engine Classification, Operating Cycles, Spark Ignition and Compression-Ignition Engines.

Combustion in Spark Ignition Engines

Ignition limits, Normal combustion, Thermodynamic Analysis of SI Engine Combustion - stages, ignition lag, and effect of engine variables on ignition lag Causes of Cycle-by-Cycle and Cylinder-to-Cylinder Variations and flame propagation phase, detonation, Abnormal Combustion: Knock Fundamentals and fuel factors, Factors affecting knock.SI engine combustion chambers.

Chapter 2: Combustion in Compression Ignition Engines 5 hrs

Types of Diesel Combustion Systems, Direct and Indirect-Injection Systems, Comparison, Combustion Efficiency, Normal combustion – stages, delay period, variables affecting delay period. Diesel knock, comparison between diesel and petrol engine knocks. CI engine combustion chambers, Fuel spray behavior. HRR analysis.

Unit – 2

Chapter 3: Engine Exhaust Emission Control 5 hrs

Formation of NO_X, HC/CO mechanism , Smoke and Particulate emissions, Green House Effect, Methods of controlling emissions , Three way catalytic converter and Particulate Trap, Emission (HC, CO, NO and NO_X) measuring equipments, Smoke and Particulate measurement, Indian Driving Cycles and emission norms.

Chapter 4: Recent Trends in IC Engines 6 hrs

Dual fuel Engine, Common Rail Direct Injection Diesel Engine (CRDI), Homogeneous Charge Compression Ignition Engine (HCCI), Reactivity controlled compression ignition engine (RCCI) Lean Burn Engine, Surface Ignition alcohol CI Engine, VVT engines, Gasoline Direct Injection Engine.

Unit – 3

Chapter 5: Overall Engine Performance: 4 hrs

Operating Variables that Affect SI Engine Performance, Efficiency, and Emissions: Spark Timing, Mixture Composition, Load and Speed, Compression Ratio. Variables that Affect CI Engine Performance, Efficiency, and Emissions: Load and Speed, Fuel-Injection Parameters.

Chapter 6: Alternate Fuels for IC Engines 3 hrs

Alcohols, bio-diesel, Natural Gas, Hydrogen, Properties, Suitability, Engine Modifications

TEXT BOOK:

1. John B Heywood, Internal Combustion Engine Fundamentals, Tata McGraw-Hill, 1988
2. Heinz Heisler, Advanced Engine Technology, SAE International Publications, USA,1998
3. Patterson D.J. and Henein N.A, Emissions from combustion engines and their control, Ann Arbor Science publishers Inc, USA, 1978

REFERENCES:

1. Ganesan V. Internal Combustion Engines, Third Edition, Tata Mcgraw-Hill, 2007.
2. Gupta H.N, Fundamentals of Internal Combustion Engines, Prentice Hall of India, 2006.
3. Ultrich Adler, Automotive Electric / Electronic Systems, Published by Robert Bosh GmbH, 1995.

Course Code: 17EMEC308	**Course Title: CAD Modeling, Analysis & PLM**

L-T-P: 2-0-5	Credits: 7	Contact Hrs: 15 hrs/week
ISA Marks: 80	ESA Marks: 20	Total Marks: 100
Teaching Hrs: 80		Exam Duration: 2 hrs

Sl no	**Work benches**	**description**	**No of weeks**
1	Sketcher	Brief introduction on Sketcher work bench environment Structure of users and saving of files. **Exercises on Sketch** Tools, Profile Tool bar and Constraint Tool bar: Generate the following 2D sketches and make them Iso-constrained.	1
2	Part Design	Exercise on 3d models using pad, slot, shaft, groove, hole ,rib and stiffener commands, cut revolve, Dress up commands like chamfer, fillets etc. ***(***Multi-Sections Solid and Removed Multi-Sections Solid Commands)	2
3	Generative Shape Design (GSD)	Exercises using GSD to generate complicate surfaces using sub tool bars: Extrude-Revolution, Offset Var and Sweeps Extrude, Revolve, Trim, Transformation and Fillet tools Exercises on Wireframe, Surfaces and Operations Tool bar: (Conversion of Surface model into Solid model	2
4	Sheet Metal	Setting Sheet Metal Parameters, Bend Extremities Tab, Creating the Base Wall, Creating the Wall On Edge, Creating extrusions, Creating swept walls, Creating Hems on Sheet Metal part, Creating A Bend. Development of sheet metal drawings.	1
5	Assembly design	Introduction to Assembly Design Work bench Bottom-Up and Top-Down assembly approaches Invoking existing components into assembly work Exercise to demonstrate Top-Down assembly approach.	2
6	Drafting	Converting existing 3D models into 2d drawings with all relevant details, sectional views, sheet selection, indicating GD&T symbols and dimensioning**.**	3
7	Enovia	Introduction to CATIA V6 PLM Import the existing CATIA V5 data and store in V6 Search and identify the data located in V6 database Modify the data in any PLM process Sharing information with users Analyze and Identify impacts of modifications Save the modifications into database	1

Course Code: 15EMEP304 | **Course Title: Thermal Engineering Lab.**

L-T-P: 0-0-1	Credits: 1	Contact Hrs: 2 hrs/week
ISA Marks: 80	ESA Marks: 20	Total Marks: 100
Teaching Hrs: 24		Exam Duration: 2 hrs

1. **Fluid mechanics and hydraulic machines**
   - i. To obtain the performance characteristics of centrifugal blower
   - ii. To study the effect of speed on the performance of centrifugal pump
   - iii. To study the effect of speed / gate opening on the performance of Pelton turbine
   - iv. To study the effect of speed / gate opening on the performance of Francis turbine

2. **Heat transfer**
   - i. To determine the emissivity of given surface
   - ii. To determine the thermal conductivity of metal bar and to study the effect of temperature on thermal conductivity
   - iii. To study the performance of pinfin
   - iv. To study the performance of vapour compression refrigeration (VCR) system

3. **I C Engines**
   - i. To study the performance of two stroke engine
   - ii. To obtain the performance characteristics of multicylinder engine using Morse test
   - iii. To study the effect of engine operating variables (Injection pressure/ injection timing/ compression ratio)

Materials and Resources Required:

1. White, F.M., Fluid Mechanics, 5ed., McGraw Hill International, 2003
2. Nicati Ozisik **-** Heat transfer-A basic approach, Tata Mc Graw Hill, 2002
3. Yunus A. Cengel - Heat transfer, a practical approach, Tata Mc Graw Hill, 4th Edn, 2011
4. John B. Heywood, Fundamentals of Internal Combustion Engines, McGrawHill, Singapore.
5. Ganesan.V, Internal Combustion Engines, Tata McGraw Hill, 2nd Edition, 2003
6. Manuals: Lab manual prepared by the Department

Course Code: 15EMEW303 **Course Title: Mini Project -- II**

L-T-P: 0-0-3	Credits: 3	Contact Hrs: 3 hrs/week
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
		Exam Duration: 3 hrs

Minor Project Theme

The minor project is designed to help students develop practical ability and knowledge to understand basics of Machine tool design. This course project involves practically designing a given specifications of a machine develop alternate designs carry out design calculations. The theoretical knowledge gained from the MACHINE TOOL DESIGN course helps in providing the necessary foundation/principles to develop effective solutions. Students shall apply methodologies learnt in Engineering Design Course. A batch of 10 students each will be given specifications of a machine or system.

The students will have to develop proficiency in 2D and 3D modeling, Geometrical dimensioning & tolerancing. He/she should be well versed in material selection based on applications and develop assembly and part drawings as per industry standard,

Individual team has to prepare final model in 2D and 3D with proper documentation for the entire project. Progress of the project work will be presented by student's periodically to the panel of reviewers.

The project given will be CNC lathes, CNC milling or any other project like development of a lathe headstock and feedbox etc

Phases of Project Work:

- Students will first be given an assignment to showcase their proficiency in Auto CAD, Solid modeling and application of GD&T on manufacturing drawings.
- For projects, specifications will be provided for each batch of 10 students. They have to prepare layouts of assemblies, and convert the specifications into layouts taking due accounts of standards from ISO, IS, ASTM & Machine testing.
- Prepare alternate designs wherever required and select the most optimal design.
- Carry out design calculations to select various machine tool elements like servo motor, spindle motor, keys, poly-v belts, ball-screws etc.
- Prepare assembly drawings of various assemblies with all part drawings as per industry standards and prepare Bill of Material.
- Carry out aesthetics, ergonomics and safety standards and incorporate them in the drawings.
- Prepare a final detailed report explaining the various stages and give a presentation.

Course Code: 15EMEE301		**Course Title: Mechanical Vibrations**
L-T-P: 3-0-0	Credits: 3	Contact Hrs: 3 hrs/week
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 40		Exam Duration: 3 hrs

Unit – 1

1. Undamped Free Vibrations 6hrs

Introduction, Importance of vibration and its physical significance, Types of vibrations, Mechanical system components, Equivalent stiffness of spring combinations, Derivation of differential equation and Natural frequency for undamped free vibrations of single degree freedom systems, Newton's method and Energy method, Torsional vibrations, Transverse vibrations of beams.

2.Damped Free Vibrations 5hrs

Introduction, types of damping, study of response of single degree freedom viscous damped systems for cases of under damping, critical damping and over damping, Logarithmic decrement, Torsional system with viscous damping.

3.Whirling of Shafts

Introduction, Whirling of shafts with and without damping, Discussion of speeds above and below critical speeds, Introduction to Noise. 5hrs

Unit – 2

4. Forced Vibrations

Introduction, Forced vibrations of single degree freedom viscous damped system due to harmonic excitation, Response of a rotating and reciprocating unbalance system, Support excitation, Vibration isolation and transmissibility. 7 hrs

5. Two Degree of Freedom Systems

Introduction, Principal modes and Normal modes of vibration, Vibrations of undamped systems, Torsional vibrations, Forced harmonic vibration, Systems with damping, Co-ordinate coupling; applications in vehicle suspension, Dynamic vibration absorber. 7 hrs

Unit – 3

6. Multi Degree of Freedom Systems

Introduction, Influence coefficients, Maxwell reciprocal theorem, Orthogonality principle, Matrix iteration method to determine all the natural frequencies of multi degree freedom systems, Dunkerley's method, Rayleigh's method. 5 hrs

7. Vibration Measurement and Condition Monitoring

Introduction, Vibrometer and accelerometer, Frequency measuring instruments. Signal analysis: Spectrum analyzers, Dynamic testing of machines and structures, Experimental modal analysis, Machine maintenance techniques, Machine condition monitoring techniques, Vibration monitoring techniques. Demonstration of experimental modal analysis using Sakshat Virtual lab. 5 hrs

Text Book

1. S. S. Rao, Mechanical Vibrations, Pearson Education , 6th Edition, 2017
2. W.T. Thomson and Marie Dillon Dahleh - Theory of Vibration with Applications, Pearson Education 5th edition, 2007

References

1. S. Graham Kelly, Adopted by: Shashidhar K Kudari - Mechanical Vibrations, Schaum's Outlines, The McGraw-Hill, 2007.
2. Mechanical Vibration Practice with Basic Theory- V. Ramamurti, Narosa, 2000

Course Code: 15EMEE302		**Course Title: Failure Analysis in Design**
L-T-P: 3-0-0	Credits: 3	Contact Hrs: 3 hrs/week
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 50		Exam Duration: 3 hrs

Unit – 1

1. Introduction: Study of Failure criteria and its importance, Role of failure prevention analysis in mechanical design, Modes of mechanical failure, Review of failure theories for ductile and brittle materials including Mohr's theory and modified Mohr's theory, Numerical examples.	8hrs
2.Surface Failure: Introduction, Surface geometry, Mating surface, Friction, Adhesive wear, Abrasive wear, Corrosion wear, Surface fatigue spherical contact, Cylindrical contact, General contact, Numerical examples.	7hrs

Unit – 2

3. Fatigue of Materials: History of failure due to fatigue loads and development of fatigue failure, Concepts and terminology, High cycle and low cycle fatigue, Fatigue design models, Fatigue design methods, Fatigue design criteria, Fatigue testing, Fatigue fracture surfaces and macroscopic features, Fatigue mechanisms and microscopic features.	5hrs
4. Stress-Life (S-N) Approach: S-**N** curves, Statistical nature of fatigue test data, General S-N behavior, Different factors influencing S-N behavior, S-N curve representation and approximations, Constant life diagrams, Fatigue life estimation using S-N approach, Case study.	5hrs
5. Strain-Life (ε-N)approach: Monotonic stress-strain behavior , Strain controlled test methods, Cyclic stress-strain behavior ,Strain based approach to life estimation, Determination of strain life fatigue properties, Mean stress effects, Effect of surface finish, Life estimation by ε-N approach.	5hrs

Unit – 3

6. **Creep deformation:** The evolution of creep damage, primary, secondary and tertiary creep. Stress dependence of creep – power law dependence. Comparison of creep performance under different conditions – extrapolation and the use of Larson-Miller parameters. Creep-fatigue interactions. Numerical examples.	5hrs
7. Buckling Analysis of rectangular palates: Governing differential equation and boundary conditions, plate with all edges simply supported, plates with other boundary conditions, buckling under in-plane shear, post buckling analysis.	5hrs

Text Book

1. Ralph I. Stephens, Ali Fatemi, "Metal Fatigue in Engineering", John Wiley New York, 2nd edition, 2001.
2. Robert L. Norton, Pearson, "Machine Design- An Integrated Approach", 2nd edition, 2000.
3. Jack A Collins, Failure of Materials in Mechanical Design John Wiley & Sons, 1993.
4. Gambhir, M.L, Stability Analysis and Design of Structures, Springer-Verlag, 2004.

Course Content

Course Code: 15MEE303 | **Course Title: Piping systems Design**

L-T-P: 3-0-0	Credits: 3	Contact Hrs: 3
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 3		Exam Duration: 3 hrs

Unit - 1

Chapter No. 01. Introduction to piping — 2 hrs

Role of piping design engineers, Inputs and outputs of piping department, Scope and prospects in various industries, trends in piping industry.

Chapter No. 02. Piping systems Basics — 3 hrs

Process Design, Block Flow diagrams, Process flow diagrams (PFD), Piping and Instrumentation Diagrams(P&ID's), Commonly used symbols in PFD and P & ID, Lines/signals, Piping: services, equipments, Fluid codes (process), Insulation.

Chapter No. 03. Codes and Standards — 2 hrs

Standards, major organizations for standards, Design code-ASTM standards, ASME standards

Chapter No. 04. Piping elements and symbolic representations — 4 hrs

Fittings used to join pipes, Fittings used to change pipe direction, Fittings used to join different sizes of pipes, Fittings used for various purposes –such as flange, gaskets, Fittings used for branching, special fittings used for Branching.

Unit - 2

Chapter No. 05. Valves — 3 hrs

Types of valves, control valves, safety valves, constructional features. Criteria for selection. Piping components, pressure relieving devices, constructional features, selection criteria. Gate valve, globe valve, ball valve, check valve, Butterfly valve, Diaphragm Valves, Needle valve, Piston valve, Knife Gate valve.

Chapter No. 06. Process Equipments used in plants — 3 hrs

Pumps, storage tanks, vertical vessels, Horizontal dryer, Heat Exchangers, filters, blowers, Industrial boilers, steam turbines, compressors,

Chapter No. 07. Process Instruments — 3 hrs

Pressure Gauge, Temperature Gauge, Level indicators, flow metering/indicators, Safety valves, breather valves.

Chapter No. 08. Plot Plan Development — 2 hrs

Plot plan development, Basic data, steps to be considered while developing the plot plan. Layout of Liquid storage, Layout considerations for explosive tank farm, Layout of gas Storage.

Unit - 3

Chapter No. 09. Piping Layouts — 3 hrs

Introduction to P&I Diagrams, process flow diagrams, standard symbols and notations. Introduction to various facilities required. Guidelines for plot plan/ plant layout. Introduction to equipment layout, piping layout, piping isometrics and bill of material. Typical piping system layout considerations. Piping arrangements, clearances and access, pipe rack, valve location, tower piping,

Chapter No. 10. Conversion of orthographic to isometric view — 3 hrs

Introduction to isometric view, symbolic representation of elements in isometric environment, Pipe layout exercises,

Chapter No. 11. Plant Layout Design software - LAB — 12 hrs

Introduction to CADMATIC Software, 15 most important shortcut commands and practice Construction of Pipe line Route, 4 (Pipe D)(refer to the drawing in the next subsequent pages), Construction of Pipe line Route 6 (Pipe F) , Construction of Pipe line Route 8.(Pipe H) , Construction of Pipe line Route 9(Pipe I), Construction of Pipe line Route 11 (Pipe K), Construction of Pipe line Route No 14 (Pipe M). Construction of Pipe line Route No 3, 1, 2, (Pipe C, A, B) , Construction of Pipe line Route No 5 ,7, 10,(Pipe E, G, J) , More features of software namely ladder, pipeline rack, and cable tray construction. Construction of all the pipeline network and Practice session

Text Books (List of books as mentioned in the approved syllabus)

1. Ed. Baushbacher, Roger Hunt, Process Plant Layout and Piping Design, 1993, Prentice Hall , 1993

References

1. Suvidya Institute of Technology Pvt. Ltd, Manual on Piping Engineering, Suvidya Institute of Technology Pvt. Ltd. Mumbai

2. Yunus A. Cengel, John M. Cimbala,, Fluid Mechanics Fundamental and Applications, 2nd, MGH,, 2006

Course Code: 15EMEE304		**Course Title: Product Innovation**
L-T-P: 2-1-0	Credits: 3	Contact Hrs: 4 hrs/week
ISA Marks: 70	ESA Marks: 30	Total Marks: 100
Teaching Hrs: 24	Tutorial Hrs : 24	Exam Duration: 3 hrs

Unit – 1

1. Innovation Types, Drivers and Enablers

Definition and different types of innovations shall be discussed with live examples in the product development industry. Innovation drivers and enablers which lead to product innovations shall be elucidated with case studies. 8hrs

Unit – 2

2.Innovation Tools and Methods

Though it might sound like contradiction, innovations can be developed systematically by using tools and methods. Innovation methods such as TRIZ, ToC shall be explained with relevant examples. Innovation tools to explore opportunities such as brain-storming, contextual mapping, demographic studies and fore-sighting shall be discussed 8hrs

Unit – 3

3. Innovation Opportunity - Customer and Market Analysis

Customer mapping, demographics and persona shall be explained with examples and tutorials. Market potential and opportunity analysis for different innovations. Technology and demographic trends which shape the market, Competition analysis 5hrs

4. Intellectual Property

Tools and methods to protect IP – Patents, Design Patents, copyrights etc 3hrs

References

1. Playbook for strategic foresight and Innovation – Stanford University
2. R. T. Krishnan and V. Dabholkar- 8 Steps of Innovation
3. TRIZ and ToC – Handouts
4. Skogstad, P., Leifer, L.edited by Meinel, C., Leifer, L., Plattner, H. Springer Berlin Heidelberg. 2011: 19–43, A Unified Innovation Process Model for Engineering Designers and Managers **(**In Design Thinking)

Course Code: 15EMEE305		**Course Title: Advanced Machining Processes**
L-T-P: 3-0-0	Credits: 3	Contact Hrs: 3 hrs/week
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 40		Exam Duration: 3 hrs

Unit – I

Chapter 1: Introduction to Advanced Machining Processes 03 hours

Introduction to new methods of production; Need and Capability analysis of various processes, Classification and Selection of Non-Traditional Machining Technologies, Hybrid Processes, Cases.

Chapter 2: Mechanical Advanced Machining Processes 12 hours

Abrasive Jet Machining (AJM): Machining setup, parametric analysis, Process capabilities. Ultrasonic machining (USM): Machining setup, Mechanics of Cutting - Model Proposed by Shaw, Parametric analysis, Process capabilities, Abrasive Flow Machining, Magnetic Abrasive Finishing. Water jet cutting (WJC).

Unit – II

Chapter 3: Thermal Advanced Machining Processes 08 hours

Plasma Arc Machining (PAM): Working System, Elements of PAM, Process Performance, PAM Parameters, Process Characteristics, Safety Precautions, Electric Discharge Machining (EDM): Working Principle, Analysis, Process Variables, Process Characteristics, Applications

Chapter 4: Thermo-electric Advanced Machining Processes 07 hours

Electron Beam Machining (EBM): Working Principle, Process Parameters, Characteristics of The Process, Application of EBM, Laser Beam Machining (LBM): Working Principle, Types of Laser, Process Characteristics, Applications, Ion Beam Machining (IBM): Working Principle, Process Parameters, Applications

Unit – III

Chapter 5: Chemical Machining Processes 06 hours

Chemical Machining: Elements of process, Process Characteristics of CHM. Electro Chemical Machining: Elements and Characteristics and Theory of ECM

Chapter 6: Hybrid Processes 05 hours

Electro chemical grinding (ECG), Electrochemical spark machining (ECSM), electrochemical arc machining (ECAM) and electro discharge abrasive grinding (EDAG).

TEXT BOOKS:

1. Jain V. K. “Advanced Machining Processes”, Allied Publishers, Private Limited.
2. Pandey P. C. and Shan H. S., “Modern Machining Processes”, TATA McGraw Hill Publishing Company Limited, New Delhi.

REFERANCES:

1. HMT, “Production Technology”, TATA McGraw Hill.
2. Adithan M, “Modern Machining Methods”, S. Chand & Company, New Delhi.

Course Code: 15EMEE306 **Course Title: Computer Integrated Manufacturing**

L-T-P: 3-0-0	Credits: 3	Contact Hrs: 3 hrs/week
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 40		Exam Duration: 3 hrs

Unit – I

Chapter 1: Manufacturing operations: 08 hrs

Production system facilities, manufacturing support systems, automation in production systems, manual labor in production systems. Automation principles and strategies, manufacturing industries and products, product/production relationships, production concepts and mathematical models, costs of manufacturing operations

Chapter 2: Manufacturing systems: 08 hrs

Components, classification, manufacturing process functions, single station manufacturing cells, applications. Group Technology Part families, classification and coding, production flow analysis

Unit – II

Chapter 3: Cellular Manufacturing, Flexible Manufacturing Systems: 05 hrs

Cellular manufacturing quantitative analysis in cellular manufacturing, FMS components, planning and implementation, quantitative analysis of FMS

Chapter 4: Material handling and storage: 05 hrs

Material handling equipment, considerations in material handling system design, principles of material handling, material transport systems:, storage systems: automated storage systems, automatic data capture, automatic identification methods

Chapter 5: PLM and IIoT: 05 hrs

Areas of Product Life cycle Management (PLM), phases of product life cycle and technologies, benefits of PLM.

Definition of Industrial Internet of Things (IIoT), Evolution, Enablers for IIoT platform, drivers, Benefits, protocols, challenges, future

Unit – III

Chapter 6: Robot fundamentals: 05 hrs

Robot anatomy and related attributes, classification, robot control systems, end effectors, sensors in robotics, robot programming

Chapter 7: Robot kinematics: 05 hrs

Matrix representation, Homogeneous transformation matrices, Representation of transformations, Inverse transformation matrices, forward and inverse kinematics of robots, D-H representation of forward kinematic equations, degeneracy and dexterity

Text Books:

1. Grover M.P., "Automation, Production Systems and Computer Integrated Manufacturing", Prantice Hall, India.
2. Chris McMahon & Jimmie Browne, "CAD & CAM Principles", Practice & Mfg. Mngt.', Pearson Education.

Reference Books:

1. Radhakrishnan P., "CAD/CAM/CIM", New Age International Private Limited.
2. Zeid Ibrahim, "CAD/CAM", McGraw Hill International.
3. Rao P.N., 'CAD/CAM Principles and Applications', Tata McGraw-Hill.
4. Vajpayee S. K., "Principles of CIM", Prentice Hall of India.
5. Saeed B. Niku, "Introduction to Robotics", Prentice Hall of India.

Course Code: 15EMEE307		**Course Title: Sustainable Energy Conversion**
L-T-P: 3-0-0	Credits: 3	Contact Hrs: 3 hrs/week
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 40		Exam Duration: 3 hrs

Unit – I

Chapter No. 1. Energy Analysis of Thermodynamic Systems: 5hrs
Energy Analysis of flow and non-flow processes (Nozzles - Diffusors, Turbine and Compressors, Throttling Valves, Mixing Chambers, Heat Exchangers, Pipe and Duct flow), Isentropic Efficiencies of steady flow devices.

Chapter No. 2.Exergy: A Measure of Work Potential: 4hrs
Exergy associated with kinetic and potential energy, Reversible work and Irreversibility, Second Law efficiency, Second law analysis for non-flow and flow processes.

Chapter No. 3. Vapour and Combined Power Cycles: 6hrs
Criteria for the comparison of cycles; overall efficiency of a plant: combustion efficiency, mechanical efficiency, generator efficiency; work ratio; specific steam consumption; improvement of Rankine cycle, Reheat cycle, Regenerative cycle - with open and closed heaters; Second Law analysis of Vapour Power Cycles, Combined Gas - Vapour Power Cycles.

Unit – II

Chapter No. 4. Reciprocating Compressors: 6hrs
Machine cycle analysis, work and heat transfer; performance parameters of compressors: volumetric efficiency, isothermal efficiency, intercooling, intercooling pressure; reciprocating expanders.

Chapter No. 5. Centrifugal compressors: 6hrs
Velocity diagram, torque, work, power and general heat expression; total or stagnation pressure ratio; mass flow ratio; special considerations: no prewhirl, radial exit effect of blade shape on performance, pressure ratio and volume flow.

Chapter No. 6. Nozzles: Isentropic flow in convergent and convergent - divergent nozzles; critical pressure ratio; effects of varying back pressure. 3hrs

Unit – III

Chapter No. 7. Axial Flow Turbines: 5hrs
Velocity diagram; impulse and reaction turbines; h-s diagram for a stage; frictionless one dimensional flow impulse stage; diagram efficiency, blade speed ratio, optimum blade speed ratio; velocity compounded stage.

Chapter No. 8. Reaction Turbines: 5hrs
Temperature drop across turbines; isentropic efficiency and expansion ratio; degree of reaction and its expression in term of velocity diagram parameters; 50% reaction turbine; multi - staging; losses in turbines.

Text Books

1. Rogers. G.F.C. and Mayhew. Y.R., Engineering Thermodynamics, Longman, 1980.
2. Gordon J. Van Wylen and Richard E. Sonntag, Fundamentals of Classical Thermodynamics, Jenson Books Inc.

Reference Book

1. Yunus. A. Cengel and Michael. A. Boles, Thermodynamics: An Engineering Approach, McGraw Hill.

Course Code: 15EMEC401 | **Course Title: Operation Research**

L-T-P: 3-1-0	Credits: 4	Contact Hrs: 5 hrs/week
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 50		Exam Duration: 3 hrs

Unit – I

1.Introduction to operations research: 03 hrs

Introduction to O. R.: System orientation, use of interdisciplinary teams in OR, necessity of OR in business and industry, scope of OR in modern management, OR and decision-making, overview of OR.

2. Linear programming (LP): 12 hrs

Formulation: identification of decision variables, constructing objective functions and constraints, assumptions, practical examples, methods of solution: graphical method, simplex method (Big M and 2-phase methods), by computer, examples.

Unit – II

3. Duality theory and sensitivity analysis: 08 hrs

Duality theory: Existence of dual of a LP problem, economic interpretation of duality, primal dual relationships in formulation and their solutions, Sensitivity analysis or post optimality analysis: Dual simplex method, changes affecting feasibility, changes affecting optimality, examples.

4. Transportation models: 08 hrs

The transportation algorithm: Formulation as a LP problem, determination of initial solution, stepwise improvement to obtain optimal solution, special cases such as multiple, unbalanced, degeneracy etc., the assignment model: Formulation as a LP problem, the Hungarian method of solution examples.

Unit – III

5. Network models: 05 hrs

Critical Path Method (CPM) and Program Evaluation & Review Technique (PERT): Network representation of simple projects, critical path computation, construction of time schedule, crashing of project duration, examples.

6. Game theory: 05 hrs

Formulation of games, two person zero sum game, dominance property, games with and without saddle point, graphical solutions (2 x n, m x 2 game).

Text Book :

1. F.S. Hillier and Lieberman G.J., 'Introduction to Operations Research',9e, McGraw Hill, India, 2017
2. Taha H. A., 'Operations Research: An Introduction', 8e, pearson prentice hall, 2009, .

Reference Book :

1. Wayne L. Winston, 'Operations Research', Brooks/Cole – Thomson Learning.
2. Vohra N. D., 'Quantitative Techniques in Management', Tata McGraw Hill.

Course Code: 15EMEC402		**Course Title: Design of Thermal Systems**
L-T-P: 3-0-0	Credits: 3	Contact Hrs: 3 hrs/week
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 40		Exam Duration: 3 hrs

Unit - I

1	**Heat Exchangers Classification and Selection** Introduction, Recuperation and Regeneration, Transfer process, Geometry and Construction, -Tubular Heat Exchanger, Plate Heat Exchanger, Extended Surface heat exchanger, Heat Transfer Mechanisms, Flow arrangements, Applications and Selection of Heat Exchangers	5 hrs
2	**Design of Shell and Tube Heat Exchanger** Construction of shell and tube exchanger, specifications and classification of S&T Heat Exchanger, some Typical operating limits for heat exchangers of S&T Type, Analysis of Shell and Tube Heat Exchangers for Temperature Distribution, Design of Shell and Tube Heat Exchangers	10 hrs

Unit - II

3	**Modeling of Thermal Equipment** Counter flow heat exchanger, Evaporators and Condensers, Heat exchanger effectiveness, Effectiveness of a counter flow heat exchanger, NTU, Pressure drop and pumping power, Numerical Problems	6 hrs
4	**Pump and Piping System Design:** Introduction, Physical Fundamentals, Hydraulic fundamentals, Technical fundamentals-Installation, connection, suction pipe, Delivery pipe, NPSH, suction and delivery conditions, Cavitation, Q-H characteristic diagram, Flow rate, flow head, plant characteristic curve operating point	5 hrs
5	**Optimization** Mathematical representation of optimization problems, A water chilling system, Optimization procedure, Setting up the mathematical statement of the optimization problem	4 hrs

Unit - III

5	**LagrangeMultipliers** The Lagrange multiplier equations, unconstrained optimization, Constrained optimization	5 hrs
6	**Dynamic Programming** Characteristic of the Dynamic programming solution, Apparently constrained problem, Application of Dynamic programming to energy system problems	5 hrs

Text Book

1. W.F.Stoecker, Design of Thermal Systems, 3rd edn., MGH, 1989.
2. Sarit K. Das., Process heat transfer, Narosa Publishing House 1st Edition, 2005
3. SadikKakac, Hongtan Liu, Heat Exchanger Selection, Rating and Thermal Design, 2nd edn., CRC Press, 2002.
4. Yunus A. Cengel, John M. Cimbala, Fluid Mechanics Fundamental and Applications, 2nd Edition, MGH, 2006.
5. Manual for the Design of Pipe Systems and Pumps, GEA Tuchenhagen.

References

1. Hodge B.K., Analysis and Design of Thermal Systems, 1st edn., PHI, 1990.
2. CRI pump manufacturers catalog.

Course Code: 15EMEE401		**Course Title: Mechanics of Composite Materials**
L-T-P: 3-0-0	Credits: 3	Contact Hrs: 3
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 40		Exam Duration: 3 hrs

Unit - I

Chapter No. 1: Introduction to Composite Materials 05 Hrs

Introduction, Matrix materials-polymers, metals and ceramics; Reinforcements, Interfaces-wettability, interactions at the interface, types of bonding at the interface, optimum interfacial bond strength.

Chapter No. 2: Polymer Matrix Composites 05 Hrs

Types, characteristics ,processing of PMCs, Layup and curing, fabricating process, open and closed mould process, hand layup techniques; structural laminate bag molding, production procedures for bag molding; filament winding, pultrusion, pulforming, thermo-forming, injection molding, blow molding.

Chapter No. 3: Metal and Ceramic Matrix Composites 05 Hrs

Types of MMCs, base metals selection; important metallic matrices; processing-liquid state and solid state processes; interfaces in MMCs; Need for production of MMC's and its applications; Types of CMCs, processing of CMCs-cold pressing and sintering, hot pressing, reaction bonding processes, liquid infiltration, directed oxidation, in-situ chemical reaction techniques, sol-gel and polymer pyrolysis, applications of CMCs.

Unit - II

Chapter No. 4: Macro Mechanics of a Lamina 08 Hrs

Hooke's law for different types of materials, Number of elastic constants, Derivation of nine independent constants for orthotropic material, Two - dimensional relationship of compliance and stiffness matrix. Hooke's law for two-dimensional angle lamina, engineering constants - Invariant properties. Numerical problems.

Chapter No. 5: Micro Mechanics of a Lamina: Introduction, volume and weight fractions, Assumption and limitations of micromechanical analysis, Elastic properties of a lamina, longitudinal strength and stiffness, Transverse young's modulus, major Poisson's ratio and in-plane shear modulus. Problems on micromechanical analysis.Numerical problems. 07 Hrs

Unit - III

Chapter No.6: Macro Mechanics of Laminate 05 Hrs

Macro Mechanics of Laminate: Introduction, Laminate code, Stress–Strain Relations for a Laminate, Classical Lamination theory, assumptions of CLT, Stress- Strain equation and variation in a laminate, force and moment resultants related to midplane strains and curvatures , Numerical problems.

Chapter No.7:Applications: 05 Hrs

Aircrafts, missiles, Space hardware, automobile, Electrical and Electronics, Marine, Recreational and sports equipment, future potential of composites.

Text Books

1. Krishan K. Chawla, Composite Materials - Science and Engineering, 3rd Edition, Springer, 2012.
2. Robert M.Jones, Mechanics of Composite Materials, 2nd Edition, Tailor & Francis Inc. 1999.

References

1. D. Hull and T. W. Clyne, An Introduction to Composite Materials (Cambridge Solid State Science Series), 2nd Edition, Cambridge University Press, 1996.
2. Autar K. Kaw, Mechanics of Composite Materials, 2nd Edition, CRC Press, Taylor and Francis Group, 2006.

Course Code: 15EMEE402		**Course Title: Design of Automotive Power Train**
L-T-P: 3-0-0	Credits: 3	Contact Hrs: 3 hrs/week
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 40		Exam Duration: 3 hrs

Unit – I

Chapter No.1:Vehicle Performance Parameters 5 hrs
Vehicle drag, power for propulsion, resistances to vehicle motion, traction and tractive effort, relation between engine revolutions and vehicle speed, road performance curves(acceleration, grade ability and drawbar pull), numericals.

ChapterNo.2:General Considerations in Engine Design 4hrs
Selection of type: Process, Cycle, Number of Cylinders, Arrangement of Cylinders, Single and Double acting, Engine Speed, Rotational Speed, Piston Speed, Speed Factor, Stroke to Bore Ratio, Principle of Similitude, General Design Consideration

ChapterNo.3:Cylinder, Cylinder Head and Piston 6hrs
Function, construction, materials and design of cylinder, cylinder head and piston, piston pin and piston rings.

Unit – II

ChapterNo.4:Connecting rod and Crankshaft: 5hrs
Function, construction, materials and design of connecting rod, lubrication in connecting rod, design of crankshaft and its types.

ChapterNo.5: Flywheel 5 hrs
Function, construction, material, types. Stresses in flywheel rim and arms. design of flywheel

ChapterNo.6:Manual gear boxes and overdrives 5 hrs
Necessity of gear box, sliding mesh gear box, constant mesh gear box and reverse synchromesh gear box, gear synchronization and engagement. Over drive splitter and range gear boxes, Problems.

Unit – III

ChapterNo.7:Propeller shaft, Final Drive and Differential 5hrs
Construction & types of propeller shafts, universal joints, Final drive – construction details, types, Differential-Principle, conventional and non-slip differentials, differential lock. Skid reducing differentials. Double reaction axles. Two speed axles. Third (central) differential. Four wheel drive arrangements. Electro/hydraulic limited slip differential, Problems

ChapterNo.8:Hydrokinetic fluid couplings and torque converters 5hrs
Hydrokinetic fluid couplings. Hydrokinetic fluid coupling efficiency and torque capacity. Fluid friction coupling. Hydrokinetic three element torque converter. Torque converter performance terminology. Over run clutches. Three stage hydrokinetic torque converter. torque converter with lock-up and gear change friction clutches

Text Books

1. Heinz Heisler, Advanced Vehicle Technology, 2nd Edition, 2002,Butterworth Heinemann,
2. Sharma & Aggarwal, Machine Design, 12th Edition,2012,S.K.Kataria &Sons, New Delhi

References

1. Dr. N.K. Giri, Automotive Mechanics, 8th Edition,2008,Khanna Publication, New Delhi,

Course Code:15EMEE403 **Course Title: Design and Analysis of Experiments**

L-T-P: 3-0-0	Credits:3	Contact Hrs: 40
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 40 hrs		Exam Duration: 3hrs

Unit I

Chapter 1. Introduction 04hrs
Need for Research, Need for Design of Experiments, Experimental Design Techniques, Applications of Experimental Design.

Chapter 2. Taguchi's Approach to Quality 04hrs
Taguchi's Approach to Quality and Quality loss function, Noise Factors and Average Quality Loss, Exploiting Non Linearity, Classification of Parameters, Exercises.

Chapter 3. Analysis of Variance 08hrs
Test of Hypothesis using t-test, Z –test, Chi square and F-tests, No-Way and One-Way ANOVA, Exercises.

Unit II

Chapter 4. Full Factorial Design of Experiments 08hrs
Two-Factor Complete Factorial Experiments, Complete Factorial experiment with Three Factors and 2^n Factorial Experiments, Exercises.

Chapter 5. Fractional Factorial Design of Experiments 04hrs
Half Fraction of 2^2 Factorial Experiments, Half Fraction of 2^3 Factorial Experiments, Half Fraction of 2^4 Factorial experiments, Exercises.

Chapter 6. Robust Design 04hrs
Control Factors and their Levels, Matrix Experiment and Data Analysis Plan, Conducting the Experiment using Orthogonal Array and Data analysis, Exercises.

Unit – III

Chapter 7. Response Surface Methodology 04hrs
Central Composite Design and Box-Behnken Design, Case Studies

Chapter 8. Signal to Noise Ratio 04hrs
Relationship between Signal to Noise Ratio and quality loss after adjustment, Signal to Noise Ratios for static problems, Signal to Noise Ratios for dynamic problems, Exercises.

Text Books:

1. Douglas C. Montgomery, "Design and Analysis of Experiments", John Wiley and Sons.
2. Madhav S. Phadke, "Quality Engineering using Robust Design", Prentice Hall PTR, Englewood Cliffs, New Jersey.
3. R. Panneerselvam, "Design and Analysis of Experiments- R PHI Learning Private Limited ,New Delhi.

References:

1. R. H. Myers and D. C. Montgomery and Anderson-Cook C. M. "Response Surface Methodology: Process and Product Optimization Using Designed Experiments", John Wiley & sons, Inc., New York.
2. Philips .J. Ross, "Taguchi Techniques for Quality Engineering", McGraw Hill, New York.

Course Code: 15EMEE404		**Course Title: Product Design & Development**
L-T-P: 2-1-0	Credits: 3	Contact Hrs: 5 hrs/week
ISA Marks: 70	ESA Marks: 30	Total Marks: 100
Teaching Hrs: 24	Tutorial Hrs : 24	Exam Duration: 3 hrs

Unit – 1

Product Development Process 8hrs

Part manufacturing processes, Design and functional review methods, Assembly process and virtual builds, Quality goals and control plans

Unit -2

Product Verification and Validation 8hrs

Load goals and duty cycle definition, Reliability and durability goals, Virtual prototyping techniques, Accelerated product verification methods

Unit – 3

Product family management 8hrs

Product lifecycle management; Evolution of product models and families, Modeling of product family lifecycle, Product Strategy, Product market positioning, Product positioning – psychological, Brand, customer segment.

Technology management

Technology management methods, Technology as a competitive tool, Critical Component Development Process, Technology Development Process

References:

1. Karl Ulrich and Steven Eppinge, Product Design and Development
2. Kenneth B. Kahn, The PDMA Handbook of New Product Development, Second Edition
3. Monica Bordegoni (Editor), Caterina Rizzi (Editor)Innovation in Product Design: From CAD to Virtual Prototyping

Course Code: 15EMEE405		**Course Title: Operations Management**
L-T-P: 3-0-0	Credits: 3	Contact Hrs: 3 hrs/week
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 40		Exam Duration: 3 hrs

Unit – I

Chapter 1: Operations management & operations decision making: 08 hrs

Introduction, importance of operations management in manufacturing and service industries, Information and Non-manufacturing systems. Factors affecting productivity. The environment of operations. Characteristics of decisions, framework for decision-making, decision methodology, decision support systems, economic models and statistical models. Numericals

Chapter 2: Forecasting demand 06 hrs

Forecasting objectives and uses, forecasting variables, opinion and judgmental methods, time series methods, exponential smoothing, regression and correlation methods, application and control of forecasts. Numericals

Chapter 3: Aggregate planning and master scheduling 04 hrs

Introduction- Planning and scheduling, objectives of aggregate planning and Aggregate planning methods, master scheduling objectives, master scheduling methods, Numericals

Unit – II

Chapter 4: Material and Capacity Requirements Planning 04hrs

Overview: MRP and CRP, MRP: Underlying concepts, System parameters, MRP logic, System refinements, Capacity management, and CRP activities. MRP, MRP-II and ERP, Numericals

Chapter 5: Scheduling, single machine scheduling & flow –shop & Job shop scheduling 08 hrs

Production activities, PAC objectives and data requirements, concept, measures of performance, SPT rule, Weighted MFT, EDD rule, minimizing the number of tardy jobs. Numerical problems, Johnson's rule for 'n' jobs on 2 and 3 machines. Numericals.

Job-shop scheduling: Types of schedules, heuristic procedure, scheduling 2 jobs on 'm' machines. Numericals

Unit – III

Chapter 6: Lean manufacturing: 05 hrs

Introduction, Japanese concept of continuous improvement (Kaizen), innovation concept of improvement, need for continuous improvement, steps in implementing continuous improvement, 5S principles, Lean manufacturing history

Chapter 7: Just in time- an introduction 05 hrs

Spread of JIT movement, the new production system research association of Japan, core Japanese practices of JIT, creating continuous manufacture, Enabling JIT to occur, basic element of JIT, benefits of JIT.

Text Books:

1. Monks, J.G., Operations Management, McGraw-Hill International Edition, 1987.
2. Pannerselvam. R., Production and Operations Management, Prentice Hall India, 2003.

Reference Books:

1. Krajewski E. J. and Ritzman, 'Operations Management', Strategy and Analysis, Pearson Education, 2002.
2. Chary, S.N., 'Production and Operations Management', Tata-McGraw Hill, 2004
3. Nicholas J. Aquilano, 'Fundamental of Operations Management', Irwin/McGraw-Hill; 4th edition.

Course Code: 15EMEE406 **Course Title: Supply Chain Management**

L-T-P: 3-0-0	Credits: 3	Contact Hrs: 3 hrs/week
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 40		Exam Duration: 3 hrs

Unit – I

1. Understanding supply chain: 05 hrs

Meaning of SCM, supply chain stages, decision phases in supply chain (SC), process view of SC, examples of supply chain, competitive and supply chain strategies, achieving strategic fit and expanding strategic scope.

2. Supply Chain drivers and metrics: 05hrs

Drivers of SC performance, framework for structuring drivers, facilities, transportation, information, inventory, obstacles to achieve strategic fit.

3. Designing the supply chain network: 05 hrs

Role of distribution in SC, factors influencing distribution network design, design options for a distribution network, role of network design in sc, factors influencing network design decisions.

Unit – II

4. Transportation in supply chain: 05 hrs

Role of transportation in SC & factors affecting transportation decisions, modes of transportation and their performance characteristics, design options for a transportation network, trade-offs in transportation design, tailored transportation.

5. Logistics metrics: 05 hrs

Logistics data, statistical methods of process monitoring, logistics performance metrics.

6. Facility location and layout design : 05 hrs

Design aggregation and granularity level, space representation, qualitative proximity relationship, illustrative layout design, dealing with uncertainty, dealing with an existing design.

Unit – III

7. Material handling system: 05 hrs

Ten principles of material handling, material handling equipment, how to choose the right equipment, analytical model for material handling, equipment selection

8. Warehousing: 05 hrs

Warehousing functions, role of warehouse in supply chain, functional departments and flows, storage department description and operation, sorting, packing, consolidation and staging description, warehouse management.

Text Books:

1. Sunil Chopra and Peter Meindl, 'Supply Chain Management – Strategy, Planning and Operation', Pearson Education Inc.
2. G. Don Taylor, 'Introduction to Logistics Engineering'.CRC press, Taylor & Francis group Douglas Lambert and James Stock, 'Strategic Logistics Management', Irwin McGraw Hill.

Reference Books:

1. Robert B. Handfield and Ernest L. Nichols, 'Supply Chain Redesign-Transforming Supply Chain into Integrated Value Systems', Pearson Education Inc.
2. Jeremy F. Shapiro and Duxbury, 'Modeling the Supply Chain', Thomson Learning.
3. David Simchi Levi, Philip Kaminsky and Edith Simchi Levi, 'Designing and Managing the Supply Chain', McGraw Hill.
4. Sahay B.S., 'Supply Chain Management', Mc Millan
5. Bhattacharya S. K., 'Logistic Management', S. Chand Publication.
3. Kapoor, 'Marketing Logistics: A Supply Chain Approach', Pearson Education

Course Code: 15EMEE407		**Course Title: Computational Heat transfer and Fluid Flow**
L-T-P: 3-0-0	Credits: 3	Contact Hrs: 3 hrs/week
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 40		Exam Duration: 3 hrs

Unit - I

1. **Computational Fluid Dynamics (CFD) Solution Procedure**: 7 hrs
CFD applications in Research and Design, CFD Problem set-up-Creation of geometry, Mesh generation, Specification of boundary conditions. CFD Solver- Initialization and Convergence monitoring. Post Processor-Plots, data reports and Animation

2. **Governing Equations for CFD:** 8 hrs
Continuity Equation, Momentum Equation, Energy Equation**-** Physical Interpretation and comments. The additional equations for turbulent flow, Generic form of Governing equations, Physical Boundary conditions

Unit – II

3. **CFD Techniques:** 7 hrs
Discretization of Governing Equations**-** Finite difference method, Finite volume method, Converting governing equations into algebraic equations, Direct and Iterative solutions, Pressure- velocity coupling-SIMPLE scheme

4. **CFD Solution Analysis:** 8 hrs
Consistency, Stability, Convergence, Accuracy and Efficiency of CFD solutions. Accelerating convergence, controlling solution errors, verification and Validation. Case studies related to fluid flow through channel and pipe bend

Unit - III

5. **Practical Guidelines for CFD Simulation and Analysis:** 5 hrs
Grid generation- Guidelines on grid quality and grid design, Local refinement and solution adaption. Guidelines on Boundary conditions – Setting inlet, outlet and wall boundary conditions. Symmetric and Periodic Boundary conditions. Turbulence Modelling- Approaches, selection strategies, Case study: modeling of hydrofoil flows

6. **Advanced Topics in CFD:** 5 hrs
Advances in Numerical methods and Techniques- Moving grids, Multigrids, Parallel Computing and Immersed boundary methods. Advances in computational models- Direct numerical Simulation(DNS), Large Eddy Simulation(LES), RANS-LES, Lattice Boltzmann method, Monte-Carlo method, Particle methods

Text books:

1. Jiyuan Tu, Guan Heng Yeoh, Chaoqun, Computational Fluid Dynamics, Butterworth- Heinemann, 1st Edition 2008
2. Dale A. Anderson, John C. Tannehill and Richard H. Platcher.. Computational Fluid Mechanics and Heat Transfer; McGraw Hill Book Company, 2001

References:

1. Suhas V. Patankar, Numerical Fluid flow and Heat transfer, Hemisphere Series on Computational Methods in Mechanics and Thermal Science, 2nd Edn. 2000
2. Joel H. Ferziger and Milovan Peric, Computational Methods for Fluid Dynamics, 3rd Edition, Springer-Verlag, Berlin, 2001
3. Anderson J D, Computational Fluid Dynamics- The Basics with Applications, MGH, 2nd Ed. 2001

Course Code: 15EMEE408		**Course Title: Fundamentals of Gas Turbines**
L-T-P: 3-0-0	Credits: 3	Contact Hrs: 3 hrs/week
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 40		Exam Duration: 3 hrs

Unit - I

1 Principles of Gas Turbine and Applications 4 hrs

Introduction to turbo machines, history of gas turbines, gas turbine cycles and applications – (Land, Water/Marine and Air/Aero) Components of Gas Turbines (Compressors, Combustors, Turbines, Exhaust systems). Working of Gas Turbines.

2 Compressor 7 hrs

Types of compressors, (Centrifugal and Axial), relative merits and demerits, Criteria for selecting type of compressors.

Centrifugal Compressors: Principle of operation, work done and pressure rise diffuser, compressibility effects, compressor characteristics and design procedures.

Axial Flow Compressor: Basic operations, elementary theory, factors affecting stage pressure ratio, Blockage in the compressor annulus, effect of compressibility, pre-whirl, supersonic flow, degree of reaction, design process, blade design, calculation of stage performance, off-design performance.

3 **Fuel System** 4 hrs

Fuel specifications, Properties, Manual and automatic control, Fuel control systems, Fuel spray nozzles, Fuel heating, Effect of a change of fuel, Gas turbine fuels, Fuel requirements, Vapor locking and boiling, Fuel contamination control.

Unit – II

4 Combustion System 5 hrs

Introduction, Combustion process, Enthalpy of formation, Fuel supply, Types of combustion chamber, Can-annular combustion chamber, Tube-annular combustion chamber, Annular combustion chamber, Combustion chamber performance, Combustion intensity, Combustion efficiency, Combustion stability Emissions, Materials.

5 Axial Flow Turbines 5 hrs

Types of Turbines, spool shafts in aero engines, Advantages and disadvantages, Turbine geometry, Thermodynamic and Aerodynamic theory, velocity diagrams, Impulse turbine, turbine blade cooling. **Exhaust System**: Introduction, Exhaust gas flow, environmental considerations, construction and materials.

6 Prediction of Performance of Simple Gas Turbines 5 hrs

Component characteristics, off design operation of the single shaft gas turbine, off-design operation of free turbine engine.

Unit - III

7 Cooling, Seals and Lubrication System 5 hrs

The cooled turbine, methods of blade cooling, **Seals**: Non contacting seals - labyrinth seals, ring seals, Mechanical seals, Seal system, and dry gas seals, attrition coatings. **Lubrication Systems:** Basic oil system, lubrication management program, selection, oil contamination, filter selection, cleaning and flushing, oil sampling and testing

8 Materials of Gas turbine and Maintenance 5 hrs

Introduction, Super alloys-Nickel based iron-nickel, Cobalt, Thermal barrier coating for jet engine alloys, advanced materials for jet engines**. Maintenance:** Introduction, On-wing maintenance, Scheduled maintenance, Unscheduled maintenance, Condition monitoring, Flight deck indicators, In-flight recorders, Ground indicators, Maintenance precautions, Trouble shooting, Adjustments, Ground testing.

Text Books

1. Rolls Royce - “The Jet Engine” 5th edition, ISBN 0 902121 2 35, © Rolls-Royce plc 1986
2. Saravanamutto H.I.H, Rogers G.F.C., Cohen H, Gas Turbine Theory, 5th Edn., Pearson 2006

Reference Books

1. Meherwan P. Boyce “Aircraft Propulsion and Gas Turbine Engines”, CRC press, Taylor and Francis Group, London

New York.ISBN 978-0-8493-9196-5
2. Meherwan P. Boyce "Gas Turbine Engineering Handbook (Fourth Edition)", 2012, Elesevier, ISBN-978-0-12-383842-1

Course Code: 18EMEE301 **Course Title: Advanced CAE - I**

L-T-P: 0-0-3	Credits: 3	Contact Hrs: 6 hrs/week
ISA Marks: 80	ESA Marks: 20	Total Marks: 100
Teaching Hrs: 80		Exam Duration: 2 hrs

Sl No	Details
1	**Introduction** to Finite Element Method and Altair Hyper works.
2	**Hypermesh workbench** Getting started with Hypermesh Interacting with panels
3	**Geometry Clean up - Theory** **Tools used to geometry clean up** (Edge edit, Create Surface and Surface edit, Line and Line Edit, Delete …..) Theory and Demo Exercise – 04 No
4	**2-D mesh Explanation -Theory** Auto mesh and Different types of auto mesh Types of 2 D mesh (Ruled, Spline, Rotate……) Quality Parameters checking. Normals and Edge Checking and adjusting. Theory and Demo Exercise – 04 No
5	**3-D mesh Explanation -Theory** Volume mesh Creation Types of 3 D mesh (Hexa Penta Type, Tetra mesh……) Quality Parameters checking. Normals and Edge Checking and adjusting. Theory and Demo Exercise – 03 No
6	**1-D mesh Explanation -Theory** Creation of 1 D elements (Bar, Beam Mass….) Creation of Rigid elements (Rbe2 and Rbe3) Creation of Weld elements between two adjacent components Demo Exercise - 03 No
7	Execute Linear Static Analysis using optistruct solver Theory and Demo Exercise - 01 No Assignment - 01 No
8	Perform Buckling Analysis using optistruct solver Theory and Demo Exercise - 01 No
9	Carryout Modal Analysis using optistruct solver Theory and Demo Exercise - 01 No
10	Analyze Thermal Analysis using optistruct solver Theory and Demo Exercise - 01 No
11	Execute Non Linear Analysis using optistruct solver (Geometry, Material and Contact Non-Linear) Theory and Demo Exercise - 03 No

***Materials and Resources Required*:**

1. Books/References: Practical Finite Element Analysis by Nitin Ghokale 3rd Edition Released 05/2015

Course Code: 19EMEE304 **Course Title: Advanced CAE- II**

L-T-P: 0-0-3 Credits: 3 Contact Hrs: 6 hrs/week

ISA Marks: 80 ESA Marks: 20 Total Marks: 100

Teaching Hrs: 80 Exam Duration: 2 hrs

Experiment wise plan

List of exercises planned to meet the requirements of the course.

Serial No.	Details	Category	No. of Sessions
1.	Finite Element Methods: A conceptual introduction, Failure criteria of materials	Demonstration	01
2.	Ansys workbench ➢ Getting started with Ansys ➢ Interacting with panels Case Study: Beam, Pneumatically Actuated PDMS Fingers, Spur Gears and Micro gripper etc.	Exercise/Tutorial	02
3.	Design Modeler Geometry clean-up tools: De-features, Projection. Case Study: Bar, Beam, Triangular plate.	Exercise/Tutorial	02
4.	Case study on One dimensional/Two dimensional/Three dimensional components ➢ 1D: Rod, Bar, Link, Spring, Beam ➢ 2D: Bellows Joints, Gearbox etc. ➢ 3D: Beam bracket, Cover of pressure cylinder, Lifting fork and LCD display support.	Exercise/Tutorial	03
5.	Convergence study in FEA Quality parameters for 1D/2D/3D elements, Convergence Study of 2D and 3D Solid Elements ➢ Pneumatic fingers ➢ Cover of pressure cylinder	Exercise/Tutorial	03
6.	Case study on Static structural analysis ➢ Refrigerator handle ➢ Shell –Automotive panels (Fender, Bonnet) Assignments ➢ Wooden chair ➢ Crain hook	Exercise/Tutorial	03
7.	Case study on Modal analysis ➢ Compact disk ➢ Machine tool structures- Bed, Column. ➢ Guitar string Assignments ➢ Human skeleton ➢ Car chassis ➢ Engine housing	Exercise/Tutorial	02

8.	Case study on Structural dynamic Analysis ➢ Lifting fork ➢ Ball and rod ➢ Base of compressor in Refrigerator Assignments ➢ Leaf spring ➢ Steering wheel ➢ Railway track	Exercise/Tutorial	03
9.	Case study on Non linear analysis Geometry, Material and Contact analysis ➢ Fisher rod(Geometry) ➢ snap lock(Material) ➢ Translational joint(Contact) Assignments ➢ Gasket(Contact) ➢ Advanced metal plasticity(Material) ➢ Visco-plasticity(Material)	Exercise/Tutorial	04
10.	Case study on Explicit Dynamics ➢ High-Speed Impact : Bird Crash	Exercise/Tutorial	01
11.	Case study on Buckling and Stress stiffening ➢ 3D Truss ➢ Beam Bracket Assignments ➢ Machine column(Milling/ Drilling) ➢ Dovetail guide way	Exercise/Tutorial	02
12.	Case study on Thermal analysis Steady state thermal analysis Transient thermal analysis ➢ Heat exchanger ➢ Fin Assignments ➢ PCB Panel ➢ Telephone/power cables	Exercise/Tutorial	02
13.	Case study on Fatigue Analysis Stress based approach Strain based approach ➢ Connecting rod ➢ Fin Assignments ➢ Radial tire ➢ Battery of laptop/mobile	Exercise/Tutorial	04
14.	Case study on Sub-Modeling ➢ Motor cover	Demo	01
15.	Case study on Multi Body Dynamics (MBD) ➢ Applications of Four bar mechanism ➢ Sun planet gear mechanism Assignments ➢ Power cylinder in a diesel engine ➢ Screw jack	Exercise/Tutorial	03
16.	Analysis of Composite ➢ Applications on automotive components(fender, hood, dashboard) ➢ Applications on aerospace components (wings, window panels, tale) Assignments	Exercise/Tutorial	01

	➢ Polymer matrix composite ➢ Metal matrix composite		
17.	Case study on Optimization ➢ Triangular plate ➢ Flexible gripper Assignments ➢ Electronic Fuse ➢ Radiating system ➢ Tractor trailer	Exercise/Tutorial	01
18.	Case study on Couple Field Analysis ➢ Electromagnetic-thermal (Induction heating) ➢ Electromagnetic-thermal-structural (Peltier coolers) ➢ Electrostatic-structural, electrostatic-structural-fluidic (MEMS)	Demo	02

Text Book

1. Nitin Ghokale, Practical finite element analysis, Finite to infinite, 2008.

References

1. Chen, Xiaolin_ Liu, Yijun-Finite Element Modeling and Simulation with ANSYS Workbench-CRC Press (2014)
2. Erdogan Madenci, Ibrahim Guven (auth.)-The Finite Element Method and Applications in Engineering Using ANSYS®-Springer US (2015)
3. Barbero, Ever J.-Finite Element Analysis of Composite Materials Using ANSYS®-CRC Press (2013)

Course Code: 18EMEE302		**Course Title: Programming**
L-T-P: 0-0-3	Credits: 3	Contact Hrs: 6 hrs/week
ISA Marks: 80	ESA Marks: 20	Total Marks: 100
Teaching Hrs: 40		Exam Duration: 2 hrs

Course Contents: Core Java and Database Management System

Introduction to java: History and Features of Java ,Internals of Java Program, Difference between JDK,JRE and JVM, Variable and Data Type, Naming Convention, JDK installation and configuration

OOP Concepts: Advantage of OOPs, Object and Class, Method Overloading, Constructor, static variable, method and block, this keyword, Package and Access Modifiers, Encapsulation, Object class, Java Array, Call By Value and Call By Reference, Inheritance, Method Overriding, final keyword, Runtime Polymorphism, static and Dynamic binding, Abstract class and Interface, Downcasting with instanceof operator.

String Handling: String, , Immutable String, String Comparison, String Concatenation, Substring, Methods of String class, StringBuffer class , StringBuilder class, toString method, StringTokenizer class.

Exception Handling: Introduction, try and catch block, Multiple catch block, Nested try, finally block, throw keyword, Exception Propagation, throws keyword, Exception Handling with Method Overriding, Custom Exception

Collection framework: ArrayList class, LinkedList class, ListIterator interface, HashSet class, LinkedHashSet class, TreeSet class, PriorityQueue class, ArrayDeque class, Map interface, HashMap class.

Database concepts: SQL(DDL, DML), PL-SQL, JDBC Drivers, Steps to connect to the database, Connectivity with DB, DriverManager, Connection interface, Statement interface, ResultSet interface, PreparedStatement, ResultSetMetaData.

HTML: Tags, Attributes and Elements, Links, Images, Tables, Forms.

JSP: JSP - Overview, JSP - Lifecycle, JSP - Syntax, JSP - Directives, JSP - Actions, JSP – Client Request, JSP - Server Response.

Javascript/Jquery: JavaScript Output, JavaScript Statements, JavaScript Syntax, JavaScript Variables, JavaScript Operators, JavaScript Arithmetic, JavaScript Strings, JavaScript Events, JavaScript Loop, JavaScript Objects, JavaScript functions.

CSS: CSS basics, styles, CSS syntax

Design patterns: Singleton pattern, Factory pattern

References

1. Herbert Schildt, Java: The Complete Reference, Seventh Edition, The McGraw-Hill.
2. E Balagurusamy, Programming with Java, Third edition, McGraw-Hill.
3. Ramez Elmasri, Shamkant B. Navathe, FUNDAMENTALS OF Database Systems, Sixth edition, Addison-Wesley.
4. Jim Keogh, “J2EE - The Complete Reference”, Tata McGraw Hill, 28th reprint, 2010.
5. Eric Elliott, Programming JavaScript Applications, O'Reilly Media, 2014.

Course Code: 19EMEE305		**Course Title: PLM -Technical**
L-T-P: 0-0-3	Credits: 3	Contact Hrs: 6 hrs/week
ISA Marks: 80	ESA Marks: 20	Total Marks: 100
Teaching Hrs: 40		Exam Duration: 2 hrs

Course Contents: PLM- Technical (On Enovia Platform)

Introduction to PLM: Understanding PLM: Product, Product Lifecycle, Product Data, Process Data, Product Relationship Issues in Product Development What is PLM? Evolution of PLM PLM Vendors Understanding PLM with Example PLM Terminologies

Fundamentals: Introduction to ENOVIA Components: Matrix Navigator, Business Modeler, System Manager, MQL Business Objects Attribute, Type, Relationship, Policy User Management: Person, Group, Role, Association Document Management: Files and File Format, File Check-in and Check- out Icon Mail Automating Processes: Triggers & JPOs Vaults & Stores Introduction to 3DEXPERIENCE ENOVIA Modules ENOVIA Architecture ENOVIA Licensing

Installation: Difference between CAS & No-CAS Setup Installation Procedure for No-CAS Mode: Installation of Database (SQL Server), Creation of Tables & User in Database, Installation of Studio Modelling Platform, Installation of 3DSpace, Installation of ENOVIA Modules, No-CAS Deployment of ENOVIA, Post Installation Configurations, Working with ENOVIA Services

Functional

Collaboration & Approvals: People and Organization Setup: Company, Business Unit, Department, Location, Region, User Creation Team Central: Workspaces, Folders, Subscriptions Routes: Route Templates, Routes, Route Tasks

Engineering Part, BOM and Change Management: Part Families Part Series Part Definition: Development Part & Production Part, Equivalent Part, Alternate Part, Spare Parts, Substitute Parts, Manufacturer Equivalent Part (MEP) Part Revisions Part Specifications Bill of Material (BOM) BOM Markups Engineering Change: Fast Track Change, Formal Change

Program and Project Management: Project Templates & Questions Program Project Creation & Scheduling: Phase, Gate & Checklists, Milestone, Task Project Work Calendars Project Task Dependencies & Task Constraints Meetings Project Folders & Documents Project Risk & Issue Management Project Budgets Project Baselines & Project Experiments Project Timesheets

Configuration

Business Modeler: Attribute: Attribute Types & Ranges Dimension Type Policy: Policy States, Access, Signature User Management: Person, Role, Group, Association Relationship Interface

Matrix Navigator: Search Business Objects Create Business Objects Modify & Delete Business Objects Connect Business Objects Expand Business Objects View Business Object Basics & Attributes Promote & Demote Business Object Business Object File Check-in and Check-out Business Object Signature Approvals

MQL: Queries for Admin Objects: List, Create, Modify Queries for Business Objects: temp query, print, expand, add, delete, connect, disconnect, promote, demote, eval expression Help Commands

Schema/Data Model: Understanding ENOVIA OOTB Schema Model: PnO, Project Management, Common Document Model Schema Design Symbolic Names & Registration Understanding ENOVIA Access

Precedence   Auto-Naming Configuration

UI Configuration: Command   Menu Categories/Tree Menu   Portals & Channels   Inquiry   Tables: Flat Tables & Structure Browser Tables   Editable Tables   Settings for Table Columns   Web Forms Settings for Web Form Fields   Configuration of Create, Edit & View Business Object Details using Web Form

<u>Customization:</u>

ADK: Understanding ENOVIA BusinessObject & DomainObject classes   ENOVIA StringList & MapList classes ENOVIA APIs for Business Object Creation, Modification, Deletion   ENOVIA APIs for business object querying, for getting business object details, for getting the connected business objects & their details

JPOs: Creating JPOs   Exporting & Importing JPOs   JPO Macros   JPO Method Invocation from JSP, from JPO and from UI Component settings   JPO Compilation & Debugging

Triggers: Trigger Configuration in Policy   Creation of OOTB Trigger objects   Understanding OOTB Events   Understanding check, override and action triggers   Disabling Triggers

Data Model Customization: Understanding Unified Typing Principles   Specialize Data Model: Packages, Types & Customer Extensions   Administrate Data Model   Importing & Exporting Packages.

Course Code: 15EMEE413		**Course Title: Aircraft Systems and Design**
L-T-P: 3-0-0	Credits: 3	Contact Hrs: 40
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 40		Exam Duration: 3 hrs

Unit – 1

Chapter No. 1: Aircraft industry overview
Evolution and History of Flight, Types Of Aerospace Industry, Key Players in Aerospace Industry, Aerospace Manufacturing, Airline deregulation, Structure of the industry, Airline economics, Aircraft design process, Aerospace Industry Trends. 3 hrs

Chapter No. 2: Introduction to Aircrafts
Basic components of an Aircraft, Structural members, Aircraft Axis System, Aircraft Motions, Control surfaces and High lift Devices. Types of Aircrafts - Lighter than Air/Heavier than Air Aircrafts Conventional Design Configurations based on Power Plant Location, Wing vertical location, intake location, Tail Unit Arrangements, Landing Gear Arrangements. Unconventional Configurations-Biplane, Variable Sweep, Canard Layout, Twin Boom Layouts, Span loaders, Blended Body Wing Layout, STOL and STOVL Aircraft, Stealth Aircraft. Advantages and disadvantages of these Configurations. 5 hrs

Chapter No. 3: Introduction to Aircraft Mechanical Systems
Types of Aircraft Systems, Mechanical Systems: Environmental control systems (ECS), Pneumatic systems, Hydraulic systems, Fuel systems, Landing gear systems, Engine Control Systems, Ice and rain protection systems, Cabin Pressurization and Air Conditioning Systems, Steering and Brakes Systems Auxiliary Power Unit. 8 hrs

Unit – 2

Chapter No. 4: Basic Principles of Flight
Significance of speed of Sound, Air speed and Ground Speed, Properties of Atmosphere, Bernoulli's Equation, Forces on the airplane, Airflow over wing section, Pressure Distribution over a wing section, Generation of Lift, Drag, Pitching moments, Types of Drag, Lift curve, Drag Curve, Lift/Drag Ratio Curve, Factors affecting Lift and Drag, Center of Pressure and its effects. Aero foil Nomenclature, Types of Aero foil, Wing Section- Aerodynamic Center, Aspect Ratio, Effects of lift, Drag, speed, Air density on drag, 6 hrs

Chapter No. 5: Overview of the Aircraft Design Process
Introduction, Phases of aircraft Design, Aircraft conceptual Design Process, Conceptual stage, Preliminary Design, Detailed Design, Design Methodologies. Aerodynamic loads, Inertial loads, Loads due to engine, Actuator loads, maneuver loads, VN diagrams, Gust loads, Ground loads, Ground conditions, Miscellaneous loads. Sample problems. 7 hrs

Chapter No. 6: Aircraft materials
Introduction, Basic construction, material forms- Metallic materials and forms. Alloy designations, Mechanical properties- strength, static, stress strain curves, fatigue properties, crack growth. 3 hrs

Unit – 3

Chapter No. 7: Analysis of plates
Theory of plates- Analysis of plates for bending, stresses due to bending, plate deflection under different conditions, Plate buckling, Compression buckling, shear buckling and buckling due to in plane bending moments. Sample exercises. 4 hrs

Chapter No. 8: Analysis of Beams
Theory of beams- Symmetric beams in pure bending, deflection of beams, Unsymmetrical beams in bending. Sample exercises. Torsion in closed section beams, torsion in open section beams, multi cell sections. Sample exercises. 4 hrs

Text Books

1. Daniel P.Raymer, Aircraft Design- A conceptual Approach, 6, AIAA education series, 2012
2. T.H.G. Megson, Aircraft Structures for Engineering Students, 5, Elsevier science publications, 2012

Course Code: 15EMEE414		**Course Title: Industrial Engineering Methods and Practices**
L-T-P: 3-0-0	Credits: 3	Contact Hrs: 3 hrs/week
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 40		Exam Duration: 3 hrs

Unit – I

1. Industrial engineering and productivity: 06 hrs

Evolution of industrial engineering, industrial engineering functions, recent advances in industrial engineering, productivity of materials, land, buildings, machines and manpower, measurement of productivity, factors affecting the productivity.

2 Methods engineering: 04 hrs

Objective and scope of work-study and method-study. human factor in work-study, work-study and management, work-study and supervisor, work-study and worker.

3 Methods analysis techniques: 05 hrs

Types of recording techniques, process chart symbols, construction of charts (*operation process chart, flow process chart, two hand process chart, multiple activity chart, travel chart, string diagram etc*.), applications of various charts with examples.

Unit – II

4 Micro motion study: 05 hrs

Purpose of micromotion study, fundamental hand motions, therbligs, micromotion study equipments, cycle graph and chronocyclegraph, simo-chart construction, memomotion study.

5 Work measurement & time Study practice*:* 06 hrs

Concept of human work, terminology used in work measurement, theory of work measurement, work measurement techniques, definition of time study , time study equipments, basic time study procedure, conducting the time study

6 Performance rating & computing standard time: 04 hrs

Necessity of performance rating, factors influencing rating, rating systems and their details, allowances and their details, problems in time study and time standards, standard time computation with examples.

Unit – III

7 Ergonomics: 05 hrs

Areas of study under ergonomics, system approach to ergonomics model, man-machine system, work capabilities of industrial worker, general principles for carrying out physical activities.

8 Design of man-machine system interface: 05 hrs

Concept of fatigue in industrial worker, relationship between controls and displays, design of work place and effect of environment (*influence of climate on human efficiency, influence of noise, vibrations and lighting system*).

Text Books:

1. Jhamb L. C., 'Work Study & Ergonomics', Everest Publishing House.

Reference Books:

1. ILO, 'Introduction to Work Study'. International Labour Office.
2. S Dalela and Sourabh, 'Work Study and Ergonomics', Standard Publishers Distributors.
3. Vijay Sheth, 'Industrial Engineering Methods and Practices', Penram International Publishing (India) Pvt. Ltd.

Course Code: 15EMEE415		**Course Title: Advanced Energy Technology**
L-T-P: 3-0-0	Credits: 3	Contact Hrs: 3 hrs/week
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 40		Exam Duration: 3 hrs

Unit - I

1. Solar Radiation, Measurement of Solar Radiation, Solar Radiation Geometry 8 hrs

Energy source, India's production and reserves of commercial energy sources, need for non-conventional energy sources.Solar Radiation : Extra-Terrestrial radiation, spectral distribution of extra terrestrial radiation, solar constant, solar radiation at the earth's surface, beam, diffuse and global radiation, solar radiation data. Measurement of Solar Radiation : Pyrometer, shading ring pyrheliometer, sunshine recorder, schematic diagrams and principle of working. Solar Radiation Geometry : Flux on a plane surface, latitude, declination angle, surface azimuth angle, hour angle, zenith angle, solar altitude angle expression for the angle between the incident beam and the normal to a plane surface (No derivation) local apparent time. Apparent motion of sum, day length, numerical examples.

2. Radiation Flux on a Tilted Surface, Solar Thermal Conversion 8 hrs

Radiation Flux on a Tilted Surface : Beam, diffuse and reflected radiation, expression for flux on a tilted surface (no derivations) numerical examples. Solar Thermal Conversion : Collection and storage, thermal collection devices, liquid flat plate collectors, solar air heaters concentrating collectors (cylindrical, parabolic, paraboloid) (Quantitative analysis); sensible heat storage, latent heat storage, application of solar energy water heating. Space heating and cooling, active and passive systems, power generation, refrigeration. Distillation (Qualitative analysis) solar pond, principle of working, operational problems.

Unit – II

3. Solar Photovoltaic Energy Conversion and PV System Applications 8 hrs

Principles - Physics and operation of solar cells. Classification of solar PV systems, Solar cell energy conversion efficiency, I-V characteristics, effect of variation of solar insolation and temperature, losses. Solar PV power plants.Building-integrated photovoltaic units, grid-interacting central power stations, standalone devices for distributed power supply in remote and rural areas, solar cars, aircraft, space solar power satellites. Socio-economic and environmental merits of photovoltaic systems.

4. Fuel Cell Technology 8 hrs

Fuel cell electrochemistry - Reaction rate - Butler Volmer equation-implications and use of fuel cell polarization curve - Conversion of chemical energy in electricity in a fuel cell. Cogeneration - Fuel cell electric vehicles - Fuel cell vehicles - Motor cycles and bicycles-airplanes - Fueling stations - Fuel cell power plant structure - Fuel processor and fuel cell stack. Advantages and disadvantages. Problems with fuel cells. Research related to fuel cell development in the world and in India.

Unit - III

5. Energy Storage 4 hrs

Introduction, energy demand, energy storage devices, types of battery, basic principle, components, cathode and anode materials, effect of nano-size on energy storage and electrode materials performance, electrochemical energy storage, super-capacitors, advantage of nanotechnology in energy storage devices.

6. Energy Policy 4 hrs

Energy policy issues - Fossil Fuels, renewable energy, power sector reforms, restructuring of energy supply sector, energy strategy for future. Energy conservation act and National electricity policy and plan.

Reference books

1. David Merick, Richard Marshall, (2001), Energy, Present and Future Options, Vol. I and II, John Wiley and sons.
2. Twidell, J.W. and Weir, A., Renewable Energy Sources, EFN Spon Ltd., 1986
3. Peter Gevorkian, Sustainable Energy Systems Engineering, McGraw Hill,2007
4. Bagotsky .V.S, "Fuel Cells", Wiley, 2009.
5. Ibrahim Dincer and Marc A. Rosen, "Thermal Energy Storage Systems and Applications", 2nd Edition, John Wiley

and Sons Ltd., 2011.

Course Code: 15EMEE416		**Course Title: Thermal Management of Electronic Equipment**
L-T-P: 3-0-0	Credits: 3	Contact Hrs: 3 hrs/week
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 40		Exam Duration: 3 hrs

Unit – I

Chapter No. 1. Introduction 5 hrs

Semiconductor Technology Trends, Temperature-Dependent Failures, Importance of Heat Transfer in Electronics, Thermal Design Process, Energy and Work, Macroscopic and Microscopic Energies, Energy Transfer and Heat Transfer, Equation of State.

Chapter No. 2. Thermal Resistance Network 5 hrs

Thermal Resistance Concept, Series Thermal Layers, Parallel Thermal Layers,
General Resistance Network, Thermal Contact Resistance, Thermal Interface Materials, Spreading Thermal Resistance, Thermal Resistance of Printed Circuit Boards (PCBs).

Chapter No. 3.Thermal Specification of Microelectronic Packages 5 hrs

Importance of Packaging, Packaging Types, Thermal Specifications of Microelectronic Packages, Package Thermal Resistance Network, Parameters Affecting Thermal Characteristics of a Package.

Unit – II

Chapter No. 4. Cooling methods 10 hrs

Conduction Cooling, Convection Cooling, Selection Of Fan, Liquid Immersion Cooling, Flow-Through Cooling Of CCAs, Cold wall Cooling, Cold Plates, Jet Impingement Cooling, Synthetic Jet Cooling, Thermoelectric Or Solid State Coolers, Cooling Using Phase Change– Cooling With PCM Materials, Micro/Mini Channel Cooling, Cooling Using Heat Pipes– Working Principle, Selection Of Heat Pipe Working Fluid; Selection Of Cooling Technique– Ranges Of Cooling Rates Of Different Cooling Methods, Selection Criteria.

Chapter No. 5. Fins and Heat Sinks 5 hrs

Fin Equation, Fin Thermal Resistance, Effectiveness, and Efficiency, Fins with Variable Cross Sections, Heat Sink Thermal Resistance, Effectiveness, and Efficiency, Heat Sink Manufacturing Processes.

Unit – III

Chapter No. 6. Experimental Techniques and Thermal Design 5 hrs

Flow Rate Measurement Techniques, System Impedance Measurement, Fan and Pump Curve Measurements, Velocity Measurement Methods, Temperature Measurement Techniques, Acoustic Noise Measurements, Importance of Experimental Measurements in Thermal Design.

Chapter No. 7. Computer Simulations and Thermal Design 5 hrs

Heat Transfer and Fluid Flow Equations: A Summary, Fundamentals of Computer Simulation, Turbulent Flows, Solution of Finite-Difference Equations
Commercial Thermal Simulation Tools, Importance of Modeling and Simulation in Thermal Design.

Text Books

1. Younes Shabany, Heat Transfer: Thermal Management of Electronics, CRC Press Inc, 2010.
2. Ravi Kandasamy and Arun S. Mujumdar, Thermal Management of Electronic Components, Lambert Academic Publishing, 2010.

References

1. Dave S. Steinberg, Cooling Techniques for Electronic Equipment, Wiley, 1991.
2. Sung Jin Kim, Sang Woo Lee, Air Cooling Technology for Electronic Equipment, Taylor & Francis, 1996.
3. Rao R. Tummala, Fundamentals of Microsystems Packaging, McGraw-Hill, 2001.
4. Yunus A. Cengel, Heat Transfer: A Practical Approach. McGraw-Hill, 2003.

Course Code: 15EMEO401 **Course Title: Introduction to Nanoscience and Nanotechnology**

L-T-P: 3-0-0 Credits: 3 Contact Hrs: 3 hrs/week

ISA Marks: 50 ESA Marks: 50 Total Marks: 100

Teaching Hrs: 40 Exam Duration: 3 hrs

Unit – I

1 Introduction: 5 Hrs

Nanotechnology, Frontier of future- an overview

Length scales, Variation of physical properties from bulk to thin films to nanomaterials, - confinement of electron energy states (LDOS) in 0D, 1D,2D and 3D systems (qualitative treatment) ; Surface, size, shape and assembly effects.

Bonding and crystal structure in solids, colloids and core-shell structures. Chemical and molecular interaction, functionalziation, basis for biological self-assembly and self-organization.

2 Synthesis of nanomaterials: 6 Hrs

Top-down approach: Lithography and soft processes, Ball milling, chemical stamping.

Bottom-Up approach: Chemical Routes for Synthesis of Nanomaterials, Solvo-thermal and Sol-gel synthesis; Microemulsions, micelles and reverse micelles; Physical and Chemical Vapour Deposition, Sputtering, Laser ablation, Epitaxy.

Biological Methods: Role of plants and bacteria in metal (magnetic and non-magnetic) nanoparticle synthesis

3 Characterization: 5 Hrs

Electron Microscopy (SEM/TEM); Scanning Probes (STM, AFM), X-ray Photoelectron Spectroscopy (XPS), Optical Spectroscopy –IR/UV/VIS, Raman, Photoluminescence, X-ray Diffraction (including Debye-Scherrer method), Particle Size Analyser-light Scattering, Electrical (I-V and C-V), Porosity (BET method), Zeta potential, nano-indentation.

Unit – II

4 Properties: 6 Hrs

- Electronic and optoelectronic properties: Ballistic transport, Coulomb blockade, Diffusive transport,
- Dielectric properties: Polarisation, Ferroelectric behavior.
- Optical Properties: Photoconductivity, Optical absorption & transmission, Plasmons and Excitons, Luminescence and Phosphorescence.
- Magnetic properties: Nanomagnetism, magneto-resistance; Super Para Magnetism
- Thermal and Mechanical properties: changes in thermal transport, thermal transition temperatures, and interfaces with dissimilar materials. Improved hardness and toughness of metals and alloys

Biological: Permeability through biological barriers, molecular recognition and biological assemblies.

5 General Applications: 5 Hrs

- Electrical, Electronics & Photonics- Switching glasses, Semiconductor devices including LEDs and Solar Cells, Photonic Crystals.
- Computer Science- Storage devices and Quantum computing etc
- Mechanical and Civil: Composites and their properties.
- Environmental and Chemical: Porous materials, Catalysis, tracers etc
- Biotechnology- Interaction between bimolecular and nanoparticle surface, nano-bio assemblies, Nanosensors etc

Unit - III

6 Specific Applications: 13 Hrs

Part of this can be implemented as a student project that involves: literature-survey, project report and a Seminar (Power-Point) Presentations by groups of two students each (applications and students to be identified by teachers and monitored by one teacher each):

- Carbon and its allotropes: Fullerenes (C_{60}), Carbon nanotubes and Graphene:
- Applications of Carbon Nanotubes: Field emission, Fuel Cells, Display devices, Hydrogen storage.
- Nano-Medicine: Developments and protocols for diagnostics, drug delivery and therapeutics.
- Nanotribology: Friction at nanoscale, Nanotribology and wear-resistance, MEMS and NEMS
- Photo-electronics: Merger of photonics and electronics at nanoscale dimensions
- Single electron devices, molecular circuits
- Nanocomposites (i.e. metal oxide, ceramic, glass and polymer and core-shellbased);
- Biomemitics and Biomaterials, synthetic nanocomposites for bone, teeth replacement, DNA scaffolding.
- Nanosensors: Temperature Sensors, Chemical and gas Sensors, Light and radiation sensors

7 Demonstration through experiments: 4 Hrs

1. Chemical synthesis of Au and Ag nanoparticles and characterization by Optical spectroscopy of size dependence band-gap
2. Debye Scherrer analysis of XRD data of nanoparticles of different sizes.
3. Surface area and Pore size distribution of the BET data from a nano-porous material.
4. Some experiment to study mechanical strength of nanocomposites (nano-indentation)

8 Guest lectures from industries and research laboratory personnel: 1 Hrs

Societal issues of Nanotechnology: Prospects and Dangers; Commercial aspects, emerging industry and employment opportunities.

Text Book:

References:

1. Nano Materials- A.K.Bandyopadhyay/ New Age Publishers.
2. Nanocrystals: Synthesis, Properties and Applications.
3. C. N. R. Rao, P. John Thomas and G. U. Kulkarni, Springer Series In Materials Science.
4. Nano Essentials- T.Pradeep/TMH.
5. Plenty of Room for Biology at the Bottom-An introduction to bio-nanotechnology, E. Guzit, Imperial College Press

Books Recommended for extra reading:

1. Introduction to Nanotechnology, C P Poole & F J Owens, Wiley, 2003.
2. Understanding Nanotechnology, Scientific American 2002.
3. Nanotechnology, M Ratner & D Ratner, Prentice Hall 2003.
4. Nanotechnology, M Wildon, K Kannagara G Smith, M Simmons & B Raguse, CRC
Press Boca Raton 2002.

Apart from the above, in view of the course being of advanced nature, the content of course will be supplemented with course material from the course instructors.

Course Code: 15EMEO402		**Course Title: Nanotechnology**
L-T-P: 3-0-0	Credits: 3	Contact Hrs: 3 hrs/week
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 40		Exam Duration: 3 hrs

Unit - I

1. An overview of Nanoscience & Nanotechnology: 4 Hrs
Historical background – nature, scope and content of the subject – multidisciplinary aspects – industrial, economic and societal implications

2. Experimental Techniques and Methods: 5 Hrs
For investigating and manipulating materials in the nano scale – electron microscope – scanning probe microscope – optical and other microscopes

3. Fullerenes: 6 Hrs
Discovery, synthesis and purification – chemistry of fullerenes in the condensed phase – orientational ordering – pressure effects – conductivity and superconductivity – ferromagnetism – optical properties.
Carbon Nanotubes – synthesis and purification – filling of nanotubes – mechanism of growth – electronic structure – transport properties – mechanical and physical properties – applications

Unit – II

4. Self-assembled Monolayers: 5 Hrs
Monolayers on gold – growth process – phase transitions – patterning monolayers – mixed monolayers – applications

5. Semiconductor Quantum Dots: 5 Hrs
Synthesis – electronic structure of nanocrystals – how quantum dots are studied – correlation of properties with size – uses

6. Monolayer-protected Metal Nanoparticles: 5 Hrs
Method of preparation – characterization – functionalized metal nanoparticles –applications – superlattices

Unit - III

7. Nanobiology: 5 Hrs
Interaction between biomolecules and nanoparticle surfaces – materials used for synthesis of hybrid nano-bio assemblies – biological applications – nanoprobes for analytical applications – nanobiotechnology – future perspectives

8. Molecular Nanomachines:
Covalent and non-covalent approaches – molecular motors and machines – other molecular devices single molecular devices – practical problems involved

Text Books
1. NANO: The Essentials – Understanding Nanoscience and Nanotechnology; T Pradeep (Professor, IIT Madras); Tata McGraw-Hill India (2007)

Reference Books
1. Nanotechnology: Richard Booker & Earl Boysen; Wiley (2005).
2. Introduction to Nanoscale Science and Technology [Series: Nanostructure Science andTechnology]: Di Ventra, et al (Ed); Springer (2004).
3. Nanotechnology Demystified: Linda Williams & Wade Adams; McGraw-Hill (2007)
   Introduction to Nanotechnology: Charles P Poole Jr, Frank J Owens, Wiley India Pvt. Ltd., New Delhi, 2007

Course Code: 15EMEO403 **Course Title: Design of Experiments**

L-T-P: **3-0-0**	Credits:3	Contact Hrs: 40
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **40 hrs**		Exam Duration: **3hrs**

Unit I

1	**Chapter 1. Introduction** Strategy of experimentation, applications of experimental design, basic principles, guidelines for designing the experiments.	04hrs
2	**Chapter 2. Taguchi's approach to quality** Definition of quality, Taguchi's quality philosophy, Quality loss function, off-line and on-line quality control, Signal and Noise Factors.	04hrs
3	**Chapter 3. Motivation for using ANOVA** Introduction to analysis of variance (ANOVA), test of hypothesis, limitations of testing of hypothesis for difference between the means of two samples, testing of hypothesis using chi-square, t-test and F-test, one-way ANOVA examples.	08hrs

Unit II

4	**Chapter 4. Factorial Experiments** Two-Factor Factorial Design, General Factorial Design, 2^2, 2^3 and 2^4 Full Factorial Designs, Exercises	08hrs
5	**Chapter 5. Fractional Factorial Designs** One half fraction of 2^k Design, One quarter fraction of 2^k Design, General 2^{k-p} Fractional Factorial Design , Exercises	04hrs
6	**Chapter 6. Regression Approach** Simple Regression and Multiple regressions, Types of designs, Central composite design and Box-Behnken design, Exercises	04hrs

Unit – III

7	**Chapter 7. Orthogonal Array Experiments** Introduction, Design of Orthogonal arrays, ANOVA for Orthogonal Array.	04hrs
8	**Chapter 8. Robust Parameter Design** Introduction, Signal-to-Noise ratio, ANOVA for S/N ratio, Steps of S/N approach.	04hrs

Text Books:

1. Douglas C. Montgomery, "Design and Analysis of Experiments", John Wiley and Sons.
2. Madhav S. Phadke, "Quality Engineering using Robust Design", Prentice Hall PTR, Englewood Cliffs, New Jersey.
3. R. Panneerselvam, "Design and Analysis of Experiments- R PHI Learning Private Limited,New Delhi.

References:

1. Robert H. Lochner and Joseph E. Matar, "Designing for Quality- an Introduction Best of Taguchi and Western Methods or Statistical Experimental Design", Chapman and Hall.
2. – Philips .J. Ross, "Taguchi Techniques for Quality Engineering", McGraw Hill, New York.

Course Code: 15EMEO404		**Course Title: Engine Management Systems**
L-T-P: 3-0-0	Credits: 3	Contact Hrs: 3 hrs/week
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 40		Exam Duration: 3 hrs

Unit - I

Basics of Gasoline (SI) Engine 6 Hrs

Introduction, Operating concept, Valve timing, Stages of combustion, Combustion knock, Effect of engine variables on knock, Torque and power, Engine efficiency, Specific fuel consumption, Fuels for spark ignition engines.

Gasoline engine management 4 Hrs

Technical requirement, Cylinder charge control, Air-charge control, Variable valve timing, controlled charge flow, A/F –mixture formation, Ignition- Battery ignition systems, Electronic ignition system, Inductive ignition system, Ignition coils, Spark plugs.

Gasoline fuel injection 5 Hrs

Fuel supply for manifold injection, Operating concept, Electromagnetic fuel injectors, Types of fuel injection, Fuel supply for gasoline direct injection, Operating concept, Rail, High pressure pump, Pressure control valve, High pressure injector, Combustion process, A/F mixture formation, Operating modes Motronic engine management, ME-Motronic, MED-Motronic.

Unit – II

Basics of Diesel Engine 5 Hrs

Method of operation, Stages of combustion, Operating statuses, Fuel-injection system, Combustion chambers-Di and IDI, Diesel fuels-properties, Alternative fuels- Alcohols, Vegetable oils.

Cylinder Charge Control - Intake air filters, Swirl flaps, Superchargers & Turbochargers, Exhaust Gas Recirculation.

Diesel fuel injection 5 Hrs

Requirements of ideal fuel injection system, Basic Principles of fuel supply - Mixture distribution, Start of fuel injection and delivery, Injected fuel quantity, Injection characteristics, Injection pressure, Injection direction and number of injection jets. Fuel supply system.

Fuel injection pumps 5 Hrs

Design and method of operation of in-line fuel injection pump systems, Distributor fuel injection pump systems, Unit injector system and unit pump system, Common rail system.

Nozzles and Nozzle holders - Pintle nozzles, Hole type nozzles, future development.

Unit - III

Engine Exhaust Emission Control 5 Hrs

Formation of NO_X, HC/CO mechanism , Smoke and Particulate emissions, Methods of controlling emissions- Thermal converter, Catalytic converter and Particulate Trap, Diesel Smoke and its control, Emission (HC, CO, NO and NO_X) measuring equipments, Emission norms.

Recent Trends in IC Engines 5 Hrs

Dual fuel Engine, Homogeneous Charge Compression Ignition Engine (HCCI), Reactivity controlled compression ignition engine (RCCI), Lean Burn Engine, VVT engines.

Text Books:

1. Gasoline Engine Management – Published by Robert Bosch Gmbh, 2004 – 2nd Edition
2. Diesel Engine Management " – Published by Robert Bosch Gmbh, 2004 – 3rd Edition

Reference Books:

1. A Course in I.C.Engine – Mathur and Sharma, Dhanpal Rai & sons, New Delhi
2. Internal Combustion Engine Fundamentals – John B. Heywood, McGraw- Hill

Course Code: 16EMEC201 | **Course Title: Instrumentation & Control Engineering**

L-T-P: 3-1-0	Credits:4	Contact Hrs: 64
CIE Marks: 50	SEE Marks: 50	Total Marks: 100
Teaching Hrs: 40		Exam Duration: 3 hours

Unit - I

1. Introduction to Instrumentation & Control Engineering 05 Hrs

Generalized configurations and functional description of measuring instruments, Generalized configurations and functional description of control systems. Control system design, Design examples - Open loop and Close loop automatic control

2. Mathematical Modelling of Physical Systems: 10 Hrs

Introduction, Differential equations of physical systems, The Laplace Transform, Order of system; The transfer function of linear and rotational Mechanical systems, Gear Train, Electrical systems, Electro-mechanical System, Thermal systems, Hydraulic System; Block representation of system elements, Reduction of block diagrams to get transfer function.

Unit - II

3. System Response 08 Hrs

Introduction, Poles, Zeros, and System Response, First-order system response to step, ramp and impulse inputs , Second-order system response to step input; Un-damped, Under damped, Critical damped and Over damped systems, Time response specifications. Design of 1st and 2nd order system.

Introduction to PID controller design. Types of Controllers, Mathematical modeling of PID, ON-OFF controller, Effect of Proportional, Derivative and Integral elements on system behavior, Design of Controller for given simple applications.

4. System Stability 07 Hrs

Introduction to stability and the stability analysis by Routh-Hurwitz Criterion. Defining the Root locus, General rules for constructing root loci, Sketching the Root locus, Effect of gain adjustment, addition of pole and addition of zero on system response and system stability. Frequency Response Techniques: Bode Plots. Stability analysis using bode plots.

Unit - 3

6. Instrumentation 05 Hrs

Quality Prameters of an instrument. Static and Dynamic Performance Characteristics instrument. Introduction to Signal Conditioning Processes; Motion measurement - Displacement: Translation and Rotational, Velocity: Translation and Rotational, Acceleration measurements

7. Instrument and Display 05 Hrs

Temperature measurement, Force, Torque and Power measurement, Pressure and Flow rate measurement. Display: LED, 7-segment, TFT, Plasma.

Text Books

1. Katsuhiko Ogata, Modern Control Engineering, 5th edition, Pearson Publications
2. T.G Beckwith, R.D Marangoni and J.H Lienhard, Mechanical Measurements, 5th edition, Addison Wesley
3. W. Bolton, “Mechatronics”, 2nd edition , Pearson Ed, 2001

References

1. Richard C Dorf and Robert H. Bishop, Modern Control Systems, 12th edition, Addison Wesley
2. Norman S. Nise, Control. Systems, 6th edition, John Wiley & Sons
3. R.S Figiola and D.E Beasley, Theory and Design for Mechanical Measurement, 2nd edition, John Wiley
4. Ernest Doebelin and Dhanesh Manik, Measurement Systems, 6th edition, Tata McGraw-Hill Education Pvt. Ltd

Course Code: 16EMEP202 **Course Title: Instrumentation &Control Engineering Lab**

L-T-P: 0-0-2	Credits:2	Contact Hrs: 48
ISA Marks: 80	ESA Marks: 20	Total Marks: 100
Teaching Hrs: 48 (24 sessions)		Exam Duration: 2 hours

Sl. No	Content	No. of Sessions
1	MATLAB - UI introduction, Desktop tools, Matrices, Control and condition statements, script Basic plotting, MuPad, Building GUI for few problems like addition of two numbers	3
2	Simulink- addition of numbers, temperature conversion, creation of subsystem, 1st and 2nd order system modeling with elementary block diagram. Input data from workspace.	1
3	Study of Multimeter and use of it to measure voltage, Current, Resistance etc. Simulate and Measure the same from simscape physical modelling	1
4	Physical modelling, analytical and experimental study of Inverting and Non Inverting circuits. Measurement of amplitude and phase.	2
5	Study of system response for Impulse, Step and Ramp inputs	2
6	Physical modelling, analytical and experimental study of 2^{nd} order systems for varying zeta value	1
7	Physical modelling of electro-mechanical, Gear Train, hydraulic, Hydraulic lift and study the response for step input	2
8	Stability analysis using root locus and Bode plots	2
9	Introduction to virtual instrumentation using LabVIEW	3
10	Strain Measurement with LabVIEW and DAQ.	1
11	P, PI, PID controller design	1
12	Quancer hardware for control application	2
13	Study of LVDT, Load Cell, Tachometer, Thermocouple, Thermometer, Sound measurement	1

Course Code: 16EMEP203 | **Course Title: Engineering Design**

L-T-P: 0-0-3 | Credits: 3 | Contact Hrs: 6 hrs/week

ISA Marks: 80 | ESA Marks: 20 | Total Marks: 100

Teaching Hrs: 72 | Exam Duration: 2 hrs

Engineering Design [Part A]

1	Planning: Analyse Need, Formulate a Product Proposal, Clarify the Task, Requirements Modeling (SRS), Elaborate Requirements List, Design Specifications	6
2	Concept Development: Function to Architecture, Establish Functions Structure, Search for Working Principles & Working Structures, Combine & Firm-up into Concept Variants, Evaluate against Technical & Economic criteria, Best Feasible Design	9
3	System-level Design: Product Architecture -State Diagrams, Data-flow Diagrams, Configuration Design, Parametric Design, Construction Structure, Preliminary BOM, Co-simulation across domains	9
4	Detail Design: Geometry, Dimensions, Material, PCB Design, Component Selection, Class Diagrams, Code Generation, Design Verification, Detailed & Assembly Drawings Production & Assembly Instructions, Final BOM, Product Specifications	12

Text Books (List of books as mentioned in the approved syllabus)

1. Clive L Dym and Patrick Little, "Engineering Design: A Project Based Introduction", John Wiley & Sons
2. Yousef Haik, "Engineering Design Process", Cengage Learning India Private Limited, New Delhi

References

1. Pahl, G., Beitz, W., Feldhusen, J. and Grote ; "Engineering Design-A Systematic Approach" by, K.-H- Springer; 3rd ed. 2007

Laboratory Plan

Laboratory Title: **Engineering Design[Part B]**	Lab. Code: **15EMEP203[Part B]**
Total Hours: **40**	Duration of ESA Hours: -
ISA Marks: **40**	ESA Marks: **0**

Part – B

COURSE CONTENT

Course Code: **15EMEP203 [Part B]** Course Title: **Engineering Design Practice [Part B]**
L-T-P**: 0-0-1.5** Credits:**1.5**
Contact Hrs: **3hrs/week** ISA Marks: **40** ESA Marks: **00**
Teaching Hours**: 13 Sessions of 3 hours each (40hrs)**

Part – B1 [Machine Drawing]	**13 sessions**
8. 3D Modeling using CAD software 3D modeling of machine parts such as: (1) Body of screw jack (2) Valve body (3) Body of machine vice (4) Flange of protected type flanged coupling (5) Cone pulley	9 Hours / 3 sessions
9. Sectional Views Sectional views of machine parts involving half section, full section, offset section, revolved section, and local section	9 Hours / 3 sessions
10. Threaded Fasteners Drawing of bolts, nuts, screws and their conventional representation.	6 Hours / 2 sessions
11. Part and Assembly Drawing Drawing of part and assembly drawing of machines such as: (1) Screw jack (2) Protected type flanged coupling (3) Pipe vice (4) Clapper box (5) Non-return valve (6) Universal coupling (7) Pin and cotter joints	15 hours / 5 sessions

<u>**Books/References**</u>:

<u>**Text books:**</u>

1. Machine Drawing by K.R. Gopalakrishna, Subhas Publications, 22nd Edition - 2013.
2. Machine Drawing by N.D.Bhat&V.M.Panchal, Charotar Publishing House.

Course Code: 16EMEP201 **Course Title: Manufacturing Processes Lab**

L-T-P: 0-0-1	Credits: 1	Contact Hrs: 2 hrs/week
ISA Marks: 80	ESA Marks: 20	Total Marks: 100
Teaching Hrs: 24		Exam Duration: 2 hrs

1 Machining practices involving machining time calculations and estimation of machining costs for the jobs for turning, milling, drilling, grinding. (3 slots)

2 Simulation of CNC programming on machining processes. (2 slots)

3 CNC programming turning and machining centres. (5 slots)

4 Design, Modeling and Analysis of Bulk deformation and Sheet Metal forming processes. (2 slots)

5 Demonstration of Non-traditional machines such as laser cutting, plasma cutting, electro discharge machines

Text books

1. Kalpakjian S., and Schmid S.R., Manufacturing Engineering & Technology, 7th edition, Pearson Education, 2014.
2. Mikell P. Groover, Fundamentals of Modern Manufacturing, 5th edition, John Wiley & Sons, 2012.

Reference books

5. John A. Schey, Introduction to Manufacturing Processes, 3rd edition, Tata McGraw Hill, 1999.
6. Juneja B. L. and Sekhon G. S., Fundamentals of Metal Cutting and Machine Tools, 3rd edition, New Age International Limited, 2008.
7. Mikell P. Groover, Automation, Production Systems, and Computer-Integrated Manufacturing, 4th edition, Prentice Hall, 2014.
8. Pandey P. C. and Shan H. S., Modern Machining Processes, 1st edition, Tata McGraw Hill, 2013.

Course Code: 16EMEP204 **Course Title: Mechatronics Lab**

L-T-P: 0-0-3	Credits:3	Contact Hrs: 60
ISA Marks: 80	ESA Marks: 20	Total Marks: 100
Teaching Hrs: 60 (30 sessions)		Exam Duration: 2 hours

Unit - I

1. Introduction to Mechatronics: Definition & overview of Mechatronics, Key elements, Real time Simualtion, Mechatronics Design approach, examples of mechatronic systems.	04 Hrs
2. Sensor, Actuators: Classification and application Sensors and Actuators: DC motor, Stepper motor, AC and DC Servo motor	04 Hrs
3. Signal conditioning: Introduction; Filters(Active/Passive, Analog/Digital); Encoder, Decoder; MUX, Demux; SR Latch, Flip Flop(SR, JK, D, T), Registers, Counters; ADC, DAC; Data Acquisition System(DAQ) simulation experiments.	02 Hrs

Unit - II

4. Basics of Microcontrollers/Microprocessor: Memory Hierarchy in Computer; Address/Data lines; Micro-controller Vs Microprocessor; RISC vs CISC, Harward Vs. Von neumann, Introduction to 8051 Architecture, Timer, Counter, interrupts; Different Architectures;	04 Hrs
5. Communication System Digital Communications, Centralized, hierarchical and distributed control, Networks, Protocols, Open System Interconnection Communication interface, Serial and Parallel communication interface, Wireless Protocols.	02 Hrs
6. Programmable logic controller (PLC): Introduction, Architecture of PLC; Functional Block Diagram(FBD) and Ladder diagrams for logic functions, latching, interlocking, Timer/counter, web controlled applications. Experiments on the same.	02 Hrs
7. Applications of Mechatronics: Robotics: Introduction, Robotic terminology, Robotic configuration, Robot applications, Robots Co-ordinates System**;** Experiments. **Machine Vision System:** Introduction, Image Acquisition; Image Processing;	02 Hrs

Text Book

1. W. Bolton, "Mechatronics", 2nd edition , Pearson Ed, 2001
2. Petruzella D Frank, "Programming Logic Controllers", 3rd edition, Mc Graw Hill Education, 2010
3. Mazidi Muhammd Ali et.al, "The 8051 Microcontroller and Embedded Systems", 2nd edition, Pearson Education India, 2007.

References

1. David Bradley and David W., "Mechatronics in Action", 2nd edition, Springer, 2010
2. Devdas Shetty, Richard Kolk, "Mechatronics System Design", 2nd edition, Cengage Learning, 2010.
3. Robert H. Bishop, "MECHATRONICS an Introduction", 1st edition, Taylor & F, 2006.
4. Garry Dunning, Introduction to Programmable Logic Controllers, 3, Thomson/Delmar Learning, 2005.
5. W. Bolton, Programmable Logic Controllers, 2, Elsevier, 2013.

Manuals:

1. Mechatronics Lab Manual prepared by Lab-incharge.

Others:

- Relevant Manuals and data sheets of different device/equipment manufacturers.

List of planned Experiments:

Sl. No	Name of Experiments	No. of Sessions
1	Realization of Logic gates and arithmetic circuits.	2
2	Realization of combinational circuits like Encoder, Decoder; MUX, Demux using software package. Use these circuit to understand signal conditioning concepts.	3
3	Realization of sequential circuits like SR Latch and Flip Flop (SR, JK, D, T) and build Registers and Counters using software package. Use these as basic building blocks for controller.	2
4	Simulate circuits of Filters (Active/Passive, Analog/Digital), ADC and DAC to understand the intricate details of Data Acquisition System (DAQ).	2
5	PLC software Familiarization and Basic Programming (Latching and interlocking).	1
6	Timer, Counter programming applications using PLC.	2
7	Building applications like Water level controller, Sequencing of 3 motors, Washing machine sequencing, Welding process/ conveyor controller, DCmotor controller using PLC.	2
8	Web server based control technique for remote control applications (give insight to IOT applications).	1
9	Machine vision concept realization using kits built In-house. Write a Program using Matlab to capture image, detect object and find its co-ordinates. Communicate this information to arduino to pick and place it to predefined position.	2
10	Build stand alone systems for image acquisition and processing applications using Raspberry pi. It is programmed using graphical programming (simulink).	2
11	Course Project (Open Ended Experiment.)	1

Course Code: 16EMEP205 **Course Title:** Product Realization

L-T-P: 0-0-2	Credits:2	Contact Hrs: 60
ISA Marks: 80	ESA Marks: 20	Total Marks: 100
Teaching Hrs: 60 (30 sessions)		Exam Duration: 2 hours

Product Realization Week wise Schedule/ Planning:

Week #	Particulars
Week 1 and Week 2	➢ Introduction to Prototyping - Specifications, Part Drawings, Assembly Drawings, PCB Layout, Wireframe , Pseudocode, BOM, Process Plan, Fabrication and Test Plan Validation ➢ IOT Workshop
Week 3	➢ Identifying sub-assemblies ➢ Procurement of logistics for proof of concept testing. ➢ Selection of materials for all the parts and joining techniques ➢ Selection of UI and Core Component of Android
Week 4	➢ Process plan ➢ Identifying the proper machines, tools and operations required for prototyping. ➢ Selection of appropriate raw materials for prototyping. ➢ Demonstrate breadboard prototype of entire electronics in the system. (To have tested electronic circuit for PCB design) ➢ UI implementation using XML
Week 5	➢ Fabricate the parts for sub assembly ➢ Initiate schematic entry in PCB design software, also refine and optimize thesize of the board. ➢ UI implementation and validation
Week 6	➢ Fabricate the parts for sub assembly ➢ Generate gerber files for the optimal PCB design. ➢ Android core component implementation and Unit Testing
Week 7	➢ Fabricate the parts for sub assembly ➢ Fabricate PCB using MITS machine, solder components and test the design. ➢ Android core component implementation and Unit Testing
Week 8	➢ Assemble the sub assemblies and check for interference and functionality ➢ Revisit PCB testing for increasing reliability of the design. (test to avoid/eliminate lose connections, dry soldering, andbad electronic components) ➢ Android core components integration and testing
Week 9	➢ Test the functional prototype using proper identified test methods. ➢ Demonstrate working of fully functional PCB. ➢ Configuration of IoT Server
Week 10	➢ Integratesubsystems for prototype testing. ➢ Analyse the test results ➢ System modification ➢ System integration
Week 11	➢ Final concluding review ➢ Product catalog ➢ System Tesing.

References

1. Pahl, G., Beitz, W., Feldhusen, J. and Grote ; "Engineering Design-A Systematic Approach" by, K.-H- Springer; 3rd ed. 2007

Course Code: 15EMEE308		**Course Title: HVAC Systems**
L-T-P: 3-0-0	Credits: 3	Contact Hrs: 3 hrs/week
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 40		Exam Duration: 3 hrs

Unit – I

Chapter 1: Introduction to HVAC Systems and Psychrometry 05 Hrs

Purpose, applications, definition and components of air conditioning - Need and methods of ventilation. Evolution of air properties and psychrometric chart - Basic processes such as sensible heating/cooling, humidification/dehumidification and their combinations, steam and adiabatic humidification, adiabatic mixing, etc. - Bypass factor and Sensible heat ratio, Numerical problems.

Chapter 2: Human Comfort, Summer and winter AC 05 Hrs

Heat transfer from body, convection, radiation, conduction, evaporation, clothing resistance, activity level - Concept of human comfort - Thermal response - comfort factors - Environmental indices - Indoor air quality. - Simple summer AC process, Room sensible heat factor, Coil sensible heat factor, ADP - Precision AC - Winter AC.

Chapter 3: AC Systems and Equipment 06 Hrs

Classification of air conditioning systems, Filters, types, efficiency – Fan laws, cooling coils and hearing coils, sizing and off design performance - Cooling and dehumidifying coil, dry and wet, sizing, performance.

Unit – II

Chapter 4: Heat Transfer 04 Hrs

Heat transfer in wall and roof, sol-air temperature, insulation, cooling load temperature difference - Fenestration, types of glass, sun shade, shading coefficient, maximum radiation, cooling load factor

Chapter 5: Cooling load and heating load estimation 06 Hrs

Thermodynamics of human body and mathematical model, Human comfort chart, Design conditions, outdoor, indoor - External load, wall, roof, glass - Internal load, occupancy, lighting, equipments - Ventilation, air quantity, loads - Load estimation methods. Vapour transfer in wall, vapour barrier, load estimation basics

Chapter 6: Air distribution, diffusion and Ventilation 06 Hrs

Ducts, types, energy equation for pipe flow, friction chart, methods of sizing, air distribution systems, ADPI, outlet/inlet selection.
Need, threshold limits of contaminants, estimation of ventilation rates, decay equation, air flow round buildings, Natural, wind effect, stack effect, combined effect - Mechanical, forced, exhaust, combined - Displacement ventilation

Unit – III

Chapter 7: Industrial ventilation 04 Hrs

Steel plants, car parks, plant rooms, mines, etc.

Chapter 8: Ventilation system design 04 Hrs

Exhaust ducts, filters, blowers, hoods, chimney, etc.

TEXT BOOK:

1. Faye C. McQuiston, Jerald D. Parker, Jeffrey D. Spitler, Heating, Ventilating and Air Conditioning: Analysis and Design, 6th Edition, July 2004,
2. W P Jones, Air Conditioning Engineering ELBS 3rd edn Edward Arnold (Publishers) ltd. Londan.

REFERENCES:

1. Harris, Modern Air Conditioning Practice 3rd Edn McGraw Hill Book Company
2. S. N. Sapali, Refrigeration and air conditioning 2nd Edn, PHI learning pvt ltd, Delhi 2016
3. C P Arora, Refrigeration and air conditioning 3rd edn

Course Code: 18EMEE303		Course Title: Turbo Machines
L-T-P: 3-0-0	Credits:3	Contact Hrs: 50
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 40		Exam Duration: 03

	Unit – I	
1.	**Principles of Turbo Machinery** Definition of turbo machine, Comparison with positive displacement machine, Classification; Application of first and second law to turbo-machines, Efficiencies. Dimensionless parameters and their physical significance, Effect of Reynolds number, Specific speed, Illustrative examples on dimensional analysis and model studies.	5 Hrs
2.	**Energy Exchange in Turbo Machines** Euler Turbine equation, Alternate form of Euler turbine equation-components of energy transfer, Degree of reaction, General Analysis of a turbo machine-effect of blade discharge angle on energy transfer and degree of reaction, General analysis of centrifugal pumps and compressors-effect of blade discharge angle on performance, Theoretical head-capacity relationship.	5 Hrs
3.	**Steam Turbines** Classification, single stage impulse turbine, condition for maximum blade efficiency, stage efficiency. Compounding-need for compounding, method of compounding, impulse staging-condition for maximum utilization factor for multi stage turbine with equiangular blades, effect of blade and nozzle losses, Reaction turbine, Parson's reaction turbine, condition for maximum blade efficiency, reaction staging, Problems on single stage turbines only.	6 Hrs
	Unit – II	
4.	**Compressible Flow Fundamentals** Energy and momentum equations for compressible fluid flows, various regions of flows, reference velocities, stagnation state, velocity of sound, critical states, Mach number, critical Mach number, types of waves, Mach cone, Mach angle, effect of Mach number on compressibility.	5 Hrs
5.	**Centrifugal Compressors** Stage velocity triangles, slip factor, power input factor, Stage work, Pressure developed, stage efficiency and surging and problems. Axial flow Compressors: Expression for pressure ratio developed in a stage, work done factor, efficiencies and stalling. Problems.	6 Hrs
6.	**Axial flow Compressors** Axial Flow Compressors: Basic operations, elementary theory, factors affecting stage pressure ratio, Blockage in the compressor annulus, degree of reaction, three-dimensional flow, design process, blade design, calculation of stage performance, compressibility effects, off-design performance.	5 Hrs
	Unit – III	
7.	**Flow through Variable Area Ducts** Isentropic flow through variable area ducts, T-s and h-s diagrams for nozzle and diffuser flows, area ratio as a function of Mach number, mass flow rate through nozzles and diffusers, effect of friction in flow through nozzles.	4 Hrs
8.	**Axial flow Turbines** Stage velocity triangles, single impulse stage, multi-stage velocity and pressure compounded impulse, reaction stages, blade-to-gas speed ratio, losses and efficiencies. Performance charts, low hub-to-tip ratio stages, partial admission turbine stages, supersonic flow.	4 Hrs

Text Book

1. Shepherd D.G., Principals of Turbo Machinery, Macmillan Publishers,1st Edn.1964
2. Yadav R., (2007) 'Steam & gas turbines and power plant engineering', Central Publishing House Allahabad, Vol. 1,
3. S. M. Yahya, Turbines, Compressors & Fans,Tata McGraw Hill Co. Ltd., 2nd edition, 2002.

E Rathakrishnan, Gas Dynamics, PHI- 2nd edition, 2009.

References

1. Kadambi V. Manohar Prasad, An Introduction to Energy Conversion, Vol-III Turbo Machinery, New Age International, 1st Edn, 2006.

Saravanamutto H.I.H, Rogers G.F.C., Cohen H, Gas Turbine Theory, 5th edn., Pearson Education, 2006.

Course Code: 15EMEE417		**Course Title: Modern Trends in Manufacturing**
L-T-P: 3-0-0	Credits: 3	Contact Hrs: 3 hrs/week
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 40		Exam Duration: 3 hrs

Unit - I

1. Systematic Approach for Manufacturing Strategy: 4 Hrs
Seven Losses Regarding Productivity and Profitability, Feasibility Study of Productivity Improvement, Four Levels of Manufacturing Strategy.

2. Management and Productivity in Engineering: 8 Hrs
Definition of Engineering, Management and Management Engineering, Industrial Engineering and Productivity, Necessity of Facts and Work Measurement.
Productivity, Purpose of Productivity Improvement, Engineering Approach for Productivity, Three Levels of Improvement, Points of Successful Productivity, Relationship of Methods, Performance, and Utilization to Standard Time.

3. Concurrent Engineering: 3 Hrs
Introduction, importance of CE ,building blocks of CE, Important factors in concurrent engineering process , communication models, benefits and its tools.

Unit – II

4. Continuous Process Improvement: 8 Hrs
Introduction, Japanese concept of continuous improvement (kaizen), innovation concept of improvement, need for continuous improvement, tools for continuous improvement, steps in implementing continuous improvement, three pillars of continuous improvement, standardization, quality circles, suggestion systems, kaizen and management, kaizen umbrella, TPM, Six sigma, FMEA and discussion of few case studies.

5. Pull Production Systems: 7 Hrs
Introduction to TPS, KANBAN system, difference between pull and push system, other types of kanban, kanban rules, adapting to fluctuation in demand through kanban, a detailed kanban system example, supplier kanban and sequence schedule for kanban.

Unit - III

6. Quality Management Systems: 5 Hrs
Need for ISO 9000 and Other Quality Systems, ISO 9000:2000 Quality System – Elements, Implementation of Quality System, Documentation, Quality Auditing, QS 9000, ISO 14000 –Concept, Requirements and Benefits. Occupational Health & Safety Management (OSHAS -18001) standards, Environmental Management Certification (ISO 14001) and its benefits to stakeholders.

7. **Six sigma:** 5 Hrs
Principles of Six sigma, project selection for six sigma, six sigma problem solving, design for six sigma, six sigma in service and small organization, six sigma and lean production, statistical thinking and application, statistical foundation, statistical methodology, design of experiments, analysis of variances

Text books

1. Masaki Imai, ‘KAIZEN’, McGraw Hill International.
2. Shigeyasu Sakamoto , "Beyond World-Class Productivity", Springer-Verlag London Limited 2010.
3. Dale H. Besterfield, "Total Quality Management", Pearson Education, Asia.

Reference books

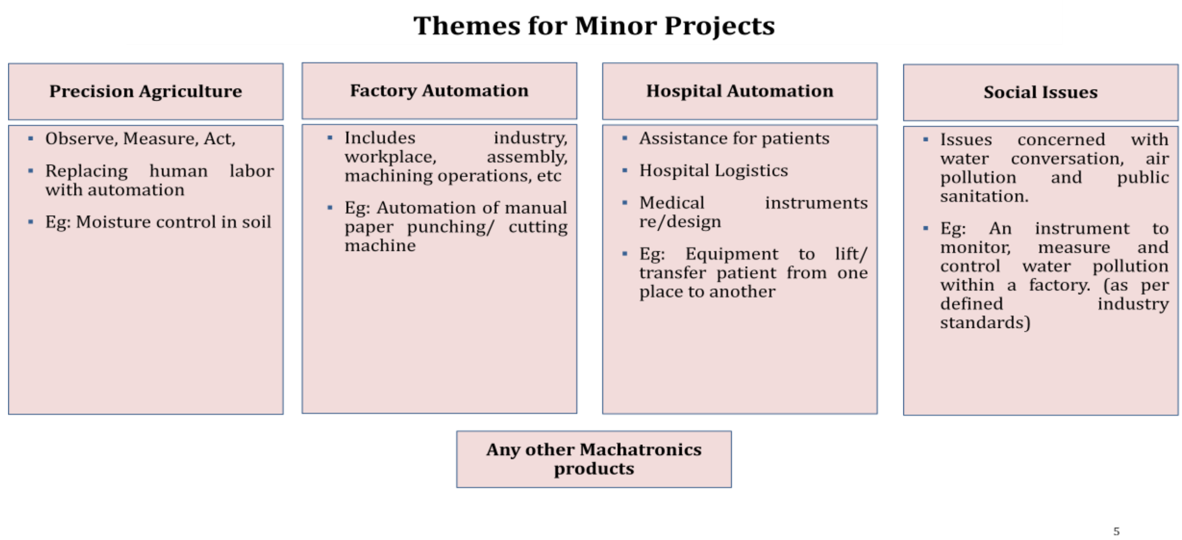
1. Richard J. Schonberger, ‘Japanese Manufacturing Techniques’, The Free Press – Macmillan Publication.
2. James R. Evans and William M. Lindsay, ‘The Management and Control of Quality’.

Course Code: 18EMEW301 | **Course Title: Minor Project**

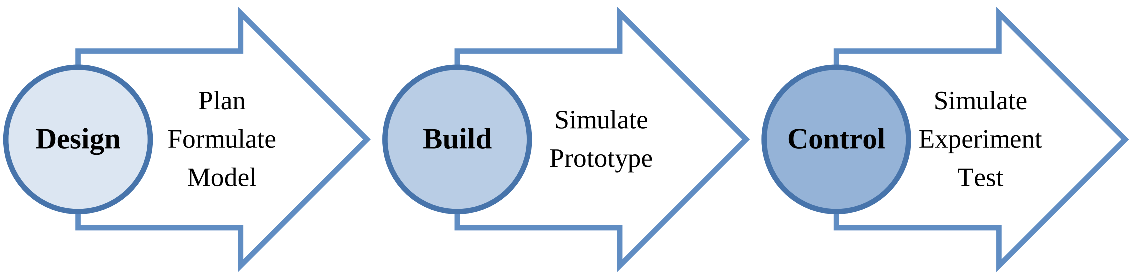
L-T-P: 0-0-3 | Credits: 6 | Contact Hrs: 3 hrs/week

ISA Marks: 50 | ESA Marks: 50 | Total Marks: 100

Exam Duration: 3 hrs



Methodology to be followed for carrying out the projects:



Role of Guide:

- The guide has to provide technical know-how from inception of project to execution
- Help students in identifying proper sources for raw materials, tools and other requirements
- Form a team and encourage students to take roles and responsibilities so that each one of them can enhance their knowledge and skills
- The Guide has to assess the student competencies with regard to his project work. More specifically to assess the student's individual contribution to the project
- Develop the clarity of assessment among the team in every phase of the project and advised to check for the formatting of the presentation and project report
- Continuous monitoring of project at different phases with the help of PLM e-NOVIA to work on paper-less office theme.

Evaluation of Minor-Project

The evaluation of project work shall be done in two stages as Continuous Internal Evaluation (CIE) and Semester End Examination (SEE) having equal weightages in marks.

CIE Evaluation:

- The CIE evaluation of project work shall be done in stages by the expert review panel including guide. In addition the guide shall separately evaluate the progress of project till its completion.
- There shall be three reviews by the panel experts and marks shall be allotted as per the weightages given for each review. The student shall showcase the progress of work through the presentation, videos, models, prototypes, etc to the panel members during the reviews.
- Each of the micro activities involved in accomplishing a project have been identified and included in the evaluation criteria as performance indicators. These performance indicators are being made known to students from day one of the project which helps them to plan and be guided to reach the intended goal. The assessment of each of the performance indicators is carried out as per rubrics which are also shared with the students.
- The review panel will be given a detailed assessment rubrics for each review based on which the panel experts will award the marks.
- Project guide shall be having individual responsibility to assess the entire project work and award the marks as per the assessment rubrics.
- During each review the panel experts shall advice the students with various aspects of the work for continuous development and Implementation.

SEE Evaluation:

- Student shall prepare a detailed project report according to approved guidelines and duly signed by the guide(s) and the Head of the Department and submit it to the examiners.
- The SEE evaluation of the project work shall be based on the demonstration of the model/prototype, presentation, project report submitted and a Viva-Voce by a team consisting of the Guide, an Internal examiner (other than the guide) and an External Examiner appointed by the department.
- Student shall submit a copy of the approved project report after the successful completion of viva examinations to the department.

Course Code: 16EMEP201		**Course Title: Manufacturing Processes Lab**
L-T-P: 0-0-1	Credits: 1	Contact Hrs: 2 hrs/week
ISA Marks: 80	ESA Marks: 20	Total Marks: 100
Teaching Hrs: 26		Exam Duration: 2 hrs

Content

Lab Exercises

1. Machining practices involving machining time calculation and estimation of machining cost for the jobs for turning, taper turning, threading, knurling.	6 Hrs
2. To manufacture and assemble parts for ball valve which involves turning, milling, tapping/slot milling, etc.	14 Hrs
3. Design, Modeling and Analysis of Bulk deformation and Sheet Metal forming processes.	4 Hrs
4. Demonstration of CNC machines and Non-traditional machines such as laser cutting, plasma cutting, electro-discharge machine.	2 Hrs

Text Books:

1. Kalpakjian S., and Schmid S.R., Manufacturing Engineering & Technology, 7th edition, Pearson Education, 2014.
2. Mikell P. Groover, Fundamentals of Modern Manufacturing, 5th edition, John Wiley & Sons, 2012.

Reference Books:

1. Juneja B. L. and Sekhon G. S., Fundamentals of Metal Cutting and Machine Tools, 3rd edition, New Age International Limited, 2008.
2. Rosenthal, P., Heine L., Principles of Metal Casting, Tata McGraw Hill, 1997.
3. John A. Schey, Introduction to Manufacturing Processes, 3rd edition, Tata McGraw Hill, 1999.
4. Mikell P. Groover, Automation, Production Systems, and Computer-Integrated Manufacturing, 4th edition, Prentice Hall, 2014.
5. Pandey P. C. and Shan H. S., Modern Machining Processes, 1st edition, Tata McGraw Hill, 2013.

Course Code: 18EMEP203 | **Course Title: Machine Drawing Lab**

L-T-P: 0-0-1	Credits: 1	Contact Hrs: 2 hrs/week
ISA Marks: 80	ESA Marks:20	Total Marks: 100
Teaching Hrs: 26		Exam Duration: 2 hrs

Laboratory Content

1. Sectional views 8 Hrs

Sectional views of machine parts involving half section, full section, offset section, revolved section and local section (use 1st and 3rd angle of projection).

2. Threaded Fasteners 6 Hrs

Drawing of bolts, nuts, screws and their conventional representation.

3. Part and Assembly Drawing 8 Hrs

Drawing of part and assembly drawing of machines such as:
(1) Screw Jack. (2) Protected type flanged coupling. (3) Pipe vice. (4) Clapper box. (5) Non-return valve. (6)Universal coupling. (7) Pin and cotter joints.

4. Assembly Drawing using CAD tool 4 Hrs

Assembly drawing of machines such as:
(1) Screw Jack. (2) Protected type flanged coupling. (3) Pipe vice. (4) Clapper box. (5) Non-return valve. (6)Universal coupling. (7) Pin and cotter joints.

Text Books:

1. Machine Drawing by K. R. Gopalakrishna, Subhas Publications, 22nd Edition - 2013.
2. Machine Drawing by N. D. Bhat & V. M. Panchal, Charotar Publishing House.
3. A Text Book of Computer Aided Machine Drawing, S. Trymbaka Murthy, CBS Publishers, New Delhi, 2007 Edition.

Reference Books:

1. Engineering drawing practice for schools and colleges SP 46:2003 (BIS).

Course Code: 19EMEC201		**Course Title: Control Systems**
L-T-P: 2-1-0	Credits: 3	Contact Hrs: 4 hrs/week
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 30		Exam Duration: 3 hrs

Unit – 1

1. Introduction to Control System 3 hrs

Generalized configurations and functional description of control systems. Control system design. Examples of Control System. Introduction to Linear, Nonlinear, Time Variant and Time Invariant systems.

2. Modeling of Physical Systems: 8 hrs

Introduction, Differential equations of physical systems, The Laplace Transform, Order of system; The transfer function of linear and rotational Mechanical systems, Gear Train, Electrical systems, Electro-mechanical System, Thermal systems, Hydraulic System; Block representation of system elements and Reduction of block diagrams.

Unit – 2

3. System Response 6 hrs

Introduction, Poles, Zeros, and System Response. First-order system response to step, ramp and impulse inputs. Second-order system response to step input; Un-damped, Under damped, Critical damped and Over damped systems, Time response specifications. Design of 1st and 2nd order system.

4. System Stability 5 hrs

Introduction to stability. Stability analysis by time response, S-plane and Routh-Hurwitz Criterion. Effect of gain adjustment, addition of pole and addition of zero on system response and system stability. Defining the Root locus, General rules for constructing root loci, Sketching the Root locus.

Unit – 3

5. Frequency Domain Analysis 4 hrs

Nyquist stability criteria, Bode Plots. Stability analysis using bode plots.

6. Control Action 4 hrs

Introduction to PID controller design. Types of Controllers, Mathematical modeling of PID, ON-OFF controller, Effect of Proportional, Derivative and Integral elements on system behavior, Design of Controller for given simple applications. Controller Design using root locus.

Text Book:

1. Richard C Dorf and Robert H. Bishop, Modern Control Systems, 12th edition, Addison Wesley
2. A. Anandkumar, Control Systems, 2nd edition, PHI Learning Private Limited, 2014.

Reference Book:

1. Katsuhiko Ogata, Modern Control Engineering, 5th edition, Pearson Publications.
2. Norman S. Nise, Control. Systems, 6th edition, John Wiley & Sons

Course Code: 19EMEP201 **Course Title: Control Systems Lab**

L-T-P: 0-0-2	Credits: 2	Contact Hrs: 4 hrs/week
ISA Marks: 80	ESA Marks: 20	Total Marks: 100
Teaching Hrs: 48		Exam Duration: 2 hrs

Experiment Number	Experiments	No of sessions
01	Scaffolding exercises to explore MATLAB / Simulink software package.	04
02	Modelling of physical systems and its response analysis	06
03	Design and investigate the effects of various controllers on a system.	03
04	Comparative study of Time response, root locus and Bode plot with respect to stability.	02
05	Control system analysis: Case Studies ✓ Hydraulic Lift ✓ DC servo motor	06
06	Case Study (Open Ended)	03

Text Book:

1. Richard C Dorf and Robert H. Bishop, Modern Control Systems, 12th edition, Addison Wesley
2. A. Anandkumar, Control Systems, 2nd edition, PHI Learning Private Limited, 2014.

Reference Book:

1. Katsuhiko Ogata, Modern Control Engineering, 5th edition, Pearson Publications.
2. Norman S. Nise, Control. Systems, 6th edition, John Wiley & Sons.
3. Data sheets provided by manufactures.

Course Code: 19EMEP301 **Course Title: CAD modelling and PLM Lab**

L-T-P: 2-0-2	Credits: 4	Contact Hrs:6hrs/week
ISA Marks: 80	ESA Marks: 20	Total Marks: 100
Teaching Hrs: 80		Exam Duration: 3 hrs

Sl. No.	Work Benches of 3D PLM	No of weeks
1	**Sketcher**- Brief introduction on Sketcher work bench environment Structure of users and saving of files. **Exercises on Sketch** Tools, Profile Tool bar and Constraint Tool bar: Generate the following 2D sketches and make them Iso-constrained.	1
2	**Part Design**-Exercise on 3d models using pad, slot, shaft, groove, hole ,rib and stiffener commands, cut revolve, Dress up commands like chamfer, fillets etc. ***(***Multi-Sections Solid and Removed Multi-Sections Solid Commands	2
3	**Generative shape design (GSD)**- Exercises using GSD to generate complicate surfaces using sub tool bars: Extrude-Revolution, Offset Var and Sweeps Extrude, Revolve, Trim, Transformation and Fillet tools Exercises on Wireframe, Surfaces and Operations Tool bar: (Conversion of Surface model into Solid model	3
4.	**Assembly Design**- Introduction to Assembly Design Work bench Bottom-Up and Top-Down assembly approaches Invoking existing components into assembly work Exercise to demonstrate Top-Down assembly approach.	2
5	**Drafting**- Converting existing 3D models into 2d drawings with all relevant details, sectional views, sheet selection, indicating GD&T symbols and dimensioning**.**	3
6	**Enovia**- Introduction to CATIA 3D experience PLM Import the existing CATIA 3D experience data and store in Search and identify the data located in 3D experience database Modify the data in any PLM process Sharing information with users Analyze and Identify impacts of modifications Save the modifications into database	1

Reference Book:

Training material given by EDS on 3D experience

Course Code:19EMEP302 **Course Title: FEM Lab**

L-T-P: 0-0-1	Credits: 1	Contact Hrs: 2 hrs/week
ISA Marks: 80	ESA Marks: 20	Total Marks: 100
Teaching Hrs: 24	No of Sessions: 12	Exam Duration: 2 hrs

Category: Demonstration		**No. of Lab. Sessions per batch (estimate)**
1	Scientific Research Exposure (Research Education): Methods to search/extract Journal papers (Reputed journal paper), Referring papers, Drafting a paper. Introduction to ANSYS Workbench and familiarity. Real time Current/future field issues : Problem Identification	**03**
Category: Exercises		
Expt./Job No.	**Experiment/job Details**	**No. of Lab. Sessions per batch (estimate)**
10.	Static Structural analysis d) Uniform bar, e) Bracket, f) Machine Components	01
11.	Linear Buckling a) Columns & Struts (Different Boundary Conditions) b) Machine component	01
12.	Non-Linear Structural Analysis d) Geometric Nonlinearity e) Material Nonlinearity f) Contact Nonlinearity	02
13.	Dynamic Analysis (Modal/Harmonic/Transient Analysis) c) Beam (Different Boundary Conditions) d) Machine components	01
14.	Thermal Analysis d) Fins e) Heat Exchangers f) Machine component	01
15.	Drop Test & Impact Analysis c) Mobile drop test d) TV, Refrigerator etc.	01
16.	Optimization	01
17.	Model Test	01
Category: Structured Enquiry		
Execute all the FEM Analysis modules which are dealt under the lab exercise. Identify the component (Sub-assembly need have Minimum 3 to 4 components) Start from scratch ➢ Measure the dimensions of component ➢ Generate the Solid Modeling of components with overall assembly (In any of the CAD Software) ➢ Import the model in neutral form to ANSYS Workbench ➢ Collection of data relevant to Material Properties ➢ Understand the physics of the problem (Working Principle with load's and boundary conditions)		

➢ Interpretation of Results with conclusion.
Category: Open ended
8. Identify field issue pertaining to any component/product in today's industry. 9. Collect the information/literature on earlier worked project through external/internal search (Journal Paper/Patent/reports) 10. Comprehend the physics of the problem with working principle. 11. Prepare the abstract and apply to a national/international conference 12. Identify material properties, boundary conditions and load steps. 13. Carryout the analysis as per the FEA steps. 14. Provide engineering solutions to the identified sub assembly (deformation and stresses, material change, weight reduction, increasing load bearing capacity, fatigue life calculation, prediction of endurance limit of component and damage factor). 15. Prepare the draft on the worked out problem and apply to a national/international conference

Materials and Resources Required:

3. Books/References: Nitin Ghokale, Practical finite element analysis
4. Manuals: Sham Tickoo, ANSYS for Engineers and Designers

Course Code:19EMEE302		**Course Title: Advanced Statistics and Machine Learning**
L-T-P: 0-0-3	Credits: 3	Contact Hrs: 6 hrs/week
ISA Marks: 80	ESA Marks: 20	Total Marks: 100
Teaching Hrs: 80		Exam Duration: 2 hrs

Unit - I

1. Introduction to Machine Learning 25 Hrs

Introduction to Supervised, Unsupervised, and Reinforcement Learning; Statistics for ML; Exploratory Data Analysis; Use of Python and working with CSV/XLS files.

Python hands on: Installation, Introduction to Python libraries (Pandas, Numpy, matplotlib and so forth)

Unit - II

2. Applied Statistics 15 Hrs

Statistics for ML; Data Wrangling; Exploratory Data Analysis; Visualization; Use of Python and working with CSV/DB

Hands on: Preprocessing techniques

18 Hrs

3. Machine Learning Methods

Introduction to ML Life Cycle; Regression – Predictive Modeling; Regularization; Feature Selection; Metrics for Prediction; Visualization;

Unit - III

4. ML – Classification 22 Hrs

Introduction to Classification; Logistic Regression; Random Forests; Metrics for Classification; Visualization; Use of Python and DB

Text Books

1. Trevor Hastie, Robert Tibshirani, and Jerome Friedman, “The Elements of Statistical Learning: Data Mining, Inference, and Prediction”, Springer, 2017.
2. Roger D Peng, “R Programming for Data Science”, Learnpub, 2015.

References

1. Geetha James, Trevor Hastie, Daniela Whitten, Robert Tibshirani, “An Introduction to Statistical Learning with Applications in R”, Springer, 2017.
2. Andrew Ng, “Machine Learning Yearning”, https://www.mlyearning.org/.
3. Michael Nielsen, “Neural Networks and Deep Learning”, http://neuralnetworksanddeeplearning.com/.

Course Code: 19EMEE307		**Course Title: Machine Learning Applications**
L-T-P: 0-0-3	Credits: 3	Contact Hrs: 6 hrs/week
ISA Marks: 80	ESA Marks: 20	Total Marks: 100
Teaching Hrs: 80		Exam Duration: 2hrs

Unit - 1

1. Unsupervised Learning 18 Hrs

Refresher week, Introduction to Unsupervised Learning, Clustering Analysis: K-Means, K-Medoid, DBSCAN, Hierarchical Clustering.

Unit - 2

2. Introduction to Deep Learning Frame-Work 15 Hrs

Introduction to DL, Exploring the popular DL frameworks, Getting started with TensorFlow, Introduction to Keras, Setting up the environment.

21 Hrs

3. Introduction to Deep Neural Network (DNN)

Introduction- What is Deep Learning, Why Deep Learning and Why now, Mathematical building blocks of NN, Examples on Regression, Classification.

Unit - 3

4. Deep Learning in practice 12 Hrs

Introduction to Convnets, Understanding Recurrent NN, Examples

Text Books

1. Deep Learning, Ian Goodfellow, Yoshua Bengio et.al
2. Trevor Hastie, Robert Tibshirani, and Jerome Friedman, "The Elements of Statistical Learning: Data Mining, Inference, and Prediction", Springer, 2017
3. Deep Learning with Python, Francois Chollet

References

1. Andrew Ng, "Machine Learning Yearning", https://www.mlyearning.org/.
2. Michael Nielsen, "Neural Networks and Deep Learning", http://neuralnetworksanddeeplearning.com/.

Course Code: 19EMEE301 **Course Title: Vehicle Structure and Design Optimization**

L-T-P: 0-0-3 Credits: 3 Contact Hrs: 3 hrs/week

ISA Marks: 80 ESA Marks: 20 Total Marks: 100

Teaching Hrs: 80 Exam Duration: 2 hrs

PART A (Study of Vehicle Structure)		
Sl. No.	**Content**	**Teaching Hours**
1	Brief explanation of different types of Loads and its effect; Different types of stresses- Static and Thermal, Different types of beams, Struts and Columns, thick and thin cylinders;	02
2	Understanding vehicle structure based on application; (e.g: 3box, load body and chassis)	04
3	Choices for Preparation of Virtual Model (1D, 2D, 3D representation);	03
4	Importance of Joinery;	02
5	Common performance measures for vehicle structures; (Stiffness, Modal, Durability)	03
6	Understanding Data and Assumptions; (e.g. nominal and tolerance, etc.)	02
7	Baseline data; (Initial collection of data which serves as a basis for comparison with the subsequently acquired data.)	02
8	Quality control in virtual environment;	03
9	Example case of static stiffness of BIW, Chassis; (BIW (short for Body in White) is a stage in automotive design and manufacturing. BIW refers to the body shell design of an automotive product such as cars. It is just a sheet metal welded structure. BIWwill not have doors, engines, chassis or any other moving parts.)	05
10	Understanding effect of thermal loads on structure;	02
11	Understanding how to compute life based on stress results;	02
	Total-Theory	**30**
Hands on Session		
01	Demonstrate importance of geometric parameters on performance of structure	05
02	Demonstrate importance of cross members on performance of structure	05
Total-Hands-on		**10**
TOTAL		**40**
PART A (Design Optimization)		
Sl. No.	**Content**	**Teaching Hours**
1	Optimization in the Design Process, Engineering Design Practice, Characteristics of Different Industries, CAE and the Design Cycle, The impact of optimization on CAE, What is an Optimum Design?, Optimization terminology in a nutshell, Finding an Optimum, Formulation of an Optimization problem;	02
2	What is optimization in the context of EV structure;	02
3	Different types of design optimization;	02
4	How to plan and approach giving design guidance;	02
5	What is concept level design guidance (generative designs);	03
6	How to handle design guidance at a detailed design stage;	03
7	Examples - design guidance for stiffness attribute;	04
8	Examples - design guidance for durability attribute;	04

9	What is MDO, its application; (Medium density overlay-MDO is produced with a high-quality thermosetting resin-impregnated fiber surface bonded to one or both sides under heat and pressure to create an exterior-grade plywood panel.)	02
10	Watch-outs during design guidance process;	02
11	Examples - design guidance for NV & crash attribute;	04
	Total-Theory	**30**
	Hands on Session	
01	Optimize front control arm of a vehicle for all its performance criteria. FAW up by 10%	05
02	Optimize B-Pillar for roof crush if GVW goes up by 20% due to electrification Effect of wheel base increase on chassis stiffness and how to bring it back, Section optimization using morphing.	05
	Total-Hands-on	**10**
	TOTAL	**40**

PROJECTS:

Objective: To carry out Baseline Performance, Virtual Testing and Design Countermeasures	
Sl. No.	**Content**
01	Battery case for EV;
02	Motor compartment / Passenger compartment - improve performance;

Objective: To Provide design guidance		
Sl. No.	**Content**	
01	Battery case for EV (Metal vs Composite);	
02	Motor compartment / Passenger compartment - improve performance;	

Course Code:19EMEE401 **Course Title: Dynamics & Durability of Vehicles**

L-T-P: 3-0-0	Credits: 3	Contact Hrs: 3 hrs/week
ISA Marks: 80	ESA Marks: 20	Total Marks: 100
Teaching Hrs: 40		Exam Duration: 3 hrs

PART A
(Dynamics of Vehicles)

Sl. No.	Content	Teaching Hours
1	Introduction - Kinematics & Compliance in vehicles;	02
2	Introduction to Roads and Loads;	02
3	Introduction to Durability in industry;	02
4	Data and Assumptions for multi-body systems - quality control;	03
5	Loads mapping for downstream use with examples;	03
6	Example applications using Multi-Body Dynamic Systems;	03
7	Introduction - Flex Body;	02
8	Durability example with and without Flex body;	03
9	Control systems in Multi-Body;	04
	Total-Theory	**24**
	Hands on Session	
01	Build a 2/3 wheeler suspension system to carry out K&C	08
02	Build a 3 wheeler suspension system to carry out loads extraction for durability	08
	Total-Hands-on	**16**
	TOTAL	**40**

PART B
(Durability of Vehicles)

Sl. No.	Content	Teaching Hours
1	Conduction, Convection, Steady state, Transient flows, Turbulence and its significance	02
2	Importance of BTMS, Current state of thermal management in EV	02
3	Types of battery packs for xEV	02
4	Heat load calculation for battery packs	02
5	How to approach design assessment of power pack for thermal management	02
6	Importance of data & assumptions (includes baselining)	02
7	Example case of using AcuSolve to assess a design	03
8	How to improve the thermal performance of a power pack design	02
9	Importance of Drag co-eff for vehicles moving at high speeds	02
10	Fast assessment of A-Surface design for drag using VWT	02
11	Introduction to thermal management in electronic circuits	03
	Total-Theory	**24**
	Hands on Session	
01	Assume 2 different designs and compare the thermal performance	07
02	Prepare 2 vehicle designs (external surface) and compute drag	07
	Total-Hands-on	**16**
	TOTAL	**36**

Text Books/Reference Books:

3. Dr. N.K. Giri, Automotive Mechanics, 8th Edition, 2008, Khanna Publication, New Delhi.
4. Nitin Ghokale, Practical finite element analysis, Finite to infinite, 2008.
5. Practical Aspects of Structural Optimization, Altair University, 3rd Edition.
6. Robin Hardy, Iqbal Husain, "Electric and Hybrid Vehicles”. CRC Press, ISBN 0-8493-1466-6.

7. Ron Hodkinson and John Fenton, “Lightweight Electric/ Hybrid Vehicle Design”. SAE International
8. John M. Miller, Propulsion Systems for Hybrid Vehicles" Institute of Electrical Engineers, London, ISBN0 863413366.
9. Automobile Electrical and Electronic systems, Tom Denton, Third Edition, 2004, SAE International, SAE ISBN 0 7680 147 2, Society of Automotive Engineers. Inc 400 common wealth Drive, Warrendale, PA 15096-0001 USA.

PROJECTS:

Part A

Objective: To carry out Dynamic and Durability of different chassis

Sl. No.	Content
01	Compare durability of conventional ICE chassis with Electric version

Part B

Objective: To carry out to analyze the heat produced during EV operation and streamline external airflow

Sl. No.	Content
01	Compute Delta T for a chosen EV battery pack
02	Improve drag performance of a chosen external vehicle element

Course Code: 19EMEE308 **Course Title: Applications of Vibrations and Acoustics**

L-T-P: 3-0-0	Credits: 3	Contact Hrs: 3 hrs/week
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 40		Exam Duration: 3 hrs

Unit I

1. Response of Mechanical Systems to Vibrations and Shocks 5 Hrs

Characteristics of vibration and shock, response of linear mechanical systems to vibrations, response properties of non-linear systems, response of mechanical systems to stationary random vibrations, shock response and shock spectra, vibrations in structures.

2. Vibration Measuring Instrumentation and Techniques 5 Hrs

Introduction, displacement, velocity and acceleration transducers, smart sensors and transducers, electronic data sheets, selection of accelerometer, calibration and system performance checks, practical considerations in mounting accelerometers, sensor design technique (FEA), sensor selection, mounting, cabling practices and signal conditioning, sensor and signal analysis.

3. Fundamentals of Signal Analysis 5 Hrs

Data acquisition and processing, signal operations, frequency domain analysis, sampling of continuous time signals, Fast Fourier transform, FFT analyser setup, leakage and windowing, averaging, real-time analysis of stationary and transient signals.

Unit II

4. Vibration Monitoring and Analysis Techniques 5 Hrs

Transducer considerations, vibration data collection errors, time domain analysis, statistical descriptors of vibration signals, Lissajous pattern, frequency domain analysis, quefrency domain analysis, demodulation technique, advanced fault diagnostic techniques.

5. Modal Analysis 5 Hrs

Experimental aspects of modal testing, FRF data of SDOF and MDOF systems, Classical, OMA, ODS, SRS & FE Correlation, vibration and shock testing, examples of vibration and acoustics – automotive, aerospace and defence, engineering and white goods, research.

6. Vibration Control 5 Hrs

Introduction; Vibration Nomo graph and vibration criteria; Reduction of vibration at the source, Control of vibration; Control of natural frequencies, Introduction of damping, Vibration isolation for different types of foundation, Shock isolation, Active vibration control, Vibration absorbers: Undamped and damped dynamic vibration absorber.

Unit III

7. Fundamentals of Sound 5 Hrs

Sensor selection, measurement techniques, applications-environmental, product noise: sound power and sound pressure, noise source identification: intensity and acoustic holography, building acoustics, sound quality.

8. Standards for Noise and Vibration 5 Hrs

Standards for sensors, frequency analysis, sound level meter, sound power measurement, sound intensity measurement, vibration measurement, measurement of damping.

Text Books:

1. C. Sujatha, Vibration and Acoustics, Tata McGraw-Hill Education, 2010
2. Singiresu S. Rao, Mechanical Vibrations, 6th Edition, Pearson Education, 2018.

Reference Books:

1. M. L. Munjal, Noise and Vibration Control, World Scientific Publishing Co, Pvt. Ltd., 2013
2. Bruel and Kjaer, Mechanical Vibration and Shock Measurements, 2nd Edition, Larsen & son, 1984.

Course Code: 20EMEW401		**Course Title: Senior Design Project**
L-T-P: 0-0-3	Credits: 6	Contact Hrs: 3 hrs/week
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
		Exam Duration: 3 hrs

About The Course:

Senior Design project course uses User experience design (UX) approach to solve complex engineering problems. In this course students are challenged to solve frontier complex engineering problems in the field of smart manufacturing, green engineering, and Design engineering and advanced materials. The objective of the course is to infuse lifelong qualities in students such as research, design thinking, innovation and entrepreneurial qualities. After this course students are capable to convert customer pain points into business solution.

Course Code: **15EESC701**	Course Title: **Renewable Energy Systems**	
L-T-P: **4-1-0**	Credits: **5**	Contact Hrs: **6 hrs/week**
CIE Marks: **50**	SEE Marks: **50**	Total Marks: **100**
Teaching Hrs: **50 hrs**		Exam Duration: **3 hrs**

1. **Thermo-chemical conversion :** Thermo-chemical conversion of biomass, biomass processing, briquetting, pelletisation, biomass stoves, biomass carbonization, pyrolysis of biomass, biomass gasification, gasifiers: [updraft(forced draft & Natural draft),downdraft (Open core, throat type & modular)], Gasifier stoves, gasifier thermal applications, gasifier engine applications: dual fuel and 100% gas mode operation, power generation systems: (decentralized grid interactive).
2. **Bio-chemical conversion** :.Aerobic, and anaerobic processes, activated sludge process, plug flow reactors, anaerobic fixed film reactor, UASB reactor, anaerobic fluidized bed reactor, estimation of methane yield, anaerobic digestion system for MSW, Vermi-composting, different designs of biogas plants for animal waste, Biogas engine applications.
3. **Liquid Bio fuels** : Liquid biofuels, non-edible oilseeds, oil extraction, preprocessing, transesterification, biodiesel, characterization of liquid fuels, production of syngas from biomass, production of methanol from syngas, production of ethanol from ligno-cellulosic biomass, Liquid bio-fuel applications.,
4. **Wind Energy**: Rotor aerodynamics, aerofoils, rotor design, wind turbine and its subsystems, Induction generator- characteristics, wind farms, power evacuation aspects, site selection, Integration with electric grid.
5. **Small Hydropower** : Classification of schemes, siting and economic considerations, System components: weir/intake, channel, desilting, forebay, spillway, penstock, turbine, generator, governor, control.
6. **Other Renewable Energy Technologies** : Geothermal, wave energy, tidal energy, ocean thermal energy
7. **Financial feasibility** of renewable energy technologies: case studies

Text / Reference Books

1. Donald Klass: Biomass for Renewable Energy, Fuels, and Chemicals, 1st Edn, Entech International Inc., USA, 1998
2. Paul Gipe, Wind energy Basics: A guide to Small and Micro-wind, Chelsea Green Publishing, 2008
3. Thomas Read, Agua Das, Handbook of Biomass Downdraft Gasifier Engine Systems, The Biomass Energy foundation Press, 1988
4. Klaus Von Mitzlaff, Engines for Biogas – Theory, Modification, Economic Operation, Division of the Deutsche Gesellschaft Fur Technische Zusammenarbeit (GTZ) GmbH - 1988

Course Code: **15EESC703**	Course Title: **Energy Management**	
L-T-P: **4-1-0**	Credits: **5**	Contact Hrs: **6 hrs/week**
CIE Marks: **50**	SEE Marks: **50**	Total Marks: **100**
Teaching Hrs: **50 hrs**		Exam Duration: **3 hrs**

1. **Energy Management**: Scope of energy management, necessary steps in energy management programme, general principles of energy management, qualities of energy manager, functions of energy manager, language of energy manager. Organizing, Initiating and managing an energy management program.
2. **Energy Auditing**: Elements and concepts, Types of energy audits, energy audit Instruments. Energy surveying and auditing, objectives, uses of energy, energy conservation schemes, energy index, cost index, pie charts, Sankey diagrams, load profiles (histograms), preliminary energy audit – detailed energy audit, questionnaire, energy audit instruments, Energy audit report writing.
3. **Economic Analysis**: Cash flows, Time value of money, Formulae relating present and future cash flows - single amount, uniform series. Payback period, Net present value, and Benefit-cost ratio, Internal-rate of return & Life cycle costs/benefits.
4. **Energy efficiency in Thermal utilities**: Oil-coal and gas Combustors, FBC boilers, Steam and condensate system, Furnaces, Cogeneration, Waste heat recovery equipments, Turbines, and Heat exchangers
5. **Insulation and Refractories**: types and application, economic insulation thickness, heat saving criteria, application of refractory, heat loss
6. **Utilization of Electric energy**: Heating methods: Resistance ovens, dielectric heating. Space heating in buildings, Illumination Engineering
7. **Energy Conservation in Electric Utility**: Motors, Fans and blowers, Pumps and Pumping System, Diesel Generating system, HVAC and Refrigeration System, Lighting System, Energy efficient technologies in electrical systems: power factor controllers, energy efficient motors, variable speed drives, energy efficient transformers, electronic ballast.

Text /.Reference Books

1. Turner W.C., Doty S., Energy Management Handbook, 8 ed., Wiley Inter Sc., 1982.
2. Taylor E. O., Utilization of Electric Energy, 1ed, Orient Longman. 2007
3. Reay D.A., Industrial Energy Conservation, 1ed., Pergamon Press. 1980.
4. Tripathy S.C.: Electric Energy Utilization and Conservation, TMG Delhi, 1991.
5. Indian Bureau of Energy Efficiency Manuals, BEE Publications, 2002

Course Code: **15EESP701**		Course Title: **Computational Lab**
L-T-P: **0-0-1**	Credits: **1**	Contact Hrs: **2 hrs/week**
CIE Marks: **80**	SEE Marks: **20**	Total Marks: **100**
Teaching Hrs: **---**		Exam Duration: **2hr**

(Exercises should be executed using relevant Computing and Programming tools)

1. zero, first and second order systems
2. Uncertainty analysis in the design of experiments-
3. Uncertainty analysis in use of manometers for pressure measurement
4. Uncertainty analysis in use of thermocouples for temperature measurements
5. Uncertainty analysis in use of pitot tube for flow velocity measurement
6. Use of the concept of Design of Experiments in simple flow related experiments

Course Code: **15EESP702**		Course Title: **Renewable Energy conversion Lab**
L-T-P: **0-0-1**	Credits: **1**	Contact Hrs: **2 hrs/week**
CIE Marks: **80**	SEE Marks: **20**	Total Marks: **100**
Teaching Hrs: **--**		Exam Duration: **---**

1. Solar radiation and wind speed measurements
2. Studies on Solar water heating system
3. Studies on solar Air heating System
4. Studies on Wind turbine for power generation and water lifting
5. Studies of Solar PV system
6. Studies on Biomass based Gasification and Bio-digester system
7. Use of HOMER for simulation of renewable energy systems

Course Code: **15EESC706**	Course Title: **Computational Fluid Dynamics**	
L-T-P: **4-1-0**	Credits: **5**	Contact Hrs: **6hrs/week**
CIE Marks: **50**	SEE Marks: **50**	Total Marks: **100**
Teaching Hrs: **50 hrs**		Exam Duration: **3 hrs**

1. **Computational Fluid Dynamics Solution Procedure**: CFD applications in Research and Design, CFD Problem set-up-Creation of geometry, Mesh generation, Specification of boundary conditions. CFD Solver- Initialization and Convergence monitoring. Post Processor-Plots, data reports and Animation
2. **Governing Equations for CFD**: Continuity Equation, Momentum Equation, Energy Equation**-** Physical Interpretation and comments. The additional equations for turbulent flow, Generic form of Governing equations, Physical Boundary conditions
3. **CFD Techniques**: Discretization of Governing Equations**-** Finite difference method, Finite volume method ,Converting governing equations into algebraic equations, Direct and Iterative solutions, Pressure- velocity coupling-SIMPLE scheme
4. **CFD Solution Analysis**: Consistency, Stability, Convergence, Accuracy and Efficiency of CFD solutions. Accelerating convergence, controlling solution errors, verification and Validation. Case studies related to fluid flow through channel and pipe bend.
5. **Practical Guidelines for CFD simulation and Analysis**: Grid generation- Guidelines on grid quality and grid design, Local refinement and solution adaption. Guidelines on Boundary conditions – Setting inlet, outlet and wall boundary conditions. Symmetric and Periodic Boundary conditions. Turbulence Modelling- Approaches, selection strategies, Case study: modeling of hydrofoil flows.
6. **Advanced Topics in CFD**: Advances in Numerical methods and Techniques- Moving grids, Multigrids, Parallel Computing and Immersed boundary methods. Advances in computational models- Direct numerical Simulation (DNS), Large Edddy Simulation (LES), RANS-LES, Lattice Boltzmann method, Monte-Carlo method, Particle methods.

Text /Reference Books

1. Jiyuan Tu, Guan Heng Yeoh, Chaoqun, Computational Fluid Dynamics, Butterworth- Heinemann, 1st Edn., 2008
2. Anderson D.A., Tannehill J.C., Platcher.R.H., Computational Fluid Mechanics and Heat Transfer; MGH, 2001.
3. Patankar Suhas V., Numerical Fluid flow and Heat transfer, Hemisphere Series on Computational Methods in Mechanics and Thermal Science,2nd Edn. 2000
4. Ferziger Joel H., Milovan Peric, Computational Methods for Fluid Dynamics, 3rd Edn., Springer- 2001
5. Anderson J D, Computational Fluid Dynamics Basics with Applications, MGH, 2nd Edn.,2001

Course Code: **15EHSC701**	Course Title: **Mathematical Thinking and Logical Reasoning**	
L-T-P:3-0-0	Credits: 3	Contact Hrs: 3 hrs / week
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 50		Exam Duration: 180 min

No	**Content**	**Hrs**
1	**Unit 1: Arithmetical Reasoning and Analytical Thinking** **Chapter 1** – Arithmetical Reasoning 1.1 Number Systems and Speed Math 1.2 Factors and Multiples 1.3 Combinations 1.4 Probability 1.5 Percentages, Gain and Loss 1.6 Interest 1.7 Alligations and Averages 1.8 Man-Hour Calculations 1.9 Time, Speed and Distance **Chapter 2** – Analytical Thinking 2.1 Data Analysis 2.2 Data Interpretation 2.3 Data Sufficiency 2.4 Puzzle Tests	**34**
2	**Unit 2: Verbal and Non Verbal Logic** **Chapter 1 – Verbal Logic** 1.1 Verbal Analogy 1.2 Verbal Classification 1.3 Letter and Number Series 1.4 Decoding the Codes **Chapter 2 – Non – Verbal Logic** 2.1 Non – Verbal Analogy 2.2 Non – Verbal Classification 2.3 Pattern Completion 2.4 Pattern Comparison **Chapter 3 – Critical Reasoning** 3.1 Statements and Assumptions 3.2 Conclusive Reasoning	**06**

Reference Book:

1. R. S. Aggarwal, A Modern Approach to Verbal and Non – Verbal Reasoning – Sultan Chand and Sons, New Delhi.
2. Chopra, Verbal and Non – Verbal Reasoning –MacMillan India.
3. R. S. Aggarwal, Quantitative Aptitude –Sultan Chand and Sons, New Delhi.
4. Dr. Edward De Bono, Lateral Thinking –Penguin Books, New Delhi

Course Code: **15EESE706**		Course Title: **Research Methodology**
L-T-P: **4-0-0**	Credits: **3**	Contact Hrs: **4 hrs/week**
CIE Marks: **50**	SEE Marks: **50**	Total Marks: **100**
Teaching Hrs: **40 hrs**		Exam Duration: **3 hrs**

1. **Concepts and importance of Research Methodology:** Meaning of Research-Objectives-Types and Importance of Research-Research approaches, Significance of Research, Research methods versus methodology, Research and Scientific methods, Research Process, Criteria of good research
2. **Research Problem Definition**: What is a Research Problem? Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, An Illustration, and Conclusion.
3. **Research Design:** Meaning and Need, Concepts related to Research Design - Different Research Designs -Meaning–basic Principles of Experimental Designs, Important Experimental Designs
4. **Literature Review:** Clarity and focus to research problem, Improving Research methodology, Broadening knowledge base in research area, Enabling to contextualize findings, Review of Literature, Searching existing literature, Developing theoretical and conceptual framework, Writing about the literature reviewed
5. **Data Collection:** Introduction, Experiments and Surveys, Collection of Primary Data, Collection of secondary data, Selection of Appropriate Method for Data Collection, Case study method
6. **Data Preparation:** Data Preparation Process, Some Problems in Preparation process, Missing Values and Outliners, Types of Analysis, Statistics in research
7. **Testing of Hypothesis:** Basic Concepts of Hypothesis Testing, Test statistics and Critical region, Critical Value and Decision Rule, Hypothesis Testing- Procedure, Testing of Mean, Proportions, Variance, Difference of two Means, Difference of two Proportions, Difference of two variances, Limitations of the Tests of Hypotheses
8. **Chi-Square Tests:** test of Difference of more than two Proportions, test of Independence of Attributes, Test of Goodness of Fit, and Cautions in Using Chi-Square tests
9. **Interpretation and Writing Research Report:** Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports, Conclusions

Text/ Reference Books

1. Kothari C. R., Garg Gaurav, Research Methodology – Methods & Techniques, 3rd Edn, New Age International Pvt. Ltd, 2014
2. Ranjit Kumar, Research Methodology, , Sage Publications, 3rd Edn., 2011

Course Code: **15EESP704**		Course Title: **CFD Lab**
L-T-P: **0-0-1**	Credits: **1**	Contact Hrs: **2 hrs/week**
ISA Marks: **80**	ESA Marks: **20**	Total Marks: **100**
Teaching Hrs: **---**		Exam Duration: **---**

1. Illustration on mathematical behavior of PDEs through simple programme
2. Implicit and Explicit Solution for 1-D steady state heat conduction
3. Solution to transient heat conduction problem in 1D and 2D
4. Solution convective heat transfer problem on flow over flat surfaces
5. Solution of fluid flow in conduits like circular pipe and square ducts
6. Use of Open source CFD codes for simple heat flow problems

Books and References:

http://www.featflow.de
http://www.ansys.com
http://www.fluent.com

Course Code: **15EESC801**		Course Title: **Energy Systems Modeling & Analysis**
L-T-P: 4-0-0	**Credits: 4**	**Contact Hrs: 4 hrs/week**
CIE Marks: **50**	SEE Marks: **50**	Total Marks: **100**
Teaching Hrs: **50 hrs**		Exam Duration: **3 hrs**
1. **Designing a Workable System**: Workable and optimum systems, Steps in arriving at a workable system, Creativity in concept selection, Workable Vs Optimum system, Designing of a food freezing plant.		
2. **Equation-Fitting**: Mathematical modeling, Polynomial representation, Functions of two variables, Exponential forms, Best fit Method of least squares		
3. **Modeling of Thermal Equipment**: Counter flow heat exchanger, Evaporators and Condensers, Heat exchanger effectiveness, Effectiveness of a counter flow heat exchanger, NTU, Pressure drop and pumping power		
4. **System Simulation**: Classes of simulation, Information flow diagrams, Sequential and simultaneous calculations, Successive substitution, Newton-Raphson method		
5. **Optimization**: Mathematical representation of optimization problems, A water chilling system, Optimization procedure, Setting up the mathematical statement of the optimization problem		
6. **Lagrange Multipliers**: The Lagrange multiplier equations, unconstrained optimization, Constrained optimization, Sensitivity coefficients		
7. **Search Methods**: Single variable – Exhaustive, Dichotomous and Fibonacci, Multivariable unconstrained - Lattice, Univariable and Steepest ascent		
8. **Dynamic Programming**: Characteristic of the Dynamic programming solution, Apparently constrained problem, Application of Dynamic programming to energy system problems.		
9.**Geometric Programming**:One independent variable unconstrained, Multivariable and Constrained optimization with zero degree of difficulty		
10. **Linear Programming**: Simplex method, Big-M method, Application of LP to thermal systems		
Text Books		
1. W.F.Stoecker, Design of Thermal Systems, 3 ed., MGH,1989		
Reference Books:		
1.Hodge B.K., Analysis and Design of Thermal Systems, 1ed.,PHI, 1990.		
2. Nagrath I.J., Gopal M., Systems Modelling and Analysis, 1 ed., TMGH., 2001		
3. Wilde D.J., Globally Optimal Design, 1ed.,Wiley- Interscience, 1985		

Course Code: **15EESE802**		Course Title: **Sustainable Building Design**
L-T-P-S: **4-0-0-0**	Credits: **4**	Contact Hrs: **4 hrs/week**
CIE Marks: **50**	SEE Marks: **50**	Total Marks: **100**
Teaching Hrs: **40**		Exam Duration: **3 hrs**

1. **Introduction: Sustainability and Building Design**.

   Site planning: Site assessment, Site selection, Site analysis**,** site development and layout, sustainable urban drainage systems, flow attenuation

2. **Efficient water management and waste water treatment techniques**

   Climate change and water conservation, the need for conservation, basic steps for reducing water consumption, Water conservation in landscape irrigation, Measures for reuse and conservation.

3. **Solid waste management:** Introduction, guidelines for waste minimisation, Segregation of wastes, Resources recovery or recycling, Processing of waste.
4. **Passive solar design:** Introduction, Thermal comfort, building physics, building design, building form, orientation, building components, Advanced soalr passive techniques, passive solar heating, passive cooling strategies, Day lighting, Factors for the design of day lighting, factors affecting daylight factor distribution. Innovative day lighting systems, Hybrid day lighting system.
5. **Building technologies:** Traditional efficient building techniques, walling systems. Traditional stone masonry, Roofing systems, Doors and windows, High-rise masonry, curtain walls, pre-fabrication,
6. **Energy systems:** units of lighting, lighting equipment, system design approach for energy-efficient lighting, Additional parameters for design approach for lighting, Approach for an energy efficient lighting system by sector, Energy conservation opportunities in existing lighting systems,
7. **Building Envelop**: Domestic appliances, Non-domestic appliances, Heating ventilation and air conditioning systems, Use of renewable energy.

Text Books

1. Sustainable building Design manual volume-2, sustainable building design practices, TERI, New Delhi, 2004.

References:

1. S.P. Sukhatme, Nayak J.K.,Solar Energy:Principles of Thermal Collection and Storage, Tata-Mc-Graw Hill Education, 2008
2. Garg & Prakash, H. P. Garg,Solar Energy:Fundamentals and Applications, Tata-Mc-Graw Hill Education, 2000
3. G.N. Tiwari, Solar Energy:Fundamentals, Design, Modelling and Applications, Alpha Science International Limited, 2002

Course Code: **15EESW801**		Course Title: **Minor Project**
L-T-P-S: **0-0-8-0**	Credits: **10**	Contact Hrs: **---**
CIE Marks: **100**	SEE Marks: **100**	Total Marks: **200**
Teaching Hrs: **---**		Exam Duration: **---**
Problem statement for the Minor Project is defined by the Guide. The Minor Project aims at developing professional competency and research aptitude by working in areas which otherwise are not covered in theory or laboratory sessions. The project work motivates the students to apply theoretical and practical tools/techniques to solve real life problems related to industry and current research The student will execute the project within three months duration during the 3rd semester		

Course Code: **15EESW802**		Course Title: **Major Project**
L-T-P-S: **0-0-20-0**	Credits: **30**	Contact Hrs: **30**
CIE Marks: **100**	SEE Marks: **100**	Total Marks: **200**
Teaching Hrs: **40 Hrs**		Exam Duration: **3 Hrs**
The Major Project aims at developing professional competency and research aptitude by working in areas which otherwise are not covered in theory or laboratory sessions. The project work motivates the students to apply theoretical and practical tools/techniques to solve real life problems related to industry and current research Major Project is for a period of 8 months commencing from start of Industrial Training/Mini Project. The Project aims at developing professional competency and research aptitude by working in areas which otherwise are not covered in theory or laboratory sessions. The project work motivates the students to apply theoretical and practical tools/techniques to solve real life problems related to industry and current research		

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Course Code: 17EMEE701	**Course Title: Wind Energy Conversion Systems**	
L-T-P: 4-0-0	Credits: 4	Contact Hrs: 4hr/week
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 50		Exam Duration: 3 hrs

Introduction: Metrology of wind, Wind speed variation with height, Wind speed statistics. Wind Measurements Biological indicators, Rotational anemometers, other anemometers, Wind direction	10hrs
Basic concepts of Wind energy: Power output from an ideal turbine, Aerodynamics, Practical turbines, Transmission and generation efficiency	10hrs
Energy production and capacity factor, Torque at constant speeds, Drive train oscillations, Turbine shaft power and torque at variable speeds.	10hrs
Wind Turbine Connected to the Electrical Network: Methods of generating synchronous power, AC circuits, The synchronous generator, Per unit calculations, The induction machine, Motor starting, Capacity credit, features of electrical network.	10hrs
Asynchronous Electric Generators: Asynchronous systems, DC shunt generator with battery load, Per unit calculation, Self excitation of the induction generators, Single phase operation the induction generator, Asynchronous Loads like Piston/ Centrifugal pumps, Paddle wheel heaters, Batteries	5hrs
Economics of Wind Systems: Capital costs, Economic concepts, Revenue requirements, Value of wind generated electricity, Hidden costs in Industrialized and developing nations	5hrs

Text Books

1. Gary L Johnson, Wind Energy Systems ,1ed., PHI, New Jersey, 2001
2. D.P.Kothari, I.G.Nagrath, Electrical Machines, 2ed.,TMGH, 2004

Reference Books

1 Rai G.D., Non-Conventional Energy Sources, 4 ed., Khanna Publications, 2002

Course Code: 17EMEC705	**Course Title: Energy Audit and Conservation**	
L-T-P: 4-0-0	Credits: 4	Contact Hrs: 4hr/week
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 50		Exam Duration: 3 hrs

1.	**Energy Management & Audit:** Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution, Energy audit instruments.	10hrs
2.	**Energy Conservation:** Indian energy conservation act-2001, second law of thermodynamics, rules for efficient energy conservation of energy and materials, technologies for energy conservation (reducing demand using alternative supplies, load factor, balancing and energy storage), supply side options, demand side options, maximum demand controller, transmission and distribution side options	10hrs
3.	**Energy Efficient Motors and Power factor:** Constructional details, factors affecting efficiency, losses distribution, soft starters, variable speed drives**.** Power Factor Causes and disadvantages of low power factor, methods to improve power factor, automatic power factor controllers	8hrs
4.	**Energy efficient lighting** Terminology, cosine law of luminance, types of lamps, characteristics, design of illumination systems, good lighting practice, lighting control, steps for lighting energy conservation	7hrs
5.	**Heat Recovery Systems:** Sources of waste heat, guidelines to identify waste heat, grading of waste heat, feasibility study of waste heat recovery, gas to gas heat recovery, rotary generators, heat pipes, gas to liquid heat recovery, waste heat boilers.	5hrs
6.	**Cogeneration** Definition and need, basics of thermodynamic cycles, classification of cogeneration systems, steam turbine, gas turbine, typical heat to power ratio in various industries, operating strategies for cogeneration plant, typical cogeneration performance parameters, relative merits of cogeneration systems.	5hrs
7.	**Compressed air network** Types of compressors, compressor selection, monitoring performance, specific power consumption, FAD test, capacity control and power consumption, compressed air distribution system, moisture separation**.**	5hrs

Text Books

1. WC Turner: Energy Management Handbook, Seventh Edition, (Fairmont Press Inc., 2007)
2. LC Witte, PS Schmidt and DR Brown: Industrial Energy Management and Utilization (Hemisphere Publishing Corporation, Washington, 1998).

Reference Book

1. George Polimeros: Energy Cogeneration Handbook, (Industrial Press, Inc., NY, 1981)
2. W Trinks, MH Mawhinney, RA Shannon, RJ Reed, JR Garvey: Industrial Furnaces, Sixth Edition, (John Wiley & Sons, 2003)

Course Code: 17EMEE706	Course Title: Solar Photovoltaic System Design	
L-T-P: 4-0-0	Credits: 4	Contact Hrs: 4hr/week
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 50		Exam Duration: 3 hrs

1. **Introduction to PV Systems:** The PV Cell, The PV Module, The PV Array, Energy Storage, PV System Loads, PV System Availability, Associated System Electronic Components, Generators, Balance of System (BOS) ,Components. Present and Proposed PV Cells and Systems: Silicon PV Cells, Gallium Arsenide Cells, Copper Indium (Gallium) Diselenide Cells, Cadmium Telluride Cells, Emerging Technologies, New Developments in System Design	10hrs
2. **Grid-Connected Utility-Interactive PV Systems:** Applicable Codes and Standards, Design Considerations for Straight Grid-Connected PV Systems, Design of a System Based on Desired Annual System Performance, Design of a System Based on Available Roof Space, Design of a Micro-inverter-Based System, Design of a Nominal 21 kW System that Feeds a Three-Phase Distribution Panel, Design of a Nominal 250 kW System, System Performance Monitoring	10hrs
3. Mechanical Considerations: Important Properties of Materials, Establishing Mechanical System Requirements, Design and Installation Guidelines, Forces Acting on PV Arrays, Array Mounting System Design, Computing Mechanical Loads and Stresses, Stand-off, Roof Mount Examples.	10hrs
4. **Battery-Backup Grid-Connected PV Systems:** Battery-Backup Design Basics, A Single-Inverter 120 V Battery-Backup System Based on Standby Loads, A 120/240 V Battery-Backup System Based on Available Roof Space, An 18 kW Battery-Backup System Using Inverters in Tandem, AC-Coupled Battery-Backup Systems, Battery Connections.	10hrs
5. **Stand-Alone PV Systems:** The Simplest Configuration: Module and Fan, A PV-Powered Water-Pumping System, A PV-Powered Parking Lot Lighting System, A Cathodic Protection System, A Portable Highway Advisory Sign A Critical-Need Refrigeration System, A PV-Powered Mountain Cabin, A Hybrid-Powered, Off-Grid Residence, Summary of Design Procedures	5hrs
6. **Economic Considerations:** Life-Cycle Costing, Borrowing Money, Payback Analysis, Externalities and Photovoltaics**:** Externalities, Environmental Effects of Energy Sources, Externalities Associated with PV Systems	5hrs

Text Books

1. Roger Messenger, Amir Abtahi, Photovoltaic Systems Engineering, 3rd Edition, CRC Press, 2010,
2. Solanki C.S. Solar Photovoltaics : Fundamentals, Technologies and Applications, PHI., 2011

Reference Books

1. Matthew Buresch, Photovoltaic Energy Systems-Design and Installation, 1ed., MGH, 1983
2. Seippel R.G., Photovoltaics, 1 ed., Roston publication, 1986

Course Code:18EESP701		Course Title: **Energy System Lab**
L-T-P: 0-0-2	Credits: 2	Contact Hrs: 4 hr/week
ISA Marks: 80	ESA Marks: 20	Total Marks: 100
Teaching hrs: 24		Exam Duration: 02 hrs

Studies on : a. Operational experience on i) Pyranometer, ii) Sunshine recorder b. Measurement of temperature using Infrared Thermometers d. Measurement of illumination using Lux meter e. Exhaust gas analysis using gas analyzer **List of experiments** 1. Performance evaluation of a solar flat plate thermo-syphon water heating 2. Conversion efficiency of a solar flat plate forced solar water heating system 3. Conversion efficiency of a solar Concentrating water heating system 4. Determination of conversion efficiency of a solar air heating system 5. Study and analysis of a solar still / distillation plant 6. Performance estimation of photovoltaic water pumping system 7. Investigation on a solar dryer 8. Operational characteristics of P.V. Indoor lighting system 9. Determination of characteristics of a wind generator 10. Performance evaluation of solar cooker 11. P.V. System sizing exercise 12. Data acquisition system for monitoring of P.V system using LABVIEW s/w 13. Performance estimation of Solar fuel cell 14. Performance evaluation of vertical and horizontal axis wind turbine rotors.	24 hrs

Course Code:18EESP702	Course Title: **Industrial Instrumentation and Control Lab**	
L-T-P: 0-0-2	Credits: 2	Contact Hrs: 4 hr/week
ISA Marks: 80	ESA Marks: 20	Total Marks: 100
Teaching hrs: 24		Exam Duration: 02 hrs

1. **Control technologies** Local manual, remote electrical, Local pneumatic, Remote analog/digital 2. **Basic electrical and math concepts**: Applications to instruments, Electrical principles and symbols, Series/parallel circuits 3. **Pressure instrumentation & measurements**: Pressure measurement devices, U-tube manometer, bourdon gauge, bellows gauge, piezoelectric 4. **Temperature instrumentation and measurements** • Measurement devices and techniques, Bimetallic temperature measurement, Filled capillary and bulb, thermocouple, resistance temperature detector (RTD), thermistors, thermowells, infrared 5. **Flow Instrumentation and Measurements:** Flow measurement methods, Factors influencing flow measurement, Flow measurement devices: orifice plates, venturi tube, flow nozzle, elbow taps, pitot tube, magnetic flow meter (Mag meter), vortex shedding meter, turbine meter, target flowmeter, ultrasonic, variable area rotameter, coriolis meter 6. **Level instrumentation and measurements:** Level measurement methods: sight glass, differential pressure level measurement, bubbler, displacer level sensor, float level sensors, capacitance, radiation-based, radar and ultrasonic level sensors 7. **Manipulating the process**: Final control element, Actuators, valve positioners, I/P, valves • Variable frequency drives 8. **Controllers:** Control modes: proportional, integral, derivative, Tuning feedback controllers ¼ decay, Zeigler-Nichols, damped oscillation, Ratio, cascade and feed-forward control 9. **Control systems**: Overview of PLCs, DCS and SCADA systems **Hands-on Exercises**: Sensor checkout, Hookup to calibration stands, Transmitter calibration check, Program/tune controller, Set up of differential pressure, temperature, and other process-simulation devices, Checking current output with Volt-Ohm Mille-ammeter (VOM) & tracing around loop, Simulate and source 4-20mA-DC signals	24 hrs

Course Code:18EESP703	Course Title: **Process Modeling and Simulation Lab**	
L-T-P: 0-0-2	Credits: 2	Contact Hrs: 4 hr/week
ISA Marks: 80	ESA Marks: 20	Total Marks: 100
Teaching hrs: 24		Exam Duration: 02 hrs

MATLAB Analysis 1. Declination of earth, hour angle, day length, local apparent time. 2. Monthly average, hourly global and diffuse radiation on a horizontal surface and tilted Surfaces. 3. Power generation from a wind turbine, Variation of wind velocity and power with altitude. 4. Solution of ordinary differential eqations-4th order R K Method. 5. Solution of one-dimensional steady state heat conduction equation. 6. Solution of two-dimensional steady state PDE. 7. Solution of one-dimensional transient PDE. **Finite Element Analysis** 8. Two dimensional heat conduction. 9. One dimensional transient heat conduction. 10. Transient analysis of a casting process. **CFD Analysis** 11. Flow through a pipe bend. 12. Flow through a nozzle.	24 hrs

Course Code:18EESP704	Course Title: **IoT based Living Space Lab**	
L-T-P: 0-0-2	Credits: 2	Contact Hrs: 4 hr/week
ISA Marks: 80	ESA Marks: 20	Total Marks: 100
Teaching hrs: 24		Exam Duration: 02 hrs

1. Introduction to IoT, Automation, Arduino, Raspberry Pi and IoT.	24 hrs
2. Introduction to Arduino programming and interfacing with peripherals and sensors Motor, Servo motor, LDR, PIR sensor, ultrasonic sensor, DHT 11, MQ2 smoke sensor, LCD and RC522 RFID	
3. Wireless communication with Arduino: GSM Module, Ethernet Shield. Raspberry Pi and Raspbian operating system: Installing operating system ,Starting Raspberry Pi desktop and using Linux commands	
4. Connecting to the network: Wired networking and Wireless networking, Setting up static IP for raspberry pi, Remote accessing of Raspberry Pi	
5. Python programming with Raspberry Pi: Introduction to Python, Python commands and Python scripting for programming GPIO	
6. Interfacing of Arduino with Raspberry Pi: Programming Arduino from Raspberry Pi using IDE Programming Arduino from Raspberry Pi using Python	
7. Raspberry Pi as web server: Installing Apache Server	
8. Connecting Arduino and Raspberry Pi to cloud service: Uploading Arduino sensor data to cloud. Connecting Raspberry Pi to cloud and interfacing sensors	
9. Conduction Of Living Space Lab Experiments Design of IoT based weather DAQ system IoT based temperature data monitoring and DAQ IoT based humidity data monitoring and DAQ IoT based solar insolation data monitoring and DAQ IoT based wind speed data monitoring and DAQ	
10. Design of Energy management system IoT based SPV - Solar generation data monitoring IoT based Wind generation data monitoring IoT based SPV – Wind hybrid generation data monitoring	

Course Code:**19EESC703**	Course Title: **Computational Methods in Engineering Analysis**	
L-T-P: 3-1-0	Credits: 4	Contact Hrs: 5
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 40		Exam Duration: 3 hrs

1.Approximations and round off errors: Significant figures, accuracy and precision, error definitions, round off errors and truncation errors. Mathematical modelling and Engineering problem solving: Simple mathematical model, Conservation Laws of Engineering.	06 hrs
2.Roots of Equations: Bracketing methods-Graphical method, Bisection method, False position method, Newton-Raphson method, Secant Method. Multiple roots, Simple fixed point iteration.	06hrs
3.Roots of polynomial- Polynomials in Engineering and Science, Muller's method, Bairstow's Method Graeffe's Roots Squaring Method.	06 hrs
4.Numerical Differentiation and Numerical Integration: Newton –Cotes and Guass Quadrature Integration formulae, integration of Equations, Romberg integration, Numerical Differentiation Applied to Engineering problems, High Accuracy differentiation formulae.	06 hrs
5.System of Linear Algebraic Equations and Eigen Value Problems: Introduction, Direct methods, Cramer's Rule, Gauss Elimination Method, Gauss-Jordan Elimination Method, Triangularization method, Cholesky Method, Partition method, error Analysis for direct methods, iteration Methods.	06 hrs
6.Eigen values and Eigen Vectors: Bounds on Eigen Values, Jacobi method for symmetric matrices, Givens method for symmetric matrices, Householder's method for symmetric matrices, Rutishauser method for arbitrary matrices, Power method, Inverse power method.	05 hrs
7.Linear Transformation: Introduction to Linear Transformation, The matrix of Linear Transformation, Linear Models in Science and Engg.	05 hrs

Reference Books

1. Erwin Kreyszig , Advanced Engineering Mathematics, 10th Edition , Willely India, 2016.
2. S.S.Sastry, Introductory Methods of Numerical Analysis, PHI, 2005.
3. Steven C. Chapra, Raymond P.Canale, Numerical Methods for Engineers, TMGH, 4th Ed, 2002.
4. M K Jain, S.R.K Iyengar, R K. Jain, Numerical methods for Scientific and engg computation, New Age International, 2003.
5. Pervez Moin, Fundamentals of Engineering Numerical Analysis, Cambridge, 2010.
6. David. C. Lay, Linear Algebra and its applications, 3rd edition, Pearson Education, 2002.

Course Code: **15EMDC701**	Course Title: **Failure Analysis and Design**	
L-T-P: 4:0:0	Credits: 4	Contact Hrs: 4 / week
CIE Marks: 50	SEE Marks: 50	Total Marks: 100
Teaching Hrs: 50		Exam Duration: 180 min

No	Content	Hrs
1	**Introduction:** Role of failure prevention analysis in mechanical design, Modes of mechanical failure, Review of failure theories for ductile and brittle materials including Mohr's theory and modified Mohr's theory, Numerical examples.	**06**
2	**Fatigue of Materials**: Introductory concepts, High cycle and low cycle fatigue, Fatigue design models, Fatigue design methods, Fatigue design criteria, Fatigue testing, Test methods and standard test specimens, Fatigue fracture surfaces and macroscopic features, Fatigue mechanisms and microscopic features.	**06**
3	**Surface Failure:** Introduction, Surface geometry, Mating surface, Friction, Adhesive wear, Abrasive wear, Corrosion wear, Surface fatigue spherical contact, Cylindrical contact, General contact, Dynamic contact stresses, Surface fatigue strength.	**08**
4	**Stress-Life (S-N) Approach:** S-**N** curves, Statistical nature of fatigue test data, General S-N behavior, Mean stress effects, Different factors influencing S-N behaviour, S-N curve representation and approximations, Constant life diagrams, Fatigue life estimation using S-N approach.	**06**
5	**Strain-Life (ε-N)approach**: Monotonic stress-strain behavior ,Strain controlled test methods ,Cyclic stress-strain behavior ,Strain based approach to life estimation, Determination of strain life fatigue properties, Mean stress effects, Effect of surface finish, Life estimation by ε-N approach.	**06**
6	**Notches and their effects:** Concentrations and gradients in stress and strain, S-N approach for notched membranes, mean stress effects and Haigh diagrams, Notch strain analysis and the strain – life approach, Neuber's rule, Glinka's rule, applications of fracture mechanics to crack growth at notches.	**08**
7	**Fatigue from Variable Amplitude Loading:** Spectrum loads and cumulative damage, Damage quantification and the concepts of damage fraction and accumulation, Cumulative damage theories, Load interaction and sequence effects, Cycle counting methods, Life estimation using stress life approach.	**05**
8	**Load Determination:** Loading classes, Load analysis, Vibration loading, Impact loading, Beam loading.	**05**

Reference Book:

1. Metal Fatigue in engineering, Ralph I. Stephens, Ali Fatemi, Robert .R. Stephens, Henry o. Fuchs, John wiley Newyork, Second edition. 2001.
2. Machine Design, An Integrated Approach, Robert L. Norton, Pearson. Second edition. 2000.
3. Failure of Materials in Mechanical Design, Jack A Collins, John Wiley & Sons; Second edition. 1993.
4. Fatigue of Materials, S. Suresh. Cambridge University Press; Second edition. 1998.

Course Code: **15EMDC703**	Course Title: **Finite Element Practice in Machine Design**	
L-T-P: 4:0:0	Credits: 4	Contact Hrs: 4 / week
CIE Marks: 50	SEE Marks: 50	Total Marks: 100
Teaching Hrs: 50		Exam Duration: 180 min

No	Content	Hrs
1	**Introduction:** Introduction to FEA, General FEM procedure, • Approximate solutions of differential equations: FDM method, W-R technique, collocation least square sub-domain and Galerkin method Numerical integration, Gauss quadrature in 2-D and 3-D, Structure of FEA program, Pre and Post processor, commercially available, standard packages, and desirable features of FEA packages, • Principal of minimum total potential, elements of variational calculus, minimization of functional, Rayleigh-Ritz method, Formulation of elemental matrix equation, and assembly concepts.	**10**
2	**One Dimensional FEM:** Coordinate system: Global, local, natural coordinate system, Shape functions: Polynomial shape functions, Derivation of shape functions, Natural co-ordinate and coordinates transformation, Linear quadratic and cubic elements, Shape functions using Lagrange polynomials. Convergence and compatibility requirement of shape functions, One dimensional field problems: structural analysis (step-bar, taper-bar), Structural analysis with temperature effect, Thermal analysis, heat transfer from composite bar, fins.	**10**
3	**Two Dimensional FEM** Trusses, Thermal effects in truss members, Beams, Two dimensional finite elements formulations, Three noded triangular element, Four-noded rectangular element, Four-noded quadrilateral element, derivation of shape functions: natural coordinates, triangular elements, and quadrilateral elements, Six-noded triangular elements, Eight-noded quadrilateral elements, Nine noded quadrilateral element, Strain displacement matrix for CST element	**10**
4	**Three dimensional elements**: Tetrahedron, Rectangular prism (brick), Arbitrary hexahedron, Three Dimensional polynomial shape functions, Natural co-ordinates in 3D, Three dimensional Truss(space trusses), Introduction to material models: Introduction to plasticity (Von-Mises Plasticity), Hyper –elasticity. Generating and using experimental data to model material behaviour, Errors in FEA, sources of errors, method of elimination, Patch test.	**10**
5	**Penalty Method,** Lagrange methods, Multipoint Constraints, Concept of Master/Slave entities, Examples of Contact problems, Iso-parametric concepts, basic theorem, Iso-parametric, super-parametric, sub-parametric elements, Concept of Jacobian. Finite element formulation of Dynamics, application to free-vibration problems, Lump and consistent mass matrices, Eigen value problems, Transient dynamic problems in heat transfer and solid mechanics, Convergence, Impact of Mesh quality on convergence.	**10**

Reference Book:

1. Reddy J. N., “Finite Element Method”, McGraw-Hill
2. S.S.Rao, “The Finite Element Method in Engineering” , 4th Edition, Academic Press, Elsevier
3. Desai and Abel, “Introduction to Finite Elements Methods”, CBS Publication
4. Tirupati R. Chandrupatla and Ashok D.Belegundu, “Introduction to Finite Elements in Engineering”
5. David Hutton, “ Fundamentals of Finite Element Analysis”, Tata McGrawHill, 2005
6. Kenneth Huebner, Donald Dewhirst, Douglas Smith and Ted Byrom, “The Finite Method for Engineers”, Wiley-India Edition, 2009

Course Code: **15EMDC705**	Course Title: **Dynamics and Mechanism design**	
L-T-P: 4:1:0	Credits: 5	Contact Hrs: 6 / week
CIE Marks: 50	SEE Marks: 50	Total Marks: 100
Teaching Hrs: 50		Exam Duration: 180 min

No	Content	Hrs
1	**Geometry of Motion:** Introduction, analysis and synthesis, Mechanism terminology, planar, Spherical and spatial mechanisms, mobility, Grashoffs law, Equivalent mechanisms, Unique mechanisms, Kinematic analysis of plane mechanisms**:** Auxiliary point method using rotated velocity vector, Hall - Ault auxiliary point method, Goodman's indirect method.	**08**
2	**Synthesis of Linkages:** Type, number, and dimensional synthesis, Function generation, Path generation and Body guidance, Precision positions, Structural error, Chebychev spacing, Two position synthesis of slider crank mechanisms, Crank-rocker mechanisms with optimum transmission angle Motion Generation: Poles and relative poles, Location of poles and relative poles, polode, Curvature, Inflection circle.	**10**
3	**Graphical Methods of Dimensional Synthesis:** Two position synthesis of crank and rocker mechanisms, Three position synthesis, Four position synthesis (point precision reduction) Overlay method, Coupler curve synthesis, Cognate linkages.	**08**
4	**Ana1ytical Methods of Dimensional Synthesis:** Freudenstein's equation for four bar mechanism and slider crank mechanism, Examples, Bloch's method of synthesis, Analytical synthesis using complex algebra.	**06**
5	**Spatial Mechanisms:** Introduction, Position analysis problem, Velocity and acceleration analysis, Eulerian angles	**04**
6	**Generalized Principles of Dynamics:** Fundamental laws of motion, Generalized coordinates, Configuration space, Constraints, Virtual work, principle of virtual work, Energy and momentum, Work and kinetic energy, Equilibrium and stability, Kinetic energy of a system, Angular momentum, Generalized momentum.	**10**
7	**Lagrange's Equation:** Lagrange's equation from D'Alembert's principles, Examples, Hamiltons equations, Hamiltons principle, Lagrange's, equation from Hamiltons principle, Derivation of Hamiltons equations, Examples.	**04**

Reference Book:

1. Theory of Machines and Mechanism - E.Shigley & J.J.JickerMcGraw Hill company.
2. Machines and Mechanisms - David H. Myszka, PearsonEducation, 2005.
3. Greenwood “Principles of Dynamics”, Prentice Hall of India, 1988.
4. Erdman Sandor “Advanced Mechanism Design” Prentice Hall.
5. Soni A.H “Mechanism synthesis and analysis”, McGraw Hill.

Course Code: **15EMDC706**	Course Title: **Theory of Vibrations with Application**	
L-T-P: 4:0:0	Credits: 4	Contact Hrs: 4 / week
CIE Marks: 50	SEE Marks: 50	Total Marks: 100
Teaching Hrs: 50		Exam Duration: 180 min

No	Content	Hrs
1	**Fundamentals of Vibration** Importance of the Study of Vibration; Basic Concepts of Vibration-Vibration, Elementary Parts of Vibrating Systems, Number of Degrees of Freedom, Discrete and Continuous Systems; Classification of Vibration-Free and Forced Vibration, Un-damped and Damped Vibration, Linear and Nonlinear Vibration, Deterministic and Random Vibration; Vibration Analysis Procedure; Harmonic Analysis-Fourier Series Expansion, Numerical Computation of Coefficients;	**08**
2	**Free Vibration of Single-Degree-of-Freedom Systems** Introduction; Free Vibration of an Un-damped Translational System- Equation of Motion Using Newton's Second Law of Motion, Equation of Motion Using Other Methods, Equation of Motion of a Spring-Mass System in Vertical Position, Solution, Harmonic Motion; Free Vibration of an Un-damped Torsional System-Equation of Motion, Solution; Free Vibration with Viscous Damping-Equation of Motion, Solution, Logarithmic Decrement, Energy Dissipated in Viscous Damping, Torsional Systems with Viscous Damping, Solution;	**08**
3	**Harmonically Excited Vibration** Introduction; Equation of Motion; Response of an Undamped System under Harmonic Force-Total Response, Beating Phenomenon; Response of a Damped System under Harmonic Force- Total Response, Quality Factor and Bandwidth; Response of a Damped System Under Damped System Under the Harmonic Motion of the Base- Force Transmitted, Relative Motion; Response of a Damped System Under Rotating Unbalance;	**10**
4	**Two-Degree-of-Freedom Systems** Introduction; Equations of Motion for Forced Vibration; Free Vibration Analysis of an Un-damped System; Torsional System; Coordinate Coupling and Principal Coordinates; Forced-Vibration Analysis; Semi definite Systems;	**04**
5	**Multi degree-of-Freedom Systems- Determination of Natural Frequencies and Mode Shapes** Introduction; Influence Coefficients-Stiffness Influence Coefficients, Flexibility Influence Coefficients, Inertia Influence Coefficients; Dunkerley's Formula; Rayleigh s Method-Properties of Rayleigh s Quotient, Computation of the Fundamental Natural Frequency, Fundamental Frequency of Beams and Shafts; Holzer's Method- Torsional Systems, Spring-Mass Systems; Matrix Iteration Method-Convergence to the Highest Natural Frequency, Computation of Intermediate Natural Frequencies, Jacobi s Method, Standard Eigenvalue Problem-Choleski Decomposition;	**10**
6	**Vibration Control** Introduction; Vibration Nomo graph and Vibration Criteria; Reduction of Vibration at the Source; Control of Vibration; Control of Natural Frequencies; Introduction of Damping; Vibration Isolation- Vibration Isolation System with Rigid Foundation, Vibration Isolation System with Base Motion, Vibration Isolation System with Flexible Foundation, Vibration	**06**

	Isolation System with Partially Flexible Foundation, Shock Isolation, Active Vibration Control; Vibration Absorbers- Undamped Dynamic Vibration Absorber, Damped Dynamic Vibration Absorber;	
7	**Nonlinear Vibration** Introduction; Examples of Nonlinear Vibration Problems-Simple Pendulum, Mechanical Chatter, Belt Friction System, Variable Mass System; Exact Methods, Approximate Analytical Methods-Basic Philosophy, Lindstedt s Perturbation Method, Iterative Method, Ritz-Galerkin Method, Subharmonic and Superharmonic Oscillations- Subharmonic Oscillations, Superharmonic Oscillations; Systems with Time-Dependent Coefficients (Mathieu Equation); Stability of Equilibrium States-Stability Analysis, Classification of Singular Points, Limit Cycles	**04**

Reference Book:

1. Mechanical Vibrations, - S. S. Rao., fourth edition, Pearson Education, 2005.
2. Theory of Vibration with Application, - William T. Thomson, Marie Dillon Dahleh, Fifth edition, Pearson Education, 2003.
3. Mechanical Vibrations-S Graham Kelly, Adapted by: Shashidhar K Kudari, Schaum's outlines, The McGraw-Hill Companies, 2007.
4. Vibrations Problem Solving Companion- Rao V. Dukkipti, J. Srinivas, Narosa, 2007
5. Mechanical Vibration Practice with Basic Theory- V. Ramamurti, Narosa, 2000

Course Code: **15EMDC801**	Course Title: **Machine Tool Design and Analysis**	
L-T-P: 4:0:0	Credits: 4	Contact Hrs: 4 / week
CIE Marks: 50	SEE Marks: 50	Total Marks: 100
Teaching Hrs: 50		Exam Duration: 180 min

No	Content	Hrs
1	Machine design fundamentals, CAD tools-Training on modeling & drafting practice, Limits ,fits & tolerance, Materials & Heat treatment, Metal cutting Theory, CNC Machine Tools and Trends, M/c Design exercise, Design of Spindle Assembly, Design of Spindle Assembly with work holding, Design of hydraulics, Design of X & Z axis assembly of CNC Lathe, Ball Screw & L M guide ways, Design of X & Z Axes assembly, Overall machine Design, FEA approach, Manufacturing drawing, Power requirement Calculations & Controller Selection, Electrical switch gear elements, PLC Programming and Ladder Diagram, Electrical diagram, Vibration analysis, Final Test & evaluation.	50

Reference Book:

1. CMTI Machine Tool Design hand book, Tata McGraw-Hill, 1982.
2. Design of Machine Tools by S K Basu, 5th edition, 2008
3. Fanuc drives, spindle motors and servo motors.
4. Material prepared and compiled by Mechanical Engineering department (Machine Design).

Course Code: **15EMDI801**	Course Title: **Internship/Industrial Training#**	
L-T-P: 0-0-2	Credits: 2	
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
		Exam Duration: 120 min

Content

Each student has to undergo internship/industrial training for a period of 6 weeks at a reputed industry/R&D institution after the completion of III semester ESA. At the organization where the student is undergoing training, the student shall be assigned to work under the supervision of a Project Supervisor assigned for this purpose by the Head of the Department / institution. Student is expected to learn about the organization where the student is undergoing training in terms of its vision, mission, objectives, organizational structure, operations etc. At the end of the training, student must submit a report based on training.

The Project Supervisor at the industry shall award In Semester Assessment (ISA) marks out of a maximum of 50. The Department will conduct the End Semester (ESA) for a maximum of 50 marks.

Course Code: **15EMDW801**	Course Title: **Minor Project/Project Work Phase I*#**	
L-T-P: **0-0-8**	Credits: 8	
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
		Exam Duration: 120 min

Contents

Minor Project: The Guide shall define the problem statement for the Project work. The student shall execute the Minor Project within three months duration during the 3rd semester. The student who has opted **Minor Project** shall opt **Major Project** in IV semester. However, Minor Project is independent of Major Project.

Project Work Phase I:

Student must select a research project in consultation with the Guide. Student should identify the problem and conduct an exhaustive literature survey in Project Work Phase I and shall continue the project in IV semester in Phase II. Student has to submit the report at the end of the III Semester based on the following:

- Back ground and significance of the Research Project
- Problem statement
- Objectives and scope of the project
- Literature review
- Methodology
- Future plan of action

Course Code: **15EMDW802**	Course Title: Major Project/Project Work Phase II*	
L-T-P: **0-0-20**	Credits: 20	
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
		Exam Duration: 180 min

Contents

The student who has opted **Minor Project** should opt **Major Project** in IV semester. The **Major Project** shall be carried out by the student under the supervision of guide for a period of 6 months. For successful completion of this course the student should be able to identify the problem, define the objectives of the work as specific points indicating the scope within which the work is to be carried out, conduct the comprehensive literature survey, demonstrate the use of methodology adopted, analyze and interpret the experimental/numerical results obtained.

Project Work Phase II:

The student who has opted **Project Work Phase I** shall continue the project in IV semester in **Phase II**.

Phase II is assessed based on the following:

- Quality of literature survey and demonstration of creativity in the research problem
- Clarity in the objectives and scope of the research
- Clarity in the problem definition and feasibility in the problem solution
- Relevance to the current research/industrial trends
- Quality of work
- Analysis and Interpretation of results
- Quality of oral and written presentation
- Publication based on the research work in reputed national/international conference/journal.

Course Code: **17EMDP701**	Course Title: **Finite Element Analysis Lab**	
L-T-P: 0-0-1	Credits: 1	Contact Hrs: 2 hrs / week
ISA Marks: 80	ESA Marks: 20	Total Marks: 100
Teaching Hrs: 24		Exam Duration: 120 min

Content	**Hrs**
➢ Modeling of any automotive engine component using modeling software as two and three dimensional. ➢ Static analysis of above modelled component using different possible types of elements and materials. ➢ Non-Linear Analysis of 3D model created for any possible Nonlinearity criteria viz -Geometric, Material, and Contact. ➢ Dynamic Analysis of 3D model created by Modal or Harmonic or Transient for different Boundary Conditions. ➢ Thermal analysis of 3D model created. ➢ Fatigue Analysis & Fatigue life Prediction of created 3D model. ➢ Using theoretical concepts validation of the above analysis to be carried out. ➢ Report to be submitted in the prescribed format.	**24**

***Materials and Resources Required*:**

1. Nitin S. Ghokale, Sanjay Deshapande, Sanjeev Bedekar, "Practical Finite Element Analysis", Vikas Book house, Pune, 2008
2. Sham Tickoo, "Ansys Workbench 14.0 for Engineers and Designers-,A Tutorial Approach", Dream Tech Press, 2013
3. Liu G. R. and Quek S. S., "The Finite Element Method" A practical Course, 2nd Edition, Elsevier, 2014.
4. http://148.204.81.206/Ansys/150/ANSYS%20Mechanical%20Users%20Guide.pdf
5. http://abaqus.software.polimi.it/v6.12/pdf_books/CAE.pdf

Course Code: **17EMDC707**	Course Title: **Fracture Mechanics**	
L-T-P: 4-0-0	Credits: 4	Contact Hrs: 4 hrs / week
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 50		Exam Duration: 180 min

No	Content	Hrs
1	**Introduction:** History and overview, Fundamental concepts, Fracture mechanics in Metals, Ductile fracture, Cleavage, The Ductile-Brittle transition, Inter-granular fracture, Modes of Fracture Failure;	**04**
2	**Energy Release Rate:** Introduction, The Griffith energy balance, The energy release rate, Instability and the R-Curve, Thin plate vs Thick plate, Critical Energy release rate;	**06**
3	**Stress Intensity Factor:** Introduction, Stress analysis of cracks, The stress Intensity Factor, Relationship between K and Global behavior, Effect of Finite size, Principle of superposition, Weight Functions, Relationship between K and G, Crack tip plasticity, Plane stress versus plane strain, K as a failure criterion, Mixed mode fracture	**08**
4	**Elastic Plastic Fracture Mechanics:** Crack tip opening displacement**,** The J Contour Integral, Relationships between J and CTOD, Crack growth resistance curves, J-controlled fracture, Crack tip constraint under large scale yielding, HRR field;	**08**
5	**Mixed Mode fracture:** A simple Elliptical Model, Maximum Tensile Stress Criterion, Strain Energy Density Criterion, Maximum Energy Release Rate Criterion, Experimental Verifications;	**04**
6	**Fracture Toughness testing of metals:** General Considerations, K_{IC} testing, K-R Curve testing, J testing of metals, CTOD testing, Dynamic and crack arrest toughness, Fracture testing of weldments.	**06**
7	**Fatigue Crack Propagation** Similitude in fatigue, Empirical fatigue crack growth equations, Crack Closure, Variable amplitude loading and retardation, Growth of short cracks, Micro-mechanisms of fatigue, Experimental measurement of fatigue crack growth, Damage Tolerance.	**08**
8	**Dynamic and Time-Dependent Fracture** Dynamic Fracture and Crack Arrest, Rapid Loading of a Stationary Crack, Rapid Crack Propagation and Arrest, Crack Speed, Elasto dynamic Crack-Tip Parameters, Dynamic Toughness, Crack Arrest, Dynamic Contour Integrals, Creep Crack Growth, The C* Integral, Short-Time vs. Long-Time Behavior, The Ct Parameter , Primary Creep	**06**

Reference Book:

1. T.L.Anderson, “Fracture Mechanics -Fundamentals and Applications”, CRC Press, 2nd Edition, 1995.
2. Prashant Kumar, “Elements of Fracture Mechanics”, Tata McGraw-Hill Education Pvt. Ltd. New Delhi, 2010.
3. David Broek, Artinus Nijhoff , “Elementary Engineering Fracture Mechanics” , London, 1999.
4. J. F. Knott, “Fundamentals of Fracture Mechanics”, Bureworth, 2000.
5. C.T.Sun and Z.H.Jin , “Fracture Mechanics”, Elsevier, 2012.

Course Code: **17EMDE707**	Course Title: **Mechanical Behavior of Materials**	
L-T-P: 4-0-0	Credits: 4	Contact Hrs: 4 hrs / week
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 50		Exam Duration: 180 min

No	Content	Hrs
1	**Introduction:** Materials in design , The evolution of engineering materials , Fundamental Characteristics of Composites, Interfaces in Composites, Fracture in Composites, , Functionally Graded Materials. Macro Mechanics of a Lamina**:** Hooke's law for different types of materials, Number of elastic constants, Derivation of nine independent constants for orthotropic material, Two - dimensional relationship of compliance and stiffness matrix. Hooke's law for two-dimensional angle lamina, engineering constants - Numerical problems. Invariant properties. Numerical problems.	**10**
2	**Plastic Deformation and Dislocation Theory:** Lattice defects, deformation in a perfect lattice, dislocation in crystal and deformation, strain hardening of single crystal, low angle grain boundaries, Stress field of a dislocation, forces between dislocations, dislocation climb and jog, interaction with vacancy and impurity. Multiplication of dislocation and pile-up; Plastic Deformation in Tension, Plastic Deformation in Compression Testing, Plastic Deformation of Polymers.	**10**
3	**Behavior under Tensile loading:** Engineering and true stress-strain curves, yield point and strain ageing, strength coefficient and strain hardening exponent, necking or instability in tension, Effect of gauge length on strength and elongation, Effect of strain rate and temperature on tensile properties. Yield point phenomenon. Fracture under tension and torsion; Solid-Solution Strengthening, Mechanical Effects Associated with Solid Solutions.	**10**
4	**Deformation under cyclic loading:** Stress cycle, fatigue curve, fatigue fracture characteristics. Fatigue testing and testing machines, determination of fatigue strength. Factors affecting fatigue- contact under pressure. Under stressing, coaxing and overstressing. Effect of metallurgical impurities;	**10**
5	**Deformation under high temperature and Superplasticity of Metals**: Creep strain and creep-time curves, low temperature and high temperature creep theories. Fracture at elevated temperature, Stress rupture, Creep-Induced Fracture, Creep in Polymers, Heat-Resistant Materials, Superplasticity, Creep parameters and practical applications. Effect of metallurgical variables and materials for high temperature applications;	**10**

Reference Book:

1. Marc Andre Meyers and Krishan Kumar Chawla: “Mechanical Behavior of Materials”, Cambridge University Press, 2^{nd} Edition 2008.
2. Norman Dowling, “Mechanical Behavior of Materials: Engineering Methods for Deformation, Fracture and Fatigue”, Prentice Hall, 4^{th} Edition 2012.
3. G.E. Dieter: “Mechanical Metallurgy”. McGraw-Hill, 3^{rd} Edition 1988.
4. Keith Bowman, “Mechanical Behavior of Materials”, Wiley international edition, 2003.
5. Thomas Courtney, “Mechanical Behavior of Materials”, Waveland Press Inc; 2^{nd} Edition, 2005.
6. J. Roesler, H. Harders, M. Baeker, “Mechanical Behavior of Engineering Materials”, 1^{st} Edition, Springer, 2007
7. W.F. Hosford, “Mechanical Behavior of Materials”, 2^{nd} Edition, Cambridge University Press, 2009.

<table>
<tr><td>Course Code: 18EMDP701</td><td colspan="3">Course Title: CAD Modelling Lab</td></tr>
<tr><td>L-T-P: 0-0-5</td><td>Credits: 5</td><td colspan="2">Contact Hrs: 10 hrs / week</td></tr>
<tr><td>ISA Marks: 80</td><td>ESA Marks: 20</td><td colspan="2">Total Marks: 100</td></tr>
<tr><td></td><td></td><td colspan="2">Exam Duration: 02 hrs</td></tr>
<tr><td colspan="3">Content</td><td>Hrs</td></tr>
<tr><td colspan="3">➢ Introduction to CAD / CAM / CAE Software’s
➢ Brief introduction to CATIA Software and Industrial applications
➢ Introduction to Work benches
➢ Brief introduction on Sketcher work bench environment
➢ Structure of users and saving of files.
➢ Part Design
➢ Generative Sheet Metal Design (GSMD) Workbench
➢ Assembly Design Workbench
➢ Drafting Workbench</td><td>120</td></tr>
<tr><td colspan="4"><u>Materials and Resources Required</u>:
1. Material prepared by School of Mechanical Engineering, KLETU-Hubballi.
2. Sham Tickoo, “Catia V5R20 for Engineers and Designers-,A Tutorial Approach”,CAD CIM Technologies , 2009.</td></tr>
</table>

Course Code: 18EMDP702		Course Title: Advanced CAE
L-T-P: 0-0-3	Credits: 3	Contact Hrs: 6 hrs/week
ISA Marks: 80	ESA Marks: 20	Total Marks: 80
Teaching Hrs: 120		Exam Duration: 2 hrs

Sl. No.	Contents	No of Slots
01	**Over View of Abaqus** A First Look at Abaqus Linear Static Analysis of a Cantilever Beam	02
02	**Working with Geometry (Part 1)** Working with Native Geometry Creating Native Geometry: Pipe Creep Model	01
03	**Working with Geometry (Part 2)** Generating a Shell From a Thin Solid Import and Geometry Repair of Intersecting Pipes Importing and Editing an Orphan Mesh Importing and Editing an Orphan Mesh: Pump Model	02
04	**Material and Section Properties** Creating Materials and Assigning Sections Material and Section Properties: Pipe Creep Model Material and Section Properties: Pump Model	01
05	**Assemblies in Abaqus** Creating an Assembly Pump Model Assembly	01
06	**Steps, Output, Loads, & Boundary Conditions** Creating Steps Using the Load Module Step Definition and Loads: Pipe Creep Model Step Definition and Loads: Pump Model	01
07	**Meshing Imported and Native Geometry** Using the Mesh Module Structured Hex Meshing: Pipe Creep Model Free and Swept Meshing: Pump Model Meshing of Intersecting Pipes	01
08	**Job Management and Results Visualization** Using the Keywords Editor Creep of a Pipe Intersection	01
	Linear and Nonlinear Problems	

09	**Analysis Procedures (Part 1)** Nonlinear Static Analysis Linear Analysis of a Skew Plate Nonlinear Analysis of a Skew Plate	02
10	**Analysis Procedures (Part 2)** Multiple Load Cases Linear Static Analysis of a Cantilever Beam	02
11	**Analysis Procedures (Part 3)** Dynamic Analysis of a Skew Plate Pipe Whip Analysis	02
12	**Analysis Continuation Techniques** Unloading Analysis of a Skew Plate	01
13	**Constraints and Connections** Defining a Rigid Body Tie Constraints: Pump Model	01
14	**Contact** Using Automatic Contact Detection and General Contact Nonlinear Static Analysis of a Pump Assembly	02
	Total	20
15	**Case studies and Various analysis of components (Both created and imported models)**	60

Reference books:

1. Material prepared by School of Mechanical Engineering, KLETU-Hubballi.
2. Nitin S. Gokhale, Sanjay S Deshpande, Sanjeev V Bedekar, Anand N thite, “Practical Finite Element Analysis”, Finite To Infinite, 2008.
3. Bryan J Mac Donald “Practical Stress Analysis with Finite Elements”, 2nd Edition, Glasnevin Publishing, 2011
4. Abaqus 6.14 documentation, http://abaqus.software.polimi.it/v6.14/index.html
5. http://ivt-abaqusdoc.ivt.ntnu.no:2080/v6.14/pdf_books/CAE.pdf

Course Code:**19EMDC701**	Course Title:**Computational Methods in Engineering Analysis**	
L-T-P: 3-1-0	Credits: 4	Contact Hrs: 5
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 40		Exam Duration: 3 hrs

Contents	**Hrs**
1.Approximations and round off errors: Significant figures, accuracy and precision, error definitions, round off errors and truncation errors. Mathematical modelling and Engineering problem solving: Simple mathematical model, Conservation Laws of Engineering.	**06**
2.Roots of Equations: Bracketing methods-Graphical method, Bisection method, False position method, Newton- Raphson method, Secant Method. Multiple roots, Simple fixed point iteration.	**06**
3.Roots of polynomial- Polynomials in Engineering and Science, Muller's method, Bairstow's Method Graeffe's Roots Squaring Method.	**06**
4.Numerical Differentiation and Numerical Integration: Newton –Cotes and Guass Quadrature Integration formulae, integration of Equations, Romberg integration, Numerical Differentiation Applied to Engineering problems, High Accuracy differentiation formulae.	**06**
5.System of Linear Algebraic Equations and Eigen Value Problems: Introduction, Direct methods, Cramer's Rule, Gauss Elimination Method, Gauss-Jordan Elimination Method, Triangularization method, Cholesky Method, Partition method, error Analysis for direct methods, iteration Methods.	**06**
6.Eigen values and Eigen Vectors: Bounds on Eigen Values, Jacobi method for symmetric matrices, Givens method for symmetric matrices, Householder's method for symmetric matrices, Rutishauser method for arbitrary matrices, Power method, Inverse power method.	**05**
7.Linear Transformation: Introduction to Linear Transformation, The matrix of Linear Transformation, Linear Models in Science and Engg.	**05**

Reference Books:

1. Erwin Kreyszig , Advanced Engineering Mathematics, 10th Edition , Willely India, 2016.
2. S.S.Sastry, Introductory Methods of Numerical Analysis, PHI, 2005.
3. Steven C. Chapra, Raymond P.Canale, Numerical Methods for Engineers, Tata Mcgraw Hill, 4th Ed, 2002.
4. M K Jain, S.R.K Iyengar, R K. Jain, Numerical methods for Scientific and engg computation, New Age International, 2003.
5. Pervez Moin, Fundamentals of Engineering Numerical Analysis, Cambridge, 2010.
6. David. C. Lay, Linear Algebra and its applications, 3rd edition, Pearson Education, 2002.

Course Code: **19EMDE702**	Course Title: **Mechanics of Solids**	
L-T-P: 4-0-0	Credits: 4	Contact Hrs: 5
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 50		Exam Duration: 3 hrs

Contents	hrs
1. Analysis of stress Introduction, body force, surface force and stress vector, the state of stress at a point, rectangular stress components, stress components on an arbitrary plane, equality of cross shears, differential equations of equilibrium, principal stresses, Mohr's circles for the three-dimensional state of stress, octahedral stresses, decomposition into hydrostatic and pure shear states.	**07**
2. Analysis of Strain Introduction, deformation, strain displacement relations, state of strain at a point, strain tensors, cubical dilatation, principal strains, spherical and deviator strain tensors, octahedral strains, compatibility conditions.	**07**
3. Stress-Strain Relations for Linearly Elastic Solids Generalized Hooke's law, stress–strain relations for isotropic materials, transformation of compatibility condition from strain components to stress components, relations between the elastic constants, Saint Venant's principle and uniqueness theorem.	**06**
4. Two Dimensional Problems in Cartesian Co-ordinates Plane stress and plane strain problems, Airy's stress function, solution of two-dimensional problems by the use of polynomials, pure bending of a beam, bending of a narrow cantilever beam under end load, simply supported beam subjected to point load and uniformly distributed load, use of Fourier series to solve two dimensional problems.	**07**
5. Two Dimensional Problems in Polar Co-ordinates General equations, biharmonic equation, stress distribution symmetrical about an axis, strain components in polar co-ordinates, thick-walled cylinders, rotating disks of uniform thickness, effect of circular holes on stress distribution in plates.	**07**
6. Torsion of Prismatic Bars Introduction, general solution of the torsion problem, torsion of circular, elliptical and equilateral triangular cross section bar, membrane analogy, torsion of thin tubes.	**06**
7. Thermal Stresses Introduction, thermoelastic stress–strain relations, thin circular disk; temperature symmetrical about centre, long circular cylinder, normal stresses in straight beams due to thermal loading.	**05**
8. Introduction to Plasticity Mechanism of plastic deformation, factors affecting plastic deformation, strain hardening, theories of plastic flow, Tresca and Von Mises yield criteria, discussion of plasticity conditions, experimental evidence for yield criteria.	**05**

Reference Books:

1. L S Srinath, Advanced Mechanics of Solids, 3rd Edition, Tata Mcgraw Hill Company, 2009.
2. T.G. Sitharam andL. Govindaraju,Elasticity for Engineers,I K International Publishing House, 2016.
3. Dr. Sadhu Singh, Theory of Plasticity and Metal Forming Process, 3rd Edition, Khanna Publishers, 2011.
4. J. Chakraborty, Theory of Plasticity, 3rd Edition, Butterworth-Heinemann, 2006.

I Sem M. Tech. (Production Management)

Curriculum Content

Course Code: **15EPMC702**		Course Title: **Mechatronics Systems**
L-T-P**: 4-1-0**	Credits: **5**	Contact Hrs: **6 hrs/week**
CIE Marks: **50**	SEE Marks: **50**	Total Marks: **100**
Teaching Hrs: **50 hrs**		Exam Duration: **3 hrs**

Introduction to mechatronics system: Advanced mechatronics design Approaches, Review of fundamentals of electronics, Application of mechatronics in manufacturing like CNC, TMS, FMS, CIM, MVS, APS etc.

Mechatronics elements: Data conversion devices, macro sensors, micro sensors, modern transducers, micro actuators, signal processing devices, relays, contactors and timers. MEMS.

Drives and mechanisms: Drives: stepper motors, servo drives. Ball screws, linear motion bearings, cams, systems controlled by camshafts, electronic cams, indexing mechanisms, tool magazines, and transfer systems.

Hydraulic and pneumatic system: Hydraulic systems: flow, pressure and direction control valves, actuators, and supporting elements, hydraulic power packs, and pumps. Distribution and conditioning of compressed air, system components and graphic representations Design of hydraulic and pneumatic circuits.

CNC technology and Robotics: Importance of CNC Systems, CNC variety, comparison of CNC with SPM, types of CNC machines, Advanced machining- 3, 4 & 5 axis, retrofitting applications CNC machines and part programming, Industrial Robotics.

Signal systems and real time interfacing: System and interfacing and data acquisition, DAQS, Overview of the I/O process, Installation of the I/O card and software. I/O ports, peripheral adapters, and serial communications interface, Dynamic Models and analogies, System response.

Programmable Logic Controllers: Introduction - Basic structure - Input / Output processing - Programming -Mnemonics Timers, Internal relays and counters - Data handling - Analog input / output - Selection of PLC.

Design and mechatronics case studies: Design of mechatronics systems & future trends. Designing - Possible design solutions - Case studies of Mechatronics systems- pick and place robot, PC based CNC drilling machine, conveyer based material handling system etc.

References:

1. Bolton W.,"Mechatronics", Pearson publications, New Delhi.
2. Shetty D. and Kolk R.A., "Mechatronics System Design", Thomas Learning.
3. Histand M. B. and Alciatore D. G., "Introduction to Mechatronics & Measurement System",.TATA McGraw Hill Publishing Company, New Delhi.
4. Aulander D. M. and Carl J., "Mechatronics Mechanical System Interfacing", Kemp Prentice-Hall, Inc.

I Sem M.Tech. (Production Management)
Curriculum Content

Course Code: **15EPMC703**		Course Title: **Project Management**
L-T-P**: 4-1-0**	Credits: **5**	Contact Hrs: **6 hrs/week**
CIE Marks: **50**	SEE Marks: **50**	Total Marks: **100**
Teaching Hrs: **50 hrs**		Exam Duration: **3 hrs**

Planning Overview: Capital investments, Phases and objectives of capital budgeting, Facets of project analysis, Capital Allocation Framework: Key criterion, Elementary investment options, Portfolio planning modes, Strategic planning and capital budgeting, Market and Demand Analysis: Situational analysis and specification of objective, Conduct of market survey, Demand forecasting and Uncertainties in demand forecasting, Technical Analysis: Manufacturing process/technology, Technical arrangements, Material inputs and utilities, Product mix, Plant capacity, Location and site, Machineries and equipment, Structures and civil works, Environmental aspects, Project charts and layouts. Financial Estimates and Projections: Cost of a project, Means of finance, Estimates of sales and production, Cost of production, Working capital requirement and its financing, Profitability projections, Projected cash flow statements. Advance Project Network Analysis and Scheduling: Introduction to CPM and PERT, Theory of constraints and critical chain method, Allocating resources and multiple project scheduling, TOC method for allocating Resources to multiple projects, GERT. Project Selection and Portfolio Management: Project portfolio management, Framework for project selection and portfolio management, Methods for individual project analysis, Methods for comparing and selecting projects, Periodic project review and assessment. The Impact of Sustainability on Project Management: The concept of sustainability, Sustainability in project management, Inter-relating life cycles, The impact of sustainability on project management processes, Measuring and reporting projects, The impact of sustainability on project management competencies.

References:

1. Prasanna Chandra, "Projects: Planning, Analysis, Financing, Implementation and Review", Tata McGraw-Hill Publishing Company Limited, New Delhi.
2. Nicholas J. M. and Steyn H. "Project Management for Business, Engineering and Technology: Principles and Practice", Elsevier.
3. Harold R. Kerzner, "Project Management: A Systems Approach to Planning, Scheduling, and Controlling", Wiley, New York.
4. Scott Berkun, "Art of Project Management". Cambridge, MA: O'Reilly Media.
5. Choudhury, S., "Project Management", Tata McGraw Hill.
6. Wiest J. D. and Levy F. K., "A Management Guide to PERT/CPM", Prentice Hall, Englewood Cliffs.

I Sem M. Tech. (Production Management)

Curriculum Content

Course Code: **15EPME702** Course Title: **Design of Experiments and Robust Design**
L-T-P**: 4-0-0** Credits: **4** Contact Hrs: **4 hrs/week**
CIE Marks: **50** SEE Marks: **50** Total Marks: **100**
Teaching Hrs: **50 hrs** Exam Duration: **3 hrs**

Taguchi's approach to quality and quality loss function, noise factors and average quality loss, exploiting non linearity, classification of parameters, Analysis of variance: No-Way ANOVA, One-Way ANOVA, Two-Way ANOVA and Three-Way ANOVA, Two Level Experiments: Two factor factorial design, model adequacy checking and estimating model parameters, 2^2 full factorial design, 2^3 full factorial design, 2^k full factorial design and Two level fractional factorial design, General 2^{k-p} fractional factorial design. Steps in Robust Design, Identification of process and its main function, Noise factors and testing conditions, Control factors and their levels, Matrix experiment and data analysis plan, Conducting the experiment and data analysis, Verifying experiment and future plan. Signal to Noise Ratios, Comparison of the quality of two process conditions, Relationship between Signal to Noise Ratio and quality loss after adjustment, Identification of a scaling factor, Signal to Noise Ratios for static problems, Signal to Noise Ratios for dynamic problems, Analysis of ordered categorical data. Taguchi inner and outer arrays, Orthogonal arrays and fractional factorial designs, Parameter design and tolerance design, Analysis of inner/outer array experiment, Alternative inner/outer Orthogonal array experiments, Constructing orthogonal arrays, Dummy level technique, Compound factor method, Linear graphs and Interaction assignment, Modification of linear graphs, Column merging method, Branching design.

References:

1. Montgomery, D. C., "Design and Analysis of Experiments", John Wiley & Sons.
2. Khuri A. I. and Cornell J. A. "Response Surfaces: Designs and Analyses, Marcel Dekker, Inc., New York.
3. Myers R. H., Montogomery, D. C. and Anderson-Cook C. M. "Response Surface Methodology: Process and Product Optimization Using Designed Experiments", John Wiley & sons, Inc., New York.
4. Mason R. L., Gunst, R. F., Hess J. L., "Statistical design and Analysis of Experiments with Applications to Engineering and Science", John Wiley & sons, Inc., New York.
5. Phadke M. S., "Quality Engineering using Robust Design", Prentice Hall PTR Englewood Cliffs, New Jersey.
6. Ross P. J., "Taguchi Techniques for Quality Engineering", McGraw -Hill International.

I Sem M.Tech. (Production Management)

Curriculum Content

Course Code: **15EPME704**		Course Title: **Finite Element Applications in Manufacturing**
L-T-P**: 4-0-0**	Credits: **4**	Contact Hrs: **4 hrs/week**
CIE Marks: **50**	SEE Marks: **50**	Total Marks: **100**
Teaching Hrs: **50 hrs**		Exam Duration: **3 hrs**

Equations of equilibrium, stress-strain relations for 2-D and 3-D, Potential energy and equilibrium, Boundary conditions, Von Misses Stresses. Approximation Analysis: Variational methods, Rayleigh-Ritz (R-R) methods applied to simple problems on axially loaded members R-R method applied to Cantilever, simply supported arid fixed beam, with point loads and UDL, Galerkin's method as applied to simple elasticity problem. FEM for 2D Problems: Shape functions, stiffness matrix, strain matrix, load vectors for CST Elements and application problems. FEM for Axisymmetric Problems: Higher order elements in bar, triangular, quadrilateral, tetrahedral and hexahedral elements, axisymmetric formulation, triangular elements, PE approach, Body force term, application problems. FEM applications in machining processes such as turning, drilling, milling and grinding. Applications of FEM in forming processes such as forging, rolling, drawing, extrusion and deep drawing, Applications of FEM in various casting processes. Dynamic Analysis: Equations of motion for dynamic problems –consistent and lumped mass matrices --formulation of element mass matrices, free vibration and forced vibration problems formulation, Standard FE Packages and their features.

References:

1. Chandrupatla and Belegundu, "Introduction to Finite Elements in Engineering", PHI learning Pvt Ltd, New Delhi.
2. Desai G.S. and Abel J.F., "Introduction to Finite Element Method", CBS Publishers, New Delhi.
3. Rao S. S., "The Finite Element Method in Engineering", Elsevier Publications.
4. Madenci E. and Guven I., "The Finite Element Method & Applications in Engineering Using ASYS", Springer International Edition.
5. Krishnamoorthy C. S., "Finite Element Analysis", Tata McGraw Hill Publishing Co. Ltd, New Delhi.
6. Lakshiminarayana H V., "Finite Element Analysis Procedures in Engineering", Universities Press.

I Sem M. Tech. (Production Management)

Curriculum Content

Course Code: **15EPMP701** Course Title: **Machining and Mechatronics Lab**
L-T-P**: 0-0-2-0** Credit: **2** Contact Hrs: **4 hrs/week**
CIE Marks: **80** SEE Marks: **20** Total Marks: **100**
Practical Hrs: **48 hrs**

- CNC programming practices on turning and milling.
- Generation of CNC programming using CAM software.
- Machinability studies in turning, drilling, milling and non-traditional machining.
- Analysis of automation circuits for a manufacturing system using electro-hydraulic and pneumatic circuits.
- Interfacing, programming and analyzing the various working modules with PLC system.
- Open ended experiments
    - ✓ Parametric analysis in traditional/non-traditional machining for a specified work tool combination
    - ✓ Construction and validation of a mechatronic system device for a given task.

II Sem M.Tech. (Production Management)

Curriculum Content

Course Code: **15ECRC701** Course Title: **Philosophy and Practice of Engineering Education**

L-T-P**: 2-0-1**	Credits: **3**	Contact Hrs: **3hrs/week**
CIE Marks: **50**	SEE Marks: **50**	Total Marks: **100**
Teaching Hrs: **40 hrs**		Exam Duration: **3 hrs**

Module 1: Fundamental Principles of Effective Teaching and Learning
Teaching Philosophy, How Learning Works, Classroom Communication Skills, Teaching and Learning Styles, Bloom's Taxonomy.

Module 2: Fundamentals of Instructional Design
Different Instructional Design Models.

Module 3: Technology Enhanced Learning
Role of Technology, TPACK Model, Technology Tools.

Module 4: Basics of Assessment and Evaluation
Different Methods, Techniques.

Module 5: Micro Teaching
Practice and Assessment

Reference Books:
Ambrose, S., Bridges, M., DiPietro, M., Lovett, M., & Norman, M. (2010) How learning works: 7 Research-Based principles for smart teaching. San Francisco: Jossey-Bass.

Suggested Web Resources:
https://cft.vanderbilt.edu/guides-sub-pages/blooms-taxonomy/
http://educationaltechnology.net/instructional-design/
https://www.nwea.org/blog/2014/33-digital-tools-advancing-formative-assessment-classroom/
http://oedb.org/ilibrarian/101-web-20-teaching-tools/

II Sem M.Tech. (Production Management)

Curriculum Content

Course Code: **15EPMC706** Course Title: **World Class Manufacturing**
L-T-P**: 4-1-0** Credits: **5** Contact Hrs: **6 hrs/week**
CIE Marks: **50** SEE Marks: **50** Total Marks: **100**
Teaching Hrs: **50 hrs** Exam Duration: **3 hrs**

World-Class Manufacturing (WCM), Manufacturing Excellence and Competitiveness, Meaning of World-class, Competing in World markets, WCM Techniques, Review of frameworks for WCM, Justification of WCM, Case studies.

Lean Manufacturing: Elements of Lean manufacturing: Stability, Standardized work, Just in time, Jidoka, Hoshin Planning, The culture of lean, Implementation of Lean manufacturing: Implementation framework for the Lean manufacturing, DEMAIC process, Case studies.

Total Productive Maintenance (TPM): An overview of various maintenance systems, Evolution of TPM, Productivity and TP, OEE, TPM and TQC, Small Group Activities, Pillars of TQM, Kobsu-Kaizen (Continuous Improvement), Jishu-Hozen (Autonomous maintenance), Planned Maintenance System, Skill upgrade training, Initial control (Equipment Life cycle management), Hinshitsu-Hozen (Quality Maintenance), Office TPM, Total safety management, Implementation, 5s,Case studies,

Total Quality Management (TQM): Understanding quality, Evolution of TQM, Framework for TQM, Commitment and leadership, Customer satisfaction, Employee involvement, Continuous process improvement, Supplier partnership, Performance, measures, Formulation and implementation of TQM

Concurrent engineering, Design Failure Mode Effects Analysis (DFMEA) and Process Failure Mode Effects Analysis (PFMEA), Manufacturing Quality in Supply Chain Management, Manufacturing Quality and its importance in Product Life Cycle, Case studies.

References:

1. Todd J., "World Class Manufacturing", McGraw Hill, London.
2. Schonberger R.J., "World Class Manufacturing - The Lesson of Simplicity", Free Press.
3. Marcus, A. A., “Management Strategy: Achieving Sustained Competitive Advantage”, New York: McGraw-Hill/Irwin.
4. Voss C.A., "Manufacturing Strategy: Process and Content", Chapman & Hall, London.
5. Pascal D., "Lean production simplified", 2nd Edition, Productivity Press.
6. Nakajima S., "Introduction to Total Productive Maintenance", Productivity Press.
7. Besterfield D. H., et al., "Total Quality Management", Pearson Education.
8. Mohanty R.P. and Deshmukh S: G., "Advanced Operations Management", Pearson Education.

II Sem M.Tech. (Production Management)
Curriculum Content

Course Code: **15EPMC707**		Course Title: **Automation in Manufacturing**
L-T-P**: 4-0-0**	Credits: **4**	Contact Hrs: **4 hrs/week**
CIE Marks: **50**	SEE Marks: **50**	Total Marks: **100**
Teaching Hrs: **50 hrs**		Exam Duration: **3 hrs**

Automation in Production System, Principles and Strategies of Automation, Basic Elements of an Automated System, Advanced Automation Functions, Levels of Automations, introduction to automation productivity. Material handling equipment, Analysis. Storage systems, performance and location strategies, Automated storage systems, AS/RS, types. Automatic identification methods, Barcode technology, RFID. Control Technologies in Automation: Industrial Control Systems, Process Industries Verses Discrete-Manufacturing Industries, Continuous Verses Discrete Control, Computer Process and its Forms. Discrete Process Control. Automated Manufacturing Systems: Components, Classification and Overview of Manufacturing Systems, Manufacturing Cells, GT and Cellular Manufacturing, FMS, FMS and its Planning and Implementation, Flow lines & Transfer Mechanisms, Fundamentals and Analysis of Transfer Lines, product design for automatic assembly. Evaluation of automatic production: Product manufacturability, orientation devices- active and passive devices, parts orientation. Automated Assembly Systems: Fundamentals, Analysis of Assembly systems. Cellular manufacturing, part families, cooling, production flow analysis. Group Technology and flexible Manufacturing systems, Quantitative Analysis. Analysis of Transfer Lines with No Internal Storage, Analysis of Transfer Lines with Storage Buffers. Quality Control And Support Systems: Quality in Design and manufacturing, inspection principles and strategies, Automated inspection, contact Vs non-contact, CMM. Manufacturing support systems. Quality function deployment, computer aided process planning, concurrent engineering, shop floor control, just in time and lean production. Rapid manufacturing technology; Introduction to Rapid Manufacturing, Customization and Mass Customization, Classification of Rapid Manufacturing Processes (Additive/Subtractive/Formative) Process Chain for Additive and Other Rapid Manufacturing Processes. Modeling and Simulation for Manufacturing Plant Automation: Introduction, need for system Modeling, Building Mathematical Model of a manufacturing Plant, Modern Tools- Artificial neural networks in manufacturing automation, AI in manufacturing, Fuzzy decision and control, robots and application of robots for automation.

References:

1. Grover M.P., "Automation, Production Systems and Computer Integrated Manufacturing", Pearson Education Asia.
2. Grover M.P., Weiss M. M., Nagel R.N. and Odrey N.G., "Industrial Robotics, Technology, Programming and Applications", Mc Graw Hill Book Publications.
3. Krishna Kant, "Computer Based Industrial Control" PHI.
4. David W. P., "Industrial Automation" John Wiley and Sons.
5. Radhakrishnan P., "CAD / CAM / CIM", New Age International Pvt. Ltd., New Delhi.
6. Viswanandham, "Performance Modeling of Automated Manufacturing Systems" PHI.

II Sem M.Tech. (Production Management)

Curriculum Content

Course Code: **15EPMP702** Course Title: **Computer Aided Engineering and Simulation Lab**.

L-T-P**: 0-0-2** Credit: **2** Contact Hrs: **4 hrs/week**

CIE Marks: **80** SEE Marks: **20-** Total Marks: **100**

Practical Hrs: **48 hrs** Exam Duration: **3 hrs**

- 3D Modeling and FEM Structural analysis: Exercises on modeling and finite element analysis, Simulation of single point and multi point cutting tools like twist drill and milling cutter. Analysis of results obtained from post processor.
- Forming Simulation: Exercises on forming simulation and analysis of forging, rolling, extrusion/drawing, deep drawing processes. Simulation of the process and analyzing the results to optimize the die design parameters.
- Casting Simulation: Exercises on casting simulation and analysis. Analysis of results to optimize the casting and casting design parameters.
- System Simulation: Exercises on real life problems using discrete event systems simulation software.
- Modern work-study analysis: Data analysis in Method Study and creation of visual charts. Use of work Study knowledge database to do Kaizen, SMED and other Improvements. Use of work-study methodologies to do 5S with examples.

III Sem M.Tech. (Production Management)

Curriculum Content

Course Code: **15EPME802**		Course Title: **Advanced Precision Engineering**
L-T-P**: 4-0-0**	Credits: **4**	Contact Hrs: **4 hrs/week**
CIE Marks: **50**	SEE Marks: **50**	Total Marks: **100**
Teaching Hrs: **50 hrs**		Exam Duration: **3 hrs**

Concept of Measurement methods, Experimental Test plan, Calibration, Static and Dynamic characteristics of signals, Measurement system behavior, Probability and Statistics, Density functions, Infinite and finite statistics, Chi-squared distribution, Regression analysis, Data outlier detection, Uncertainty Analysis, Measurement errors, Design-stage uncertainty analysis, error sources, Bias and precision errors, error propagation, single and multiple measurement, uncertainty analysis, Surface roughness measurement, Stylus instruments (Mechanical and Electrical), Sources of error, Optical instruments (Profiling and Parametric techniques), Data acquisition and filtering, Amplitude and texture parameters, Coordinate Measuring Machines: Coordinate metrology, Configuration of CMM, Hardware components, Control system for CMM, Operating sequence, Measurement program,Automated inspection, Principles, Methods of online, offline, distributed and flexible inspections, Machine vision, Image Acquisition & digitization, Image processing & Analysis, interpretation, applications

References:

1. Figliola R. S. and Beasley, D. E., "Theory and Design for Mechanical Measurements", Third edition, John Wiley & Sons Inc.
2. Thomas Tom R., "Rough Surfaces 2nd ed", Imperial College Press, London.
3. Hooken Rabert and Pereira P. H., "Coordinate Measuring Machines and Systems", CRC press.
4. Groover M.P., "Automation, Production Systems and Computer Integrated Manufacturing", PHI.

III Sem M.Tech. (Production Management)
Curriculum Content

Course Code: **15EPME803**		Course Title: **Simulation and Modeling**
L-T-P**: 4-0-0**	Credits: **4**	Contact Hrs: **4 hrs/week**
CIE Marks: **50**	SEE Marks: **50**	Total Marks: **100**
Teaching Hrs: **50 hrs**		Exam Duration: **3 hrs**

System Models, System environment, Stochastic activities, Continuous and discrete systems, Systems modeling, Types of models. System Simulation, simulation as problem solving tool, general principles and procedure, the techniques of simulation, Monte Carlo method of simulation, comparison of simulation and analytical methods, experimental nature of simulation, Statistical models in Simulation, Random Variables and their Properties, Estimation of Means, Variances, and Correlations, Confidence Intervals and Hypothesis Tests for the Mean, The Danger of Replacing a Probability Distribution by its Mean Discrete and continuous distributions, Poisson process, empirical distributions, Queuing Models, steady state behaviors, Single and multi-channel queuing models, Random Number Generation, Properties of random numbers, generation of pseudo-random numbers, techniques for generating random numbers, tests for random numbers. Random-Variate Generation, Inverse transform techniques, acceptance-rejection techniques, Analysis of Simulation Data, Data collection, identification of the distribution, parameter estimation, goodness-of-fit tests, multivariate and time-series input models, Output Analysis of a Single Model, Types of simulation with respect to output analysis, stochastic nature of output data, measures of performance and their estimation, analysis for termination simulations, Continuous System Simulation, Historical background, various growth patterns, System dynamics diagrams. Simulation of Manufacturing Systems, Verification and Validation of Simulation Models.

References:

1. Banks J., Carson II J.S., Nelson B.L., and Nicol D.M. “Discrete-event System Simulation”, Pearson Education.
2. Gordon G., “System Simulation”, PHI, New Delhi.
3. Sterman J. D., “Business Dynamics: Systems Thinking and Modeling for a Complex World”, McGraw-Hill International.
4. Neelamkavil F., “Computer Simulation and Modelling”, Wiley, New York.
5. Law A. M.and Kelton W. D., “Simulation Modeling and Analysis”, McGraw Hill.
6. Shannon R.E., “System Simulation”, Prentice Hall.
7. Written J. L., Bentley L. D.and Barice V.M., “System Analysis and Design Methods”, Galgotia Publication.
8. Mize J. H. and Cox J. G., “Essentials of Simulation” – Prentice Hall.

III Sem M.Tech. (Production Management)
Curriculum Content

Course Code: **15EPME805**		Course Title: **Enterprise Resource Planning**
L-T-P**: 4-0-0**	Credits: **4**	Contact Hrs: **4 hrs/week**
CIE Marks: **50**	SEE Marks: **50**	Total Marks: **100**
Teaching Hrs: **50 hrs**		Exam Duration: **3 hrs**

ERP as Integrated Management Information System, Evolution of ERP, Benefits of ERP. ERP versus Traditional Information Systems, Business Process Reengineering, Need and challenges, Management concerns about BPR, BPR to build business Model for ERP, ERP & Competitive advantage, Basic Constituents of ERP, Selection criteria for ERP Packages. Procurement process for ERP Package, ERP packages – PEOPLE SOFT, SAP-R/3, BAAN IV, MFG/PRO, IFS/AVALON, ORACLE-FINANCIAL, Survey of Indian ERP Packages regarding their Coverage, performance &cost, ERP Implementation: issues, Role of Consultants, Vendors, Users, Need for training, customization. ERP implementation methodology and post implementation issues and options, Supply Chain Management, Types of SCM, Potential benefits of SCM, Possible obstacles, Application systems supporting SCM – engineering, Product Data Management, Sales, Procurement, Production, MRP, Distribution, ERP case studies in HRM, finance, production, product database, materials, sales & distribution.

References:

1. Leon Alexis, "Enterprise Resource Planning", Tata McGraw Hill, New Delhi.
2. Garg V. K. and Venkatakrishna N. K., "Enterprise Resource Planning: Concepts and Practices", PHI, New Delhi.
3. Sadagopan S., "Enterprise Resource Planning: A Managerial Perspective", Tata McGraw Hill, New Delhi.
4. Brady, "Enterprise Resource Planning", Thomson Learning.

III Sem M.Tech. (Production Management)
Curriculum Content

Course Code: **15EPME807**		Course Title: **Product Lifecycle Management**
L-T-P: **4-0-0**	Credits: **4**	Contact Hrs: **4 hrs/week**
CIE Marks: **50**	SEE Marks: **50**	Total Marks: **100**
Teaching Hrs: **50 hrs**		Exam Duration: **3 hrs**

Product Lifecycle Management (PLM), Need for PLM, Product Lifecycle, Phases, Opportunities of Globalization, Pre-PLM Environment, PLM Paradigm, Importance and Benefits of PLM, Widespread Impact of PLM, Focus and Application, A PLM Project, Starting the PLM Initiative, PLM Applications PLM Strategies: Industrial strategies, Strategy elements, its identification, selection and implementation, Developing PLM Vision and PLM Strategy, Change management for PLM, Product Design and Development Process, Engineering Design, Organization and Decomposition in Product Design, Typologies of Design Process Models, Reference Model, Product Design in the Context of the Product Development, Process, Relation with the Development Process Planning Phase, Relation with the Post design Planning Phase, Methodological Evolution in Product Design, Concurrent Engineering, Characteristic Features of Concurrent Engineering, Concurrent Engineering and Life Cycle Approach, New Product Development (NPD) and Strategies, Product Configuration and Variant Management, The Design for X System, Objective Properties and Design for X Tools, Choice of Design for X Tools and Their Use in the Design Process, Product Data Management: Product and Product Data, PDM systems and importance, Components of PDM, Reason for implementing a PDM system, financial justification of PDM, barriers to PDM implementation, Virtual Product Development Tools: For components, machines, and manufacturing plants, 3D CAD systems and realistic rendering techniques, Digital mock-up, Model building, Model analysis, Modeling and simulations in product Design, Examples/Case studies, Integration of Environmental Aspects in Product Design: Sustainable Development, Design for Environment, Need for Life Cycle, Environmental Strategies, Useful Life Extension Strategies, End-of-Life Strategies, Introduction of Environmental Strategies into the Design Process, Life Cycle Environmental Strategies and Considerations for Product Design, Life Cycle Assessment and Life Cycle Cost Analysis: Properties, and Framework of Life Cycle Assessment, Phases of LCA in ISO Standards, Cost Analysis and the Life Cycle Approach, General Framework for LCCA, Evolution of Models for Product Life Cycle Cost Analysis, Technology Forecasting: Evolution for technology forecasting and its importance, Future mapping, Methods of technology forecasting such as Relevance Trees, Morphological Methods and Mission Flow Diagram, Combining forecast of different technologies.

References:

1. Stark J., "Product Lifecycle Management: Paradigm for 21st Century Product Realisation", Springer-Verlag, ISBN: 1852338105
2. Giudice F., Rosa Guido La, Risitano A., "Product Design for the environment-A life cycle approach", Taylor & Francis, ISBN: 0849327229
3. Antti S. and Anselmie I., "Product Life Cycle Management", Springer, Dreamtech, ISBN: 3540257314
4. Grieve M., "Product Lifecycle Management: Driving the next generation of lean thinking", Tata McGraw Hill, ISBN: 0070636265

III Sem M.Tech. (Production Management)

Curriculum Content

Course Code: **15EPMI801** Course Title: **Internship/Industrial Training**
L-T-P**: 0-0-2** Credits: **2** Contact Hrs: --
CIE Marks: **50** SEE Marks: **50** Total Marks: **100**

Each student has to undergo internship/industrial training for a period of 6 weeks at a reputed industry/R&D institution after the completion of III semester SEE. At the organization where the student is undergoing training, the student shall be assigned to work under the supervision of a Project Supervisor assigned for this purpose by the Head of the Department / institution. Student is expected to learn about the organization where the student is undergoing training in terms of its vision, mission, objectives, organizational structure, operations etc. At the end of the training, student must submit a report based on training.

The Project Supervisor at the industry shall award Continuous Internal Evaluation (CIE) marks out of a maximum of 50. The Department will conduct the Semester End Examination (SEE) for a maximum of 50 marks.

III Sem M.Tech. (Production Management)

Curriculum Content

Course Code: **15EPMW801** Course Title: **Minor Project/Project Work Phase I**
L-T-P**: 0-0-8** Credits: **8** Contact Hrs: **8**
CIE Marks: **50** SEE Marks: **50** Total Marks: **100**

Minor Project: The Guide shall define the problem statement for the Project work. The student shall execute the Minor Project within three months duration during the 3rd semester. The student who has opted **Minor Project** shall opt **Major Project** in IV semester. However, Minor Project is independent of Major Project.

Project Work Phase I:
Student must select a research project in consultation with the Guide. Student should identify the problem and conduct an exhaustive literature survey in Project Work Phase I and shall continue the project in IV semester in Phase II. Student has to submit the report at the end of the III Semester based on the following:

- Back ground and significance of the Research Project
- Problem statement
- Objectives and scope of the project
- Literature review
- Methodology
- Future plan of action

IV Sem M.Tech. (Production Management)
Curriculum Content

Course Code: **15EPMW802**	Course Title: **Major Project/Project Work Phase II**	
L-T-P**: 0-0-20**	Credits: **30**	Contact Hrs: **20**
CIE Marks: **50**	SEE Marks: **50**	Total Marks: **100**

The student who has opted **Minor Project** should opt **Major Project** in IV semester. The **Major Project** shall be carried out by the student under the supervision of guide for a period of 6 months. For successful completion of this course the student should be able to identify the problem, define the objectives of the work as specific points indicating the scope within which the work is to be carried out, conduct the comprehensive literature survey, demonstrate the use of methodology adopted, analyze and interpret the experimental/numerical results obtained.

Project Work Phase II:
The student who has opted **Project Work Phase I** shall continue the project in IV semester in **Phase II**.
Phase II is assessed based on the following:

- Quality of literature survey and demonstration of creativity in the research problem
- Clarity in the objectives and scope of the research
- Clarity in the problem definition and feasibility in the problem solution
- Relevance to the current research/industrial trends
- Quality of work
- Analysis and Interpretation of results
- Quality of oral and written presentation
- Publication based on the research work in reputed national/international conference/journal.

I Sem M. Tech. (Production Management)

Curriculum Content

Course Code: **17EPMC701**		Course Title: **Manufacturing Systems and Automation**
L-T-P**: 3-0-0**	Credits: **3**	Contact Hrs: **3 hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **40 hrs**		Exam Duration: **3 hrs**

Introduction: Production system facilities, Manufacturing support systems, Automation in production system, Automation principles and strategies, Manufacturing operations, Basic elements of an automated system, Advanced automation functions, Levels of automation.

Material handling and identification technology: Considerations in material handling system design, 10 principles of material handling, Automated guided vehicle systems, Conveyor systems, Analysis of material transport system, Automated storage systems, Engineering analysis of storage system. Components of manufacturing systems, Single station automated cells, Applications and analysis of single station cells.

Flexible manufacturing systems: FMS components, FMS application and benefits, Quantitative analysis of flexible manufacturing systems.

Industrial control systems: Sensors, Actuators, Drives and other control system components. Electro-hydraulic and Electro-pneumatics in manufacturing automations

Machine vision systems: Importance of machine vision system in manufacturing automation.

Role of microcontrollers in manufacturing automation system: Microcontroller architecture, interfacing sensors and actuators with microcontroller for industrial automation, Microcontroller programming.

PLCs in manufacturing automation: Application of programmable logic controllers in manufacturing automation, PLC basic and advanced ladder logic programming using RsLogix and CoDeSys format, Usage of timers, counters, sequencing, and interlocking, latching, master control relay for developing programs for manufacturing automation. Temperature control, valve sequencing, conveyor belt control, control of a process etc

SCADA for Automation: Elements of SCADA, Benefits of SCADA, Applications, Types of SCADA systems, Features and functions of SCADA, Building applications using SCADA for manufacturing automation.

References:

1. Grover M.P., “Automation, Production Systems and Computer Integrated Manufacturing”, Pearson Education Asia.
2. Grover M.P., Weiss M. M., Nagel R.N. and Odrey N.G., “Industrial Robotics, Technology, Programming and Applications”, Mc Graw Hill Book Publications.
3. Krishna Kant, “Computer Based Industrial Control” PHI.
4. W. Bolton , “Programmable Logic Controllers” Fifth Edition, Elsevier
5. Vijay R. Jadhav, “Programmable Logic Controller”, Second Edition, Khanna Publishers.

I Sem M.Tech. (Production Management)
Curriculum Content

Course Code: **17EPMC702**		Course Title: **CNC Machining Technology and Additive Manufacturing**
L-T-P**: 4-0-0**	Credits: **4**	Contact Hrs: **4 hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **50 hrs**		Exam Duration: **3 hrs**

Structure of CNC Machine Tools: Evolution of CNC Technology, CNC and DNC concept, classification of CNC Machines – turning centre, machining centre-features and applications, Automatic tool changers and Multiple pallet system, types of control systems, CNC controllers, characteristics, interpolators. CNC Machine building, structural details, configuration and design, guide ways –Friction, Anti friction and other types of guide ways, elements used to convert the rotary motion to a linear motion – Screw and nut, recirculating ball screw, rack and pinion, spindle assembly, torque transmission elements – gears, timing belts, flexible couplings, Bearings. Swarf removal and safety considerations

Drives and Tooling Systems: Spindle drives – DC shunt motor, 3 phase AC induction motor, feed drives – stepper motor, servo principle, DC and AC servomotors, Open loop and closed loop control, Tooling requirements for turning and machining centres, Qualified, semi qualified and preset tooling, coolant fed tooling system, work holding devices for rotating and fixed work parts, modular fixtures.

Feedback systems and Adaptive Control: Axis measuring system, Adaptive control with constraints (ACC), Adaptive control with optimization (ACO), Geometric adaptive control (GAC), Variable gain AC systems-stability problem, estimator algorithm, variable gain algorithm,

CNC Programming: G & M Codes, tool length compensation, cutter radius and tool nose radius compensation, do loops, subroutines, canned cycles, mirror image, parametric programming, machining cycles, programming for machining centre and turning centre, generation of CNC codes from CAM packages. Basics of APT

Additive manufacturing (AM) processes: AM based rapid prototyping (RP) Systems like Stereo-lithography, Fused Deposition Modeling (FDM), Selective Laser Sintering (SLS), Laminated Object Manufacturing (LOM), 3-D Printing, and LENS etc.

Role of additive manufacturing and rapid prototyping in product design and development: Solid modeling techniques for additive manufacturing with comparison, advantages and disadvantages, Process planning for rapid prototyping, STL file generation, Slicing and various slicing, procedures.

Accuracy issues in additive manufacturing: Properties of metallic and nonmetallic additive manufactured surfaces, Stress induced in additive manufacturing (AM) processes. Surface roughness problem in rapid prototyping, Part deposition orientation and issues like accuracy, surface finish, build time, support structure, cost etc.

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References:

1. Radhakrishnan P “Computer Numerical Control Machines”, New Central Book Agency.
2. Rao P.N., “CAD/CAM”, Tata McGraw-Hill Publishing Company Limited, New Delhi.
3. Pabla, B.S. & Adithan, M. “CNC Machines”, New Age Publishers, New Delhi.
4. Warren. S. Seames, “Computer Numerical Control: Concepts and Programming”, 4th edition, Delmar Thomson Learning Inc.
5. James Madison, “CNC Machining Hand Book”, Industrial Press Inc.
6. Peter Smid, “CNC Programming Hand book”, Industrial Press Inc., 2000
7. Chua, C.K., Leong, K.F., “Rapid Prototyping: Principles and Applications in Manufacturing”, John Wiley and Sons Inc.
8. Hopkinson, N., Hague, R.J.M. and Dickens, P.M., “Rapid Manufacturing and Industrial Revolution for the Digital Age”, John Wiley and Sons Ltd, Chichester.
9. Gebhardt, A., “Rapid Prototyping”, Hanser Gardner Publications, Inc., Cincinnati.
10. Noorani, R., “Rapid Prototyping: Principles and Applications”, John Wiley & Sons, Inc., New Jersey.

I Sem M.Tech. (Production Management)

Curriculum Content

Course Code: **17EPMC703**		Course Title: **Operations Management**
L-T-P: **3-1-0**	Credits: **4**	Contact Hrs: **5 hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **40 hrs**	Tutorial Hrs: **24 hrs**	Exam Duration: **3 hrs**

Overview of Operations Management: Functional sub systems of organizations, Systems concept of production, Types of production systems, Productivity, Strategic management.

Product Design and Analysis: New product development, Process Planning and Design, Value analysis and Value Engineering, Standardization, Simplification, Make or Buy decisions, Ergonomic considerations in Product design.

Capacity Planning and Investment Decisions: Capacity planning and strategies, Investment formulas and comparisons of alternatives.

Forecasting: Nature and use of forecasting, Measures of Forecasting, Factors affecting forecasting, Types and models of forecasting

Facility Location and Layout: Factors influencing plant location, location evaluation methods, Different types of lay outs for operations and production, arrangement of facilities within the department, CRAFT, ALDEP, CORELAP etc.

Aggregate Planning and Master Production Scheduling: Nature of aggregate planning, Methods of aggregate planning, Approaches to aggregate planning –graphical, empirical and optimization, Development of MPS, MRP-I and MRP-II.

Inventory Analysis and Control: ABC inventory systems, Inventory models, EOQ models for purchased and manufactured parts, lot sizing techniques.

Scheduling and Controlling: Objectives in scheduling, Major steps involved, Information systems linkages in production planning and control , Production control in repetitive, batch / flow shop and job shop scheduling environment - SPT, EDD, WMFT.

Project Planning and Management: Phases of project planning, Evolution of network planning techniques - Critical Path Method (CPM) and Project Evolution and Review Technique (PERT), Crashing of project network, Project scheduling with constrained resources –Graphical Evolution and Review Technique (GERT), Project monitoring, Line balance.

References

1. Vollman.T.E., "Manufacturing Planning & Control Systems", McGraw-Hill.
2. Dilworth. B. James., "Operations Management – Design, Planning and Control for Manufacturing and services", McGraw Hill Inc., New Delhi.
3. Bedworth D.D., "Integrated production control systems: management, analysis,design", John Wiley & sons, New York
4. Panneerselvam. R., "Production and Operations Management", Prentice Hall.
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Tutorial Exercises:

Forecasting, Facility location and layout, Aggregate Planning and MPS, Inventory Control, Scheduling and Controlling, Project Planning and Management

I Sem M.Tech. (Production Management)

Curriculum Content

Course Code: **17EPME703**	Course Title: **Design and Analysis of Experiments**	
L-T-P**: 4-0-0**	Credits: **4**	Contact Hrs: **4 hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **50 hrs**		Exam Duration: **3 hrs**

Overview: Taguchi's approach to quality and quality loss function, noise factors and average quality loss, exploiting non linearity, classification of parameters

Analysis of variance: No-Way ANOVA, One-Way ANOVA, Two-Way ANOVA and Three-Way ANOVA

Two Level Experiments: Two factor factorial design, model adequacy checking and estimating model parameters, 2^2 full factorial design, 2^3 full factorial design, 2^k full factorial design and Two level fractional factorial design, General 2^{k-p} fractional factorial design.

Steps in Robust Design: Identification of process and its main function, Noise factors and testing conditions, Control factors and their levels, Matrix experiment and data analysis plan, Conducting the experiment and data analysis, Verifying experiment and future plan.

Signal to Noise Ratios: Comparison of the quality of two process conditions, Relationship between Signal to Noise Ratio and quality loss after adjustment, Identification of a scaling factor, Signal to Noise Ratios for static problems, Signal to Noise Ratios for dynamic problems, Analysis of ordered categorical data.

Taguchi inner and outer arrays, orthogonal arrays and fractional factorial designs, Parameter design and tolerance design, Analysis of inner/outer array experiment, Alternative inner/outer orthogonal array experiments.

Constructing orthogonal arrays, Dummy level technique, Compound factor method, Linear graphs and Interaction assignment, Modification of linear graphs, Column merging method, Branching design.

References:

1. Montgomery, D. C., "Design and Analysis of Experiments", John Wiley & Sons.
2. Khuri A. I. and Cornell J. A. "Response Surfaces: Designs and Analyses, Marcel Dekker, Inc., New York.
3. Myers R. H., Montogomery, D. C. and Anderson-Cook C. M. "Response Surface Methodology: Process and Product Optimization Using Designed Experiments", John Wiley & sons, Inc., New York.
4. Mason R. L., Gunst, R. F., Hess J. L., "Statistical design and Analysis of Experiments With Applications to Engineering and SISAnce", John Wiley & sons, Inc., New York.
5. Phadke M. S., "Quality Engineering using Robust Design", Prentice Hall PTR Englewood Cliffs, New Jersy.
6. Ross P. J., "Taguchi Techniques for Quality Engineering", McGraw -Hill International.

I Sem M.Tech. (Production Management)

Curriculum Content

Course Code: **17EPME704**		Course Title: **Finite Element Analysis**
L-T-P**: 4-0-0**	Credits: **4**	Contact Hrs: **4 hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **50 hrs**		Exam Duration: **3 hrs**

Introduction: Introduction to FEA, General FEM procedure, Approximate solutions of differential equations: FDM method, W-R technique, collocation least square sub-domain and Galerkin method Numerical integration, Gauss Quadrature in 2-D and 3-D, Structure of FEA program, Pre and Post processor, commercially available, standard packages, and desirable features of FEA packages, Principal of minimum total potential, elements of variational calculus, minimization of functional, Rayleigh-Ritz method, Formulation of elemental matrix equation, and assembly concepts.

One Dimensional FEM: Coordinate system: Global, local, natural coordinate system, Shape functions: Polynomial shape functions, Natural co-ordinate and coordinate transformation, Linear quadratic and cubic elements, Shape functions using Lagrange polynomials. Convergence and compatibility requirement of shape functions, One dimensional field problems: structural analysis (step-bar, taper-bar), Structural analysis with temperature effect, Thermal analysis.

Two Dimensional FEM: Trusses, Thermal effects in truss members, Beams, Two dimensional finite elements formulations, Three noded triangular element, Four-noded rectangular element, Four-noded quadrilateral element, derivation of shape functions: natural coordinates, triangular elements, and quadrilateral elements, Six-noded triangular elements, Eight-noded quadrilateral elements, Nine noded quadrilateral element, Strain displacement matrix for CST element.

Three dimensional elements: Tetrahedron, Rectangular prism (brick), Arbitrary hexahedron, Three Dimensional polynomial shape functions, Natural co-ordinates in 3D, Three dimensional Truss(space trusses), Introduction to material models: Introduction to plasticity (Von-Mises Plasticity), Hyper –elasticity. Generating and using experimental data to model material behaviour, Errors in FEA, sources of errors, method of elimination, Patch test.

Applications of FEA in Manufacturing: FE analysis of Metal casting, Analysis of metal forming- Sheet metal stamping, Analysis of Machining using standard FE analysis packages

References:

1. Reddy J. N., “Introduction to Finite Element Method”, McGraw-Hill.
2. Rao S.S, “Finite Element Method in Engineering”, Academic Press, Elsevier.
3. Desai and Abel, “Introduction to the finite element method: A numerical method for engineering analysis”, CBS.
4. Chandrupatla R T and Belegundu A D, “Introduction to Finite Elements in Engineering”, PHI.
5. David Hutton, “Fundamentals of Finite Element Analysis”, McGraw-Hill.
6. Buchanan, G R., Finite Element Analysis, Adapted by: R Rudramoorthy, The McGraw-Hill, Indian Adapted Edition, Schaum’s Outlines.

I Sem M.Tech. (Production Management)

Curriculum Content

Course Code: **17EPMP701**		Course Title: **Automation Lab**
L-T-P**: 0-0-1**	Credit: **1**	Contact Hrs: **2hrs/week**
CIE Marks: **80**	SEE Marks: **20**	Total Marks: **100**
Practical Hrs: **24 hrs**		

Laboratory Exercises:

- Non controller based applications
- Controller based applications
- Programming PLC system for small applications using CodeSys and RsLogix software
- Interfacing PLC system for analyzing industrial applications
- Building programs for manufacturing automation processes
- Building and analyzing circuits using electro hydraulics and electro pneumatics system.

I Sem M.Tech. (Production Management)
Curriculum Content

Course Code: **17EPMP702** Course Title: **Machining Lab**
L-T-P**: 0-0-1** Credit: **1** Contact Hrs: **2hrs/week**
CIE Marks: **80** SEE Marks: **20** Total Marks: **100**
Practical Hrs: **24 hrs**

Laboratory Exercises:

- CNC programming practices on machining centers and WEDM.
- CAD/CAM integration with CNC machine tool.
- Practices in 3D printing**.**
- Machinability studies in turning, drilling, milling and non-traditional machining.
- Open ended experiments on
  - ✓ Parametric analysis in traditional/non-traditional machining for a work tool combination,
  - ✓ CNC Programming

I Sem M.Tech. (Production Management)
Curriculum Content

Course Code: **17EPMW701**		Course Title: **Mini Project I**
L-T-P**: 0-0-3**	Credit: **1**	Contact Hrs: **6hrs/week**
CIE Marks: **80**	SEE Marks: **20**	Total Marks: **100**
Practical Hrs: **72 hrs**		

Mini Project I: The Guide shall define the problem statement for the Project work. The student shall execute the Project within during the 1st semester. The student who has opted Mini Project I shall opt automation theme to carry out their work.

II Sem M. Tech. (Production Management)
Curriculum Content

Course Code: **17EPMC705**		Course Title: **Data Analytics**
L-T-P**: 3-1-0**	Credits: **4**	Contact Hrs: **5 hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **40 hrs**	Tutorial Hrs: **24 hrs**	Exam Duration: **3 hrs**

Statistical Data Analysis: Data and Statistics- Review of Basic Statistical Measures-Probability Distributions-Testing of Hypotheses-Non Parametric Tests

Data Analysis I: Introduction – Basic concepts – Uni-variate, Bi-variate and Multi-variate techniques – Types of multivariate techniques – Classification of multivariate techniques – Guidelines for multivariate analysis and interpretation – Approaches to multivariate model building.

Data Analysis II: Simple and Multiple Linear Regression Analysis – Introduction – Basic concepts – Multiple linear regression model – Least square estimation – Inferences from the estimated regression function – Validation of the model.

Factor Analysis: Definition – Objectives – Approaches to factor analysis – methods of estimation – Factor rotation – Factor scores - Sum of variance explained – interpretation of results. Canonical Correlation Analysis - Objectives – Canonical variates and canonical correlation – Interpretation of variates and correlations

Data Analysis III: Multiple Discriminant Analysis - Basic concepts – Separation and classification of two populations - Evaluating classification functions – Validation of the model. Cluster Analysis – Definitions – Objectives – Similarity of measures – Hierarchical and Non – Hierarchical clustering methods – Interpretation and validation of the model.

Data Analysis IV: Conjoint Analysis – Definitions – Basic concepts – Attributes – Preferences – Ranking of Preferences – Output of Conjoint measurements – Utility - Interpretation. Multi Dimensional Scaling – Definitions – Objectives – Basic concepts – Scaling techniques – Attribute and Non-Attributes based MDS Techniques – Interpretation and Validation of models. Advanced Techniques – Structural Equation modeling.

References:

1. Joseph F Hair, Rolph E Anderson, Ronald L. Tatham & William C. Black, "Multivariate Data Analysis", Pearson Education, New Delhi.
2. Richard A Johnson and Dean W. Wichern, "Applied Multivariate Statistical Analysis", Prentice Hall, New Delhi.
3. David R Anderson, Dennis J Sweeney and Thomas A Williams, "Statistics for Business and Economics", Thompson, Singapore.

II Sem M. Tech. (Production Management)
Curriculum Content

Course Code: **17EPMC706**		Course Title: **Enterprise Resource Planning**
L-T-P**: 3-0-0**	Credits: **3**	Contact Hrs: **3 hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **40 hrs**		Exam Duration: **3 hrs**

ERP as Integrated Management Information System: Evolution of ERP, Benefits of ERP,ERP versus Traditional Information Systems, Business Process Reengineering, Need and challenges.

Management concerns about BPR: BPR to build business Model for ERP, ERP & Competitive advantage, Basic Constituents of ERP, Selection criteria for ERP Packages.

Procurement process for ERP Package, ERP packages – PEOPLE SOFT, SAP-R/3, BAAN IV, MFG/PRO, IFS/AVALON, ORACLE-FINANCIAL, Survey of Indian ERP Packages regarding their Coverage, performance and cost

ERP Implementation: Issues, Role of Consultants, Vendors, Users, Need for training, customization. ERP implementation methodology and post implementation issues and options,

Supply Chain Management: Types of SCM, Potential benefits of SCM, Possible obstacles, Application systems supporting SCM – engineering, Product Data Management, Sales, Procurement, Production, MRP, Distribution, ERP case studies in HRM, finance, production, product database, materials, sales & distribution.

References:
1. Leon Alexis, "Enterprise Resource Planning", Tata McGraw Hill, New Delhi.
2. Garg V. K. and Venkatakrishna N. K., "Enterprise Resource Planning: Concepts and Practices", PHI, New Delhi.
3. Sadagopan S., "Enterprise Resource Planning: A Managerial Perspective", Tata McGraw Hill, New Delhi.
4. Brady, "Enterprise Resource Planning", Thomson Learning.

II Sem M. Tech. (Production Management)

Curriculum Content

Course Code: **17EPMC707**		Course Title: **Manufacturing Systems Simulation**
L-T-P**: 3-0-0**	Credits: **4**	Contact Hrs: **3 hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **40 hrs**		Exam Duration: **3 hrs**

Principles of Modeling & Simulation: Basic Simulation Modeling, Systems – discrete and continuous systems, general systems theory, models of systems- variety of modeling approach, concept of simulation, simulation as a decision making tool, types of simulation, Principle of computer modeling- Monte Carlo simulation, Nature of computer modeling, limitations of simulation, area of application.

Random Number Generation: Random variables and their properties, Properties of random numbers, generation of Pseudo random numbers, techniques for generating random numbers, Various tests for random numbers-frequency test and test for Autocorrelation,

Random Variate Generation: Different techniques to generate random Variate: Inverse transform technique,-exponential, Normal, uniform, Weibull, direct transformation technique for normal and log normal distribution, convolution method and acceptance rejection techniques-Poisson distribution, **Statistical Techniques:** Comparison of two system designs, Comparison of several system designs – Bonferroni approaches to multiple comparisons for selecting best fit, for screening

Design and Evaluation of Simulation Experiments: Problem formulation, data collection and reduction , time flow mechanism, key variables, logic flow charts, starting condition, run size, experimental design consideration, output analysis, verification and validation of simulation models. **Simulation Languages:** Comparison and selection of simulation languages, study of any one simulation language.

Discrete Event Simulation: Concepts in discrete –event simulation, development of simulation models for queuing systems, production systems, inventory systems, maintenance and replacement systems, investment analysis and network, Programming for discrete event simulation, Case studies.

References:

1. Jerry Banks and John S Carson, Barry L Nelson, David M Nicol, "Discrete event system simulation", Prentice Hall, India.
2. Khoshnevi. B., "Discrete system simulation", McGraw Hill International.
3. Ronald G Askin and Charles R Standridge , "Modeling and analysis of manufacturing systems", John Wiley & Sons.
4. Gordon G , "System Simulation", Prentice Hall, India..
5. Thomas J Schriber., "Simulation using GPSS", John Wiley & Sons.
6. Shannon, R.E., "System Simulation – The art and science", Prentice Hall, India.
7. Averill Law & David M.Kelton , "Simulation, Modeling and Analysis", TMH.

II Sem M.Tech. (Production Management)

Curriculum Content

Course Code: **17EPMP703**		Course Title: **ERP Lab**
L-T-P**: 0-0-1**	Credit: **1**	Contact Hrs: **2hrs/week**
CIE Marks: **80**	SEE Marks: **20**	Total Marks: **100**
Practical Hrs: **24 hrs**		

- Introduction and selection criteria for ERP Packages, Survey of Indian ERP Packages
- Production Planning and Execution Module: - Exercises on production planning, machine scheduling, Material Requirement Planning, track daily production progress, production forecasting & actual production reporting with case studies.
- Supply Chain Management Module: - Exercises on Management of flow of products from manufacturer to consumer & consumer to manufacturer, demand & supply management, sales returns & replacing process, shipping & transportation tracking with case studies.
- Finance & Accounting module: - Exercises on Track of all account related transactions like expenditures, Balance sheet, account ledgers, budgeting, bank statements, payment receipts, tax management with case studies.
- Human Resource Module:- Exercises on Efficient management of human resources, employee information, track employee records like performance reviews, designations, job descriptions, skill matrix, time & attendance tracking. Payroll System, payment repots, travel Expenses & Reimbursement tracking. with case studies.

II Sem M.Tech. (Production Management)

Curriculum Content

Course Code: **17EPMP704**		Course Title: **Simulation Lab**
L-T-P**: 0-0-1**	Credit: **1**	Contact Hrs: **2hrs/week**
CIE Marks: **80**	SEE Marks: **20**	Total Marks: **100**
Practical Hrs: **24 hrs**		

Laboratory Exercises:

Development of simulation models for the following systems

- Queuing and Inventory systems, manufacturing system and service operations.
- Maintenance and replacement systems
- Job shop with material handling and FMS
- Exercises on real life problems using discrete event systems simulation software on product, process and FMS layouts.

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Curriculum Content

Course Code: **17EPMW702**		Course Title: **Mini Project II**
L-T-P**: 0-0-3**	Credit: **1**	Contact Hrs: **6hrs/week**
CIE Marks: **80**	SEE Marks: **20**	Total Marks: **100**
Practical Hrs: **72 hrs**		

Mini Project II: The Guide shall define the problem statement for the Project work. The student shall execute the Project within during the 2nd semester. The student who has opted Mini Project II shall opt automation theme to carry out their work.

I Sem M. Tech. (Production Management)
Curriculum Content

Course Code: **18EPMC701**		Course Title: **PLM Fundamentals**
L-T-P**: 2-0-0**	Credits: **2**	Contact Hrs: **2 hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **30 hrs**		Exam Duration: **3 hrs**

Introduction to Product Lifecycle Management (PLM): PLM Overview, Background for PLM, Scope, Components/Elements of PLM, PLM Grid, PLM Paradigm - Concepts, Consequences and Corollaries, Strategic Benefits, Operational Benefits, Spread of PLM, Overcoming Problems, Enabling Opportunities, Challenges.

The PLM Environment: Issues in the Traditional Environment, Product Data Issues, A Complex Changing Environment-Change, Interconnections, Changes Driving PLM, Product Pains-Aerospace, Automotive and Other Products, Product Opportunities - Globalization Opportunity, Technology Opportunity, Social/Environmental Opportunity, Human Resource Opportunity.

Product Lifecycle Management System: Product Data or Product Information, System Architecture, Information Models and Product Structure, Information Model, Product Information Data Model, Product Model, Reasons for the Deployment of PLM Systems.

PLM in Different Verticals: Functionality of the Systems, Use of PLM Systems in Different Organizational Verticals, Product Development and Engineering, Production, After Sales, Sales and Marketing, Sub-Contracting, Sourcing and Procurement, Different Ways to Integrate PLM Systems, System Roles - ERP, CAD.

Project/Program Management in PLM Environment: Characteristics of Projects, People in Projects, Project Phases, Project Management Knowledge Area, Project Management Tools and Templates, The Importance of Project Management in PLM, Project reality in a Typical Company, Project Management Activities in PLM Initiatives, Pitfalls of Project Management, Top Management Role with Project Management.

References:

1. Stark John, "Product Lifecycle Management: 21st Century Paradigm for Product Realization", Springer, Third Edition, 2015
2. Antti Saakasvuori, Anselmi Immonen, "Product Lifecycle Management" - Springer, 1st Edition, 2003.
3. Grieves Michael, "Product Lifecycle Management - Driving the Next generation of LeanThinking" , McGraw-Hill, 2006.

I Sem M. Tech. (Production Management)
Curriculum Content

Course Code: **18EPMC702**		Course Title: **Engineering Data Management**
L-T-P**: 3-0-0**	Credits: **3**	Contact Hrs: **3 hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **40 hrs**		Exam Duration: **3 hrs**

Introduction and Overview of Embedded Product Design: Background, Related Research and Research Problems, Structure of the Report, Design for Manufacture, Design of Embedded Products, Technical Design Disciplines and Document Management, Software Design, Electronics Design, Software-Hardware Co-Design, Mechanical design, Concurrent Engineering, Design Data Management, DFA and DFMA.

PDM Systems and Data Exchange: Product Data Management (PDM), State-of-the-art trends of PDM, Data Formats and Translators in Data Exchange, STEP (Standard for the Exchange of Product Model Data), CDIF (Case Data Interchange Format), SGML (Standard Generalized Markup Language).

PDM and SCM: PDM and Product Life Cycle, PDM Systems – Common Functionality, Product Structure and Document Management, System Architecture, Version Management, Configuration Selection, Concurrent Development, Build Management, Release Management, Workspace Management, Change Management.

Requirements of Design Data Management: Requirements for the Embedded Product's Design Data Management, Data Management, Process and Life-Cycle Management, Data Capture & Distribution, Support for Working Methods, Requirements for Enterprise-Level Design Data Management, Design Data Management Levels, The Design Data Management Features of Design Tools , Team-Level Design Data Management, Team-Level Design Data Management.

Analysis of Needs and Solutions: Comparison of Principles, Comparison of Key Functionalities, Requirements and Needs, Analysis, Different Scenarios in an Integrated Environment, Possible Integrations, Examples of integrations.

Product Data in PLM Environment: Relevance of Product Data in PLM, Product Data Across the Lifecycle, Tools to Represent Product Data, Data model diagrams, Reality in a Typical Company-Issues, Challenges and Objectives, Product Data Activities in the PLM Initiative-Product Data Improvement.

References:

1. Jukka Kaariainen, Pekka Savolainen,Jorma Taramaa & Kari Leppala, “Product Data Management (PDM) Design, exchange and integration viewpoints”, VTT- Technical research centre of Finland, 2000.
2. Rodger Burden “PDM: Product Data Management” Volume 1, Resource Publishing, 2003.
3. Annita Persson Dahlqvist et.al “PDM and SCM - similarities and differences”, The Association of Swedish Engineering Industries, 2001.

I Sem M. Tech. (Production Management)
Curriculum Content

Course Code: **18EPMC703**		Course Title: **Product Design and Development**
L-T-P**: 3-0-0**	Credits: **3**	Contact Hrs: **3 hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **40 hrs**		Exam Duration: **3 hrs**

Introduction: Characteristics of successful product development, duration and cost of product development, Challenges of product development.
Development Process and Organizations: Generic development process, concept development – Front-end process, adapting the generic product development process **Identifying Customer Needs:** Defining scope, gathering data from customers, establishing relative importance of needs etc.
Establishing Product Specifications: Target specifications & refining specifications **Concept Generation:** Five step methodology of concept generation.
Concept selection: Structured methodology for selecting a concept using selection matrix & ranking of concepts.
Product Architecture: Meaning & implication of product architecture.
Industrial Design: Meaning of ID, & its impact, Aesthetic & Ergonomic considerations, ID process
Design for Manufacturing: DFM meaning, DFM Methodology**.**
Value Engineering and Product Design: Definition of value. Value analysis job plan, creativity etc.

References:

1. Karl T Ulrich and Steven D Eppinger, 'Product design and development', Tata McGraw Hill Publication.
2. A. K. Chitale and R. C. Gupta, 'Product Design and Manufacturing', Prentice Hall India.
3. Bralla, James G., Handbook of Product Design for Manufacturing, McGraw Hill Publications.

I Sem M. Tech. (Production Management)

Curriculum Content

Course Code: **18EPMC704** Course Title: **Enterprise Resource Planning - I**
L-T-P**: 3-0-0** Credits: **3** Contact Hrs: **3 hrs/week**
ISA Marks: **50** ESA Marks: **50** Total Marks: **100**
Teaching Hrs: **40 hrs** Exam Duration: **3 hrs**

Introduction to ERP: Need for ERP, Characteristics and components of ERP, Suppliers of ERP, Integrated Management Information, Seamless Integration and Functional information system, Marketing, Accounting and Financial Management, Supply Chain Management, Resource Management, Integrated Data Model.

Business Functions and Business Processes: Functional Areas of Operation, Business Processes, A process view of business, Functional Areas and Business process of very small business. Marketing and Sales, Supply Chain Management, Accounting and Finance, Human Resources, Functional Area Information System

Business Process Reengineering: Need for reengineering, Reengineering Model, BPR Guiding principles , Business process reengineering and performance improvement, Enablers of BPR in Manufacturing, Collaborative Manufacturing, Intelligent manufacturing, Production Planning. BPR Implementation

Financial & Accounting Management: Differences between Financial accounting, Cost accounting and Management accounting, Basic finance – Concept of Cost Centre accounting, Cost – Volume – Profit Analysis, Cash Flow Analysis

Role of ERP in Purchasing: Features of purchase module, ERP Purchase System; Role of ERP in Sales and Distribution, Sub-Modules of the Sales and Distribution Module: Master data management, Order management, Warehouse management, Shipping and transportation, Billing and sales support, foreign trade, Integration of Sales and Distribution Module with Other Modules

Inventory Management: ERP inventory management system, Importance of Web ERP in Inventory Management, ERP Inventory Management Module and Sub-Modules of the ERP Inventory Management Module, Bill of Material, Safety stock, Lot number/Batch number, Inventory valuation methods

Material Requirement Planning: Product structure and Bill of Materials (BOM), MRP concept, MRP calculations, Lot sizing in MRP, capacity requirement planning, MRP-II, MRP Exercises

Production and Supply Chain Management Information Systems: Role of ERP in CAD/CAM, MRP, Closed Loop MRP, MRP-II, Manufacturing and Production Planning Module of an ERP System, Distribution Requirements Planning (DRP); ERP Approach to Production Planning, MRP to ERP.

References

1. Ellen Monk , Bret wagner "Concepts in Enterprise Resource planning" Third Edition Course Technology.
2. R.Radha Krishnan " Business Process Reengineering PHI , New Delhi.
3. Garg V. K. and Venkatakrishna N. K., "Enterprise Resource Planning: Concepts and Practices", PHI, New Delhi.
4. Sadagopan S., "Enterprise Resource Planning: A Managerial Perspective", Tata McGraw Hill, New Delhi.
5. Pauline Weetman, "Financial and Management Accounting: An Introduction", Pearson Education Limited.

I Sem M.Tech. (Production Management)
Curriculum Content

Course Code: **18EPME701**	Course Title: **Design for Additive Manufacturing**	
L-T-P:**3-0-0**	Credits: **4**	Contact Hrs: **3 hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **40 hrs**		Exam Duration: **3 hrs**

Overview of Design for Additive Manufacturing (AM): How to design for AM? Challenges & opportunities, Design process, mechanical properties, performance of materials used in AM, process driven & designer driven shape, methods, Additive manufacturing principles & processes.

Drivers for AM: Material efficiency, flow optimization, integration of functions, mass customization, lead time, automated manufacturing, Limitations, Available material, accuracy of the technology, price of the industrial machines, certification of materials and processes, surface finish(supports, post processing), part dimensions.

DFMA Principles for AM: Maximum Part size, Faces requiring support, minimum wall thickness & rigidity, Minimum feature size & manufacturing quality, Typical geometries, DFX rules for additive manufacturing. cost considerations**.**

Topology Optimization for AM: Introduction to topology optimization, Topology optimization process, characteristics, link with AM potentials & Challenges, Current developments.

Accuracy Issues in AM: Properties of metallic and nonmetallic additive manufactured surfaces, Stress induced in additive manufacturing (AM) processes. Surface roughness problem in rapid prototyping, Part deposition orientation and issues like accuracy, surface finish, build time, support structure, cost etc

References:

1. Ian Gibson, David W. Rosen, Brent Stucker, "Additive manufacturing technologies: rapid prototyping to direct digital manufacturing", Springer, 2010.
2. Andreas Gebhardt, "Understanding additive manufacturing: rapid prototyping, rapid tooling, rapid manufacturing", Hanser Publishers, 2011.
3. Christoph Klahn, Bastian Leutenecker, Mirko Meboldt, "Design for Additive Manufacturing – Supporting the Substitution of Components in Series Products", Procedia CIRP 21 2014, 24th CIRP design conference
4. Rosen, D.W., 2007. "Design for additive manufacturing: A method to explore unexplored regions of the design space". In Proceedings of the 18th Annual Solid Freeform Fabrication Symposium.

I Sem M.Tech. (Production Management)

Curriculum Content

Course Code: **18EPME703**		Course Title: **Supply Chain Management**
L-T-P:**3-0-0**	Credits: **4**	Contact Hrs: **3 hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **40 hrs**		Exam Duration: **3 hrs**

Supply Chain Concepts: Introduction to Supply Chain, SCOR model, Virtual/Extended Enterprise, Delivery Channel, Objective of a Supply Chain, Decision Phases in a Supply Chain, Production Approaches, Supply Chain Process, Push & Pull Production Systems, Push-Pull Boundary, Lack of Coordination and Bullwhip Effect, Order Management, Order-to-Cash Process, Procure-to-Pay Process, Call-off, Replenishment, Sourcing

Supply Chain Performance: Supply Chain Strategies, Value Chain, Capabilities, Uncertainties, Responsiveness vs Cost, Supply Chain Performance Drivers – Facilities, Inventory, Transportation, Information, Sourcing, and Pricing, Supply Chain Visibility, Resilience, Non-Financial Metrics Examples, Financial Metrics Examples, Sustainability

Designing Distribution Network: Introduction, Factors Influencing Distribution Network Design, Design Options for a Distribution Network, Distribution Network for Online Sales, Impact of Online Sales on Cost

Network Design: Introduction, Factors Influencing Network Design Decisions, Framework for Network Design Decisions, Facility Location Mathematical Models, Capacity Allocation Mathematical Models, Network Behavior, Types of Supply Relationship, Factors influencing Nature of Network Relationship, Vertical Integration

Demand Management and Forecast: House of SCM, Managing Demand, Managing Supply, Transportation Model, Just-in-Time in Supply Chain, Forecasting in Supply Chain, Characteristics of Forecasts, Approaches to Demand Forecasting

Inventory Management: Cycle Inventory, Cycle Inventory Related Costs, Economics of Scales, Economic Order Quantity, Multiechelon Cycle Inventory, Uncertainty and Safety Inventory, Safety Inventory Level

Logistic and Warehouse Management: Transportation in Supply Chain, Modes of Transportation, Transportation Network, Trade-offs in Transportation Design, Warehouse Layout and Design, Warehouse Types, Warehouse Operating Processes, Warehouse Management System, Procurement, Material Classification, Material Codification

Trends in SCM: Gartner's Hype Cycle, Capgemini's Consulting Hype Cycle, Trend Categories, Algorithmic Supply Chain Planning, Predictive Analytics, Global Logistics Visibility, Focus on Risk Management and Supply Chain Resiliency

References:

1. Sunil Chopra, and Peter Meindl, "Supply Chain Management – Strategy, Planning, and Operation," Pearson Education.
2. APICS, "Operations Management Body of Knowledge Framework."
3. Lora Cecere, "Supply Chain Metrics that Matter," Wiley.
4. Hartmut Stadtler, "Supply chain management and advanced planning – basics, overview and challenges," European Journal of Operations Research, 163, 2015.
5. Keely L. Croxton, Sebastián J. García-Dastugue and Douglas M. Lambert, "The Supply Chain Management Processes," The International Journal of Logistic Management.

I Sem M.Tech. (Production Management)
Curriculum Content

Course Code: **18EPMP701**	Course Title: **Collaborative Design - Modeling Lab**	
L-T-P**: 0-0-5**	Credits: **5**	Contact Hrs: **10 hrs/week**
ISA Marks: **80**	ESA Marks: **20**	Total Marks: **100**
Practical Hrs: **120 hrs**		Exam Duration: **2 hrs**

User Interface Platform:

Understand the user interface, Connect to the PLM platform, Access your Dashboard, Use the Tags for searching content, Share various documents with other users through, 3DSpace, Use standard menus and commands, Import new data and export to required file formats, Search for a 3D data using different methods, Explore and open 3D data, Manipulate the tree, Filter data

Sketcher: Exercises on sketch tools, profile tool bar and constraint tool bar.

Part Design: Exercise on 3D models using pad, slot, shaft, groove, hole, rib and stiffener commands, cut revolve etc.

Generative Shape Design (GSD): Exercises using GSD to generate complicate surfaces using sub tool bars

Sheet Metal: Setting sheet metal parameters, bend extremities tab, creating the base wall, creating the wall on edge, creating extrusions etc.

Assembly Design: Assembly design work bench Bottom-Up and Top-Down assembly approaches invoking existing components into assembly work exercise to demonstrate Top-Down assembly approach.

Drafting: Converting existing 3D models into 2D drawings with all relevant details, sectional views etc.

Data Exchange and Collaborative Lifecycle:

Import and export different file formats, manage the Mastership of imported objects, Create a new product structure, Use different sections of the Action bar effectively, Manage the changes in a product structure, Save the product structure in the database

Design Review:
Create a design review, add markups to it, Create slides, and add markers, Create sections and measures, Export sections and measures, compare 3D Objects and 2D Drawings

References

Companion Courses – https://companion.3ds.com/

I Sem M. Tech. (Production Management)

Curriculum Content

Course Code: **18EPMP702**		Course Title: **PLM Functional Lab**
L-T-P**: 0-0-3**	Credits: **3**	Contact Hrs: **6 hrs/week**
ISA Marks: **80**	ESA Marks: **20**	Total Marks: **100**
Practical Hrs: **72hrs**		Exam Duration: **2 hrs**

Collaboration and Approvals:

Illustrate the structure of PLM Business Process Services, Create and manage your folders, Create workflows, Identify and manage your assigned tasks, Subscribe to various objects and events, Report and resolve issues in objects, Create, track and organize your documents

IP Classification:

Need of IP Classification, Create different types of libraries and their related hierarchies, Create and manage documents and parts, classify the library objects based on their features, Use the Classification functionality

Engineering Bill of Material:

Create parts and specifications, Create and edit Bill of Materials, Create a Change Request to make the changes in a part or a specification, Complete Change Orders and Change Actions to implement the changes, Review and release the parts

Project Management Fundamentals:

Create programs and projects, Assign members to a project, Add tasks and assign project members to the tasks, Create folders for managing project documents, Create process flow for tasks, Review the status of programs and projects, Exchange and view projects data using Microsoft Project Integration

Project Management Advanced:

Document the various risk areas of a project and track them, Create and manage the resource requirements for a project, Create budgets and benefits to monitor the financials of a project, Track the time spent on a project using time sheets, Create calendars for the projects, Identify the quality factors of a project and monitor them, Create an assessment to measure the project’s health, Use dashboards to monitor the status of your projects

Project Execution:

Manage the project schedule, Record risks for tasks, Create and submit timesheets

References

1. Companion Courses – https://companion.3ds.com/
2. Antti Saakasvuori, Anselmi Immonen, “Product Lifecycle Management" - Springer, 1st Edition, 2003.

I Sem M.Tech. (Production Management)

Curriculum Content

Course Code: **18EPMP703**		Course Title: **ERP Functional Lab**
L-T-P**: 0-0-3**	Credits: **3**	Contact Hrs: **6hrs/week**
ISA Marks: **80**	ESA Marks: **20**	Total Marks: **100**
Practical Hrs: **72 hrs**		Exam Duration: **2 hrs**

Selection Criteria for ERP Packages: Survey of Indian ERP Packages

Financial Accounting: Basic Finance – Chart of accounts, Journal entries, Journal vouchers, Exchange rates; Banking (In and Out); Debit and Credit note

Master Data Management: Item master; Business partner master – Customer, vendor; Pricing; Tax

Supply chain Management

Sales: Sales quotation, Sales order, Delivery, Return, Invoice (A/R)

Purchase: Purchase quotation, Purchase order, Return, GRN, Invoice (A/P)

Production: Assembly BOM, Production order, Goods issue, Goods receipt

Reports: Generation of reports for various functions

II Sem M. Tech. (Production Management)

Curriculum Content

Course Code: **18EPMC705**		Course Title: **PLM Advanced**
L-T-P**: 2-0-0**	Credits: **2**	Contact Hrs: **2 hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **30 hrs**		Exam Duration: **3 hrs**

Deployment of the PLM System: Different stages of deployment, Leading a PLM Project, Understanding the need for change, PLM maturity model, Choosing a system, Realization stage of the project, Start up, Steering group, Project manager, Accomplishing change in the organization.

Challenges of Product Management in Manufacturing Industry: Life cycle thinking, value added services and after sales traceability, Special challenges of product management in the high tech industry, Case studies.

Service Industry and PLM: Introduction, Categorizing services, Rational for building service products, PLM in service business, PLM challenges in service business, Case studies.

Role of product Information Management in Collaborative Business Development: CIM, Concurrent Engineering, Product lifecycle management as an enabler of cooperation between companies, Contents of collaboration, Successful cooperation, Tools of collaboration.

Product and Product Management Strategy: PLM as a business strategy tool, Making a product strategy, Product management strategy, Time to market, Time to react, Time to volume, Time to service.

References:

1. Stark John, "Product Lifecycle Management: 21st Century Paradigm for Product Realization", Springer, Third Edition, 2015
2. Antti Saakasvuori, Anselmi Immonen, "Product Lifecycle Management" - Springer, 1st Edition, 2003.
3. Grieves Michael, "Product Lifecycle Management - Driving the Next generation of LeanThinking" , McGraw-Hill, 2006.

II Sem M. Tech. (Production Management)
Curriculum Content

Course Code: **18EPMC706**		Course Title: **Enterprise Resource Planning-II**
L-T-P**: 3-0-0**	Credits: **3**	Contact Hrs: **3 hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **40 hrs**		Exam Duration: **3 hrs**

ERP implementation Basics: Master Data Management – Item Master, Vendor Master, COA, Customer Master, Machine Master, etc. Vendors- Role of Vendor; Consultants: Types of consultants; Role of a Consultant, Employees; Role of employees; Resistance by employees; Dealing with employee resistance, Role of Top Management, Role of Implementation Partner

ERP –Functional modules: Functional modules of ERP software, integration of supply chain and customer relationship application.

ERP implementation Life cycle: Objectives of ERP implementation, Different phases of ERP implementation. Consultants, vendor and employees

ERP Projects: Project types, Implementation methodology, Project Preparation, Business Blueprinting, Gap Analysis, Realization, Final Preparation, Go Live and Support, User Training

ERP Post Implementation: Maintenance of ERP- Organizational and Industrial impact; Success and Failure factors and ERP Implementation - Case studies.

ERP and e-Business: Introduction ERP and e-business process model, components of e-Business supply chain ERP/ e-business integration ERP to ERP II –Bringing ERP to the Entire Enterprise

Future Directions in ERP: Faster Implementation Methodologies; Business Modules and BAPIs; Convergence on Windows NT; Application Platform; New Business Segments; More Features; Web Enabling; Market Snapshot.

Other Related Technologies of SCM: Relation to ERP; E-Procurement; E-Logistics; Internet Auctions; E-markets; Electronic Business Process Optimization; Business Objects in SCM; E commerce

Case Studies: ERP case studies in HRM, Finance, Production, Product Database, Materials, Sales & Distribution

References:

1. Leon Alexis, “Enterprise Resource Planning”, Tata McGraw Hill, New Delhi.
2. Garg V. K. and Venkatakrishna N. K., “Enterprise Resource Planning: Concepts and Practices”, PHI, New Delhi.
3. Sadagopan S., “Enterprise Resource Planning: A Managerial Perspective”, Tata McGraw Hill, New Delhi.
4. Brady, “Enterprise Resource Planning”, Thomson Learning.

III Sem M.Tech. (Production Management)
Curriculum Content

Course Code: **18EPMC707**		Course Title: **Project Feasibility and Analysis**
L-T-P**: 3-1-0**	Credits: **4**	Contact Hrs: **5 hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **50 hrs**		Exam Duration: **3 hrs**

Planning Overview: Capital budgeting and Allocation, Strategic planning.

Market and Demand Analysis: Situational analysis, Demand forecasting and Uncertainties in demand forecasting.

Technical Analysis: Material inputs and utilities, Product mix, Plant capacity and Location, Environmental aspects, Project charts and layouts.

Financial Estimates and Projections: Means of finance, Estimates of sales and production, Working capital requirement and its financing, Profitability projections, projected cash flow statements. Project risk analysis: Sources, Measures and Perspectives on risks, Sensitivity analysis, Scenario analysis, Break-even analysis, Simulation analysis, Decision tree analysis, managing risk.

Sustainability in Project Management: Inter-relating life cycles, The impact of sustainability on project management processes, Measuring and reporting projects

References:

1. Prasanna Chandra, "Projects: Planning, Analysis, Financing, Implementation and Review", Tata McGraw-Hill Publishing Company Limited, New Delhi.
2. Nicholas J. M. and Steyn H. "Project Management for Business, Engineering and Technology: Principles and Practice", Elsevier.
3. Harold R. Kerzner, "Project Management: A Systems Approach to Planning, Scheduling, and Controlling", Wiley, New York.

II Sem M. Tech. (Production Management)

Curriculum Content

Course Code: **17EPME705**		Course Title: **Manufacturing Systems and Automation**
L-T-P**: 3-0-0**	Credits: **3**	Contact Hrs: **3 hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **40 hrs**		Exam Duration: **3 hrs**

Introduction: Production system facilities, Manufacturing support systems, Automation in production system, Automation principles and strategies, Manufacturing operations, Basic elements of an automated system, Advanced automation functions, Levels of automation.

Material handling and identification technology: Considerations in material handling system design, 10 principles of material handling, Automated guided vehicle systems, Conveyor systems, Analysis of material transport system, Automated storage systems, Engineering analysis of storage system. Components of manufacturing systems, Single station automated cells, Applications and analysis of single station cells.

Flexible manufacturing systems: FMS components, FMS application and benefits, Quantitative analysis of flexible manufacturing systems.
Industrial control systems: Sensors, Actuators, Drives and other control system components. Electro-hydraulic and Electro-pneumatics in manufacturing automations
Machine vision systems: Importance of machine vision system in manufacturing automation.
Role of microcontrollers in manufacturing automation system: Microcontroller architecture, interfacing sensors and actuators with microcontroller for industrial automation, Microcontroller programming.
PLCs in manufacturing automation: Application of programmable logic controllers in manufacturing automation, PLC basic and advanced ladder logic programming using RsLogix and CoDeSys format, Usage of timers, counters, sequencing, and interlocking, latching, master control relay for developing programs for manufacturing automation. Temperature control, valve sequencing, conveyor belt control, control of a process etc
SCADA for Automation: Elements of SCADA, Benefits of SCADA, Applications, Types of SCADA systems, Features and functions of SCADA, Building applications using SCADA for manufacturing automation.

References:

1. Grover M.P., “Automation, Production Systems and Computer Integrated Manufacturing”, Pearson Education Asia.
2. Grover M.P., Weiss M. M., Nagel R.N. and Odrey N.G., “Industrial Robotics, Technology, Programming and Applications”, Mc Graw Hill Book Publications.
3. Krishna Kant, “Computer Based Industrial Control” PHI.
4. W. Bolton , “Programmable Logic Controllers” Fifth Edition, Elsevier
5. Vijay R. Jadhav, “Programmable Logic Controller”, Second Edition, Khanna Publishers.

II Sem M.Tech. (Production Management)
Curriculum Content

Course Code: **18EPME706**		Course Title: **Robust Design Optimization**
L-T-P**: 3-0-0**	Credits: **3**	Contact Hrs: **3 hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **40 hrs**		Exam Duration: **3 hrs**

Robust Design Overview: Taguchi's approach to quality and quality loss function, noise factors and average quality loss, exploiting non linearity, classification of parameters

Analysis of variance: No-Way ANOVA, One-Way ANOVA, Two-Way ANOVA and Three-Way ANOVA

Two Level Experiments: Two factor factorial design, model adequacy checking and estimating model parameters, 2^2 full factorial design, 2^3 full factorial design, 2^k full factorial design and Two level fractional factorial design, General 2^{k-p} fractional factorial design.

Steps in Robust Design: Identification of process and its main function, Noise factors and testing conditions, Control factors and their levels, Matrix experiment and data analysis plan, Conducting the experiment and data analysis, Verifying experiment and future plan.

Signal to Noise Ratios: Comparison of the quality of two process conditions, Relationship between Signal to Noise Ratio and quality loss after adjustment, Identification of a scaling factor, Signal to Noise Ratios for static problems, Signal to Noise Ratios for dynamic problems, Analysis of ordered categorical data.

Taguchi Inner and Outer arrays: Orthogonal arrays and fractional factorial designs, Parameter design and tolerance design, Analysis of inner/outer array experiment, Alternative inner/outer orthogonal array experiments.

Constructing orthogonal arrays: Dummy level technique, Compound factor method, Linear graphs and Interaction assignment, Modification of linear graphs, Column merging method, Branching design.

References:

1. Montgomery, D. C., "Design and Analysis of Experiments", John Wiley & Sons.
2. Khuri A. I. and Cornell J. A. "Response Surfaces: Designs and Analyses, Marcel Dekker, Inc., New York.
3. Myers R. H., Montogomery, D. C. and Anderson-Cook C. M. "Response Surface Methodology: Process and Product Optimization Using Designed Experiments", John Wiley & sons, Inc., New York.
4. Mason R. L., Gunst, R. F., Hess J. L., "Statistical design and Analysis of Experiments With Applications to Engineering and SISAnce", John Wiley & sons, Inc., New York.
5. Phadke M. S., "Quality Engineering using Robust Design", Prentice Hall PTR Englewood Cliffs, New Jersy.
6. Ross P. J., "Taguchi Techniques for Quality Engineering", McGraw -Hill International.

II Sem M. Tech. (Production Management)

Curriculum Content

Course Code: **18EPMP704**	Course Title: **Product Automation Lab**
L-T-P**: 0-0-4** Credits: **4**	Contact Hrs: **8 hrs/week**
ISA Marks: **80** ESA Marks: **20**	Total Marks: **100**
Practical Hrs: **96 hrs**	Exam Duration: **2 hrs**

Knowledge Based Engineering:

- Customize the tree to display knowledge ware features
- Create parametric models
- Embed design knowledge in the models
- Automate the design and modification processes
- Create design configurations using design tables

HTML:
Tags, Attributes and Elements, Links, Images, Tables, Forms
CSS: CSS basics, styles, CSS syntax

JavaScript:
JavaScript Output, JavaScript Statements, JavaScript Syntax, JavaScript Variables, JavaScript Operators, JavaScript Arithmetic, JavaScript Strings, JavaScript Events, JavaScript Loop, JavaScript Objects, JavaScript functions.

Python:
Python programming skills using data structures and constructs, python programming skills using functions and packages.

References:

Companion Courses – https://companion.3ds.com/

II Sem M.Tech. (Production Management)

Curriculum Content

Course Code: **18EPMP705**		Course Title: **PLM Technical Lab**
L-T-P**: 0-0-3**	Credits: **4**	Contact Hrs: **6 hrs/week**
ISA Marks: **80**	ESA Marks: **20**	Total Marks: **100**
Lab Hrs: **72 hrs**		Exam Duration: **2 hrs**

Variant Management Essentials & Product Architect:

Create the product structure, Define product portfolios based on product roadmaps, Create and manage product configurations and design variants, Use Enterprise Changes to track and release features, Generate BOMs

Traceable Requirements Management Essentials:

Capture requirements from MS Word and MS Excel documents, Create requirements and requirement specifications, Allocate requirements to products and models, Create test cases and use cases, Create revision and multiple versions of requirements, Generate traceability reports

Platform Management and Baseline Behavior:

Create collaborative spaces and users, Assign required access rights to different users, Explore the Control widget and its related features, Configure PLM platform to add additional features as per requirements

Data Model Customization Essentials:

Describe Unified Typing concepts, Create Subtypes and add attributes to it, Create Specialization, Customer and Deployment Extensions, Create Unique Keys, Create Specialization and Deployment Packages

Web Based Customization:

Use MQL to set up the schema, Create and maintain a web application based on UI configurable components, Configure automatic business rules (triggers, notifications) and automatic object naming, Execute advanced MQL commands needed for administration, Extend the application with JSP

References

1. Companion Courses – https://companion.3ds.com/
2. Stark John, "Product Lifecycle Management: 21st Century Paradigm for Product Realization", Springer, Third Edition, 2015
3. Antti Saakasvuori, Anselmi Immonen, "Product Lifecycle Management" - Springer, 1st Edition, 2003.

II Sem M. Tech. (Production Management)
Curriculum Content

Course Code: **18EPMP706**		Course Title: **ERP Technical Lab**
L-T-P**: 0-0-3**	Credits: **3**	Contact Hrs: **6 hrs/week**
ISA Marks: **80**	ESA Marks: **20**	Total Marks: **100**
Practical Hrs: **72 hrs**		Exam Duration: **2 hrs**

Financial Accounting (Advanced): Fixed assets, Budget, Cost center accounting

MRP: Sales forecast, MRP run, Order recommendation

Admin and Technical: Application installation (APP and DB), System initialization, Set-up, Technical Enhancement – UI, Report – Query generation, Crystal report, Print layout design, Basics of Integration

Reports: Generation of reports for various functions

III Sem M. Tech. (Production Management)
Curriculum Content

Course Code: **18EPMC801**		Course Title: **Manufacturing Execution Systems**
L-T-P**: 3-1-0**	Credits: **4**	Contact Hrs: **5 hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **50 hrs**		Exam Duration: **3 hrs**

Enterprise and Enterprise Integration: Enterprise and its characteristics, Strategic Planning, Feedback Loops, Time Definitions, Business Processes, Manufacturing Processes, Enterprise Integration, Horizontal Integration and Interoperability, Vertical Integration and Temporal Gap, Digitalization, Standards (ISO 15704)

Manufacturing Execution Systems and its Functionalities: Manufacturing Execution Systems (MES), MES Functionalities, MES Models, Manufacturing Operations Management (MOM), Functional Control Model, MES in Discrete Industry, MES in Process Industry, Standards (IEC 62264, IEC 61512, VDI 5600)

Process and Data Modeling: Enterprise Modeling, Process Modeling, Business Process Modeling Language (BPMN), Sankey Diagram, Entity-Relationship Diagrams, ARIS (ARchitecture for integrated Information Systems), Integrated Definition for Function Modelling (IDEF), Event-Driven Process Chain (EPC), Data Modeling, Data Flow Diagrams (DFDs), Unified Modeling Language (UML), Business to Manufacturing Markup Language (B2MML)

Data Collection: Process Analysis, Process Modeling, Data Modeling, Data Flow Diagrams (DFDs), Communication Patterns, Technologies, OPC (OLE for Process Control)

Traceability And Tracking: Tracing, Traceability, Enterprise Entities, Forward and Backward Traceability, Traceability Granularity, Tracking, Tracking Approaches, Regulations (GMP, US FDA, EudraLex)

PERFORMANCE MEASUREMENT: Performance Measurement, Performance Management, Performance Measurement System and Characteristics, Key Performance Indicators (KPIs), Overall Equipment Effectiveness (OEE), Metrics Maturity Model, KPI Effectiveness, Process Improvement, Standards (ISO 22400, VDMA 66412)

Managerial Accounting: Managerial Accounting, Cost Assignment Techniques, Cost Hierarchal Levels, Activity Drivers, Standard Cost, Actual Cost, Job Costing, Process Costing, Activity-Based Costing (ABC), Time-Driven ABC (TDABC), Resource Consumption Accounting (RCA), Cost of Poor Quality (COPQ)

Real-Time Enterprise: Real-Time Enterprise (RTE), Event-Driven Architecture (EDA), Events, Complex Event Processing (CEP)

Industry 4.0: Industry 4.0, Challenges, Industrial Internet of Things (IIoT), Reference Architecture for Industry 4.0, Cyber-Physical Systems (CPS), Cyber-Physical Production Systems (CPPS), Smart Product, Smart Manufacturing, Smart Logistics, Smart Services

Business Analytics and Business Intelligence, Blockchain: Knowledge Management, Case-Based Reasoning (CBR), Big Data, Decision Analytics, Descriptive Analytics, Predictive Analytics, Prescriptive Analytics, Bitcoin and Blockchain, Merkle Tree, Blockchain Types, Scope and Application of Blockchain in Manufacturing

References:

1. Sachin Karadgi, "A Reference Architecture for Real-Time Performance Measurement," Springer, 2014.
2. Opher Etzion, Peter Niblett, "Event Processing in Action," Manning, 2011.
3. Roger Wattenhofer, "The Science of the Blockchain," CreateSpace Independent Publishing Platform, 2016.
4. Bruce Silver, "BPMN Method and Style - With BPMN Implementer's Guide," Cody-Cassidy Press, 2011.
5. Charles T. Horngren, George Foster, Srikant M. Datar, Madhav V. Rajan, Chris Ittner, "Cost Accounting: A Managerial Emphasis," Prentice Hall, 13th Edition, 2008.
6. Wood C. Douglas (Editor), "Principles of Quality Costs: Financial Measures for Strategic Implementation of Quality Management," ASQ, 4th Edition, 2013.
7. Gary Cokins, "Activity-Based Cost Management: An Executive's Guide," Wiley, 2001.
8. Robert S. Kaplan, Robin Cooper, "Cost & Effect: Using Integrated Cost Systems to Drive Profitability and Performance," Harvard Business Review Press, 3rd edition, 1997.
9. ISO 15704: Industrial Automation Systems—Requirements for Enterprise-Reference Architectures and Methodologies, 2000.
10. IEC 62264: Enterprise-Control System Integration. Multi—part standard.
11. IEC 61512: Batch Control. Multi—part standard.
12. ISO 22400–2: Automation Systems and Integration—Key Performance Indicators for Manufacturing Operations Management, Multi—part standard.
13. VDI 5600 Part 1: Manufacturing execution systems (MES), 2007.
14. OPC Foundation: OPC unified architecture specification part 1: overview and concepts, http://www.opcfoundation.org/.
15. MESA, MES Explained: A high level vision, white paper number 6, 1997.GMP
16. WHO Good Practices for Pharmaceutical Quality Control Laboratories, WHO Technical Report Series, No. 957, 2010.
17. Mike Bourne, Pippa Bourne, Handbook of Corporate Performance Management, Wiley, 2011.

III Sem M. Tech. (Production Management)

Curriculum Content

Course Code: **18EPMC802** Course Title: **Manufacturing Systems Simulation**
L-T-P**: 3-0-1** Credits: **4** Contact Hrs:**5 hrs/week**
ISA Marks: **50** ESA Marks: **50** Total Marks: **100**
Teaching Hrs: **50 hrs** Exam Duration: **3 hrs**

Principles of Modeling & Simulation: Basic Simulation Modeling, Systems – discrete and continuous systems, general systems theory, models of systems- variety of modeling approach, concept of simulation, simulation as a decision making tool, types of simulation, Principle of computer modeling- Monte Carlo simulation, Nature of computer modeling, limitations of simulation, area of application.

Random Number Generation: Random variables and their properties, Properties of random numbers, generation of Pseudo random numbers, techniques for generating random numbers, Various tests for random numbers-frequency test and test for Autocorrelation,

Random Variate Generation: Different techniques to generate random Variate: Inverse transform technique,-exponential, Normal, uniform, Weibull, direct transformation technique for normal and log normal distribution, convolution method and acceptance rejection techniques-Poisson distribution, **Statistical Techniques:** Comparison of two system designs, Comparison of several system designs – Bonferroni approaches to multiple comparisons for selecting best fit, for screening

Design and Evaluation of Simulation Experiments: Problem formulation, data collection and reduction , time flow mechanism, key variables, logic flow charts, starting condition, run size, experimental design consideration, output analysis, verification and validation of simulation models. **Simulation Languages:** Comparison and selection of simulation languages, study of any one simulation language.

Discrete Event Simulation: Concepts in discrete –event simulation, development of simulation models for queuing systems, production systems, inventory systems, maintenance and replacement systems, investment analysis and network, Programming for discrete event simulation, Case studies.

References:

1. Jerry Banks and John S Carson, Barry L Nelson, David M Nicol, "Discrete event system simulation", Prentice Hall, India.
2. Khoshnevi. B., "Discrete system simulation", McGraw Hill International.
3. Ronald G Askin and Charles R Standridge , "Modeling and analysis of manufacturing systems", John Wiley & Sons.
4. Gordon G , "System Simulation", Prentice Hall, India..
5. Thomas J Schriber., "Simulation using GPSS", John Wiley & Sons.
6. Shannon, R.E., "System Simulation – The art and science", Prentice Hall, India.
7. Averill Law & David M.Kelton , "Simulation, Modeling and Analysis", TMH.

II Sem M. Tech. (Production Management)
Curriculum Content

Course Code: **19EPMW701**		Course Title: **Mini Project**
L-T-P**: 0-0-3**	Credits: **3**	Contact Hrs: **6 hrs/week**
ISA Marks: **80**	ESA Marks: **20**	Total Marks: **100**
Teaching Hrs: **72 hrs**		Exam Duration: **2 hrs**

Mini Project: The Guide shall define the problem statement for the Project work. The student shall execute the Project within three months duration during the 2nd semester. The student who has opted Mini Project shall opt either ERP or PLM theme to carry out their work.

Course Content

Course Code: 15EEEC201 **Course Title: Circuit Analysis**

L-T-P: 4-0-0 **Credits: 4** **Contact Hrs: 50**

CIE Marks: 50 **SEE Marks: 50** **Total Marks: 100**

Teaching Hrs: 50 **Exam Duration: 3 hrs**

Content	Hrs
Unit - 1	
Chapter No. 1.Network Equations Source Transformation, Star Delta transformation, Nodal Analysis, Super node, Mesh Analysis, Super mesh, Duality, Network Topology, Tie Set and Cut Set matrix formulation, Dot convention.	8 hrs
Chapter No. 2.Network Theorems Homogeneity, Superposition and Linearity, Thevenin's & Norton's Theorems, Maximum Power Transfer Theorem, Milman's theorem, Reciprocity principle, Application of theorems to both ac and dc networks	8 hrs
Chapter No. 3.Sinusoidal Steady state analysis Characteristics of sinusoids, Forced response to sinusoidal functions, The complex forcing function, Phasors & Phasor diagrams.	4 hrs
Unit - 2	
Chapter No. 4.First order circuits Order of a system, Concept of Time constant, System Governing equation, System Characteristic equation, Basic RL & RC circuit, Transient response with initial conditions , Frequency response characteristics, R-C , R-L circuits as differentiator and integrator models, time and frequency domain responses R-C , R-L circuits as Low pass and high pass filters	8 hrs
Chapter No. 5.Higher order circuits Higher order R-C, R-L, and R-L-C networks, time domain and frequency domain representation, Series R-L-C circuit, Transient response, Damping factor, Quality factor, Frequency response curve , Peaking of frequency curve and its relation to damping factor, Resonance Parallel, R-L-C circuit, Tank circuit, Resonance, Quality factor and Bandwidth	12 hrs
Unit - 3	
Chapter No. 6.Two Port Networks Two port variables, Z,Y, H,G, A- Parameter representations, Input and output impedance calculation, Series, Parallel and Cascade network connections, and their (suitable) models.	5 hrs
Chapter No. 7.Polyphase Circuits Polyphase systems, Single Phase three wire system, Three phase Y-Y connection, Delta connection, Analysis of balanced & unbalanced three phase circuits.	5 hrs

Text Book (List of books as mentioned in the approved syllabus)

1. W H Hayt, J E Kemmerly, S M Durban, Engineering Circuit Analysis, 6th, McGraw Hil, 2006
2. M E. Van Valkenburg, Network Analysis, 3rd, Pearson Ed, 2006

References

1. Joseph Edminister, Mahmood Nahavi, Electric Circuits, 3rd, Tata McGra, 1991
2. Bruce Carlson, Circuits, 3rd, Thomson Le, 2002
3. V. K. Aatre, Network Theory and Filter Design, 2nd, Wiley West, 2002
4. Anant Agarwal and Jeffrey H Lang, Foundations of Analog & Digital Electronics Circuits, 3rd, Morgan Kau, 2006
5. Muhammad H . Rashid, Introduction to PSPICE using OrCAD for circuits and Electronics, 3rd, Pearson Ed, 2005

Course Title: Analog Electronic Circuits **Course Code:15EEEC202**
L-T-P-SS: 4-0-0 **Credits: 4** **Contact Hours: 4Hrs/week**
CIE Marks: 50 **SEE Marks: 50** **Total Marks: 100**
Teaching Hours: 50Hrs **Examination Duration: 3Hrs**

Unit I **Chapter 1: Applications of a Junction diode:** Recap of piece-wise linear model, constant voltage drop model, ideal diode model, small signal model. Applications of diodes as a Clipping circuit and clamping circuits Voltage doubler.	06Hrs
Chapter 2: MOSFETs structure and physical operation: Device structure, operation with no gate voltage, creating a channel for current flow, applying small vds, operation as vds is increased, derivation of the id-vds relationship, the P-channel mosfet, complementary mos or cmos, operating the mos transistor in the sub threshold region. Current-voltage characteristics: circuit symbol, the id vs vds characteristics, finite output resistance in saturation, characteristics of the p-channel mosfet, the role of the substrate-the body effect, temperature effects, breakdown and input protection. MOSFET circuits at DC.	12 Hrs
Unit II **Chapter 3:Current mirrors** Basic current mirror, Widlar, Cascode and Wilson : Output impedance and Voltage swing**.**	08 Hrs
Chapter 4: MOSFET amplifiers : Biasing in MOS amplifier circuits, small signal operation and models, single stage mos amplifiers, the MOSFET internal capacitance and high frequency model, frequency response of CS amplifier.(CD and CG), Cascode Connection: Implications on gain and Bandwidth	12 Hrs
Unit III **Chapter 5: Feedback Amplifiers :** General feedback structure (Block schematic), Feedback desensitivity factor, positive and negative feedback Nyquist stability Criterion, RC phase shift oscillator, wein bridge oscillator, merits of negative feedback, feedback topologies: series-shunt feedback amplifier, series-series feedback amplifier, and shunt-shunt and shunt-series feedback amplifier with examples	06 Hrs
Chapter 6: Large Signal Amplifiers : Classification of amplifiers: (A, B, AB and C); Transformer coupled amplifier, push-pull amplifier Transistor case and heat sink.	06 Hrs

Text Books

1. A.S. Sedra & K.C. Smith, "Microelectronic Circuits", 5th Edition, Oxford Univ. Press, 1999.
2. Jacob Millman and Christos Halkias, “Integrated Electronics”, McGraw Hill,

References

1. David A. Bell, “Electronic Devices and Circuits” 4thedition , PHI publication 2007.
2. Grey, Hurst, Lewis and Meyer, “Analysis and design of analog integrated circuits,” 4thedition.
3. Thomas L. Floyd, “Electronic devices”, Pearson Education, 2002
4. Richard R. Spencer & Mohammed S. Ghousi, “ Introduction to Electronic Circuit Design”, Pearson Education, 2003
5. J. Millman & A. Grabel, "Microelectronics"-2nd edition, McGraw Hill, 1987.
6. Behzad Razavi, “Fundamentals of Microelectronics”, reprint 2015 Wiley publications.

Course Content

Course Code: 15EEEC203 **Course Title: Digital Electronics**

L-T-P : 4-0-0 **Credits: 4** **Contact Hrs: 40**

CIE Marks: 50 **SEE Marks: 50** **Total Marks: 100**

Teaching Hrs: 50 **Exam Duration: 3 hrs**

Content	
Unit I **Chapter 1:** Logic Families: Logic levels, output switching times, fan-in and fan-out, comparison of logic families	03Hrs
Chapter 2: Principles of Combinational Logic: Definition of combinational logic, canonical forms, Generation of switching equations from truth tables, Karnaugh maps-3,4 variables, Incompletely specified functions(Don't care terms),Simplifying Maxterm equations, Quine-McCluskey minimization technique- Quine-McCluskey using don't care terms, Decimal method, Reduced Prime Implicant Tables.	08 Hrs
Chapter 3: Analysis and design of combinational logic: General approach, Decoders-BCD decoders, Encoders, Digital multiplexers- Using multiplexers as Boolean function generators. Adders and subtractors-Cascading full adders, Look ahead carry adders, Binary comparators.	09 Hrs
Unit II **Chapter 4:** Flip Flops and its applications: Basic Bistable Element, Latches, A SR Latch, Application of SR Latch, A Switch De bouncer, The SR Latch, The gated SR Latch, The gated D Latch, The Master-Slave Flip-Flops (Pulse-Triggered Flip-Flops): The Master-Slave SR Flip-Flops, The Master-Slave JK Flip-Flop, Edge Triggered Flip-Flop: The Positive Edge-Triggered D Flip-Flop, Negative-Edge Triggered D Flip-Flop; Characteristic Equations.	10Hrs
Chapter 5: Analysis of Sequential Circuits: Registers and Counters, Binary Ripple Counters, Synchronous Binary counters, Ring and Johnson Counters, Design of a Synchronous counters, Design of a Synchronous Mod-n Counter using clocked JK Flip-Flops Design of a Synchronous Mod-n Counter using clocked D, T or SR Flip-Flops.	10Hrs
Unit – III **Chapter 6:** Introduction to Sequential Circuit: Introduction to Sequential Circuit Design, Mealy and Moore Models, State Machine notations, Synchronous Sequential Circuit Analysis, Construction of state Diagrams and counter design.	05Hrs
Chapter 7: Introduction to Memories: Introduction and role of memory in a computer system, memory types and terminology, Read Only memory, MROM, PROM, EPROM, EEPROM, Random access memory, SRAM, DRAM, NVRAM.	05Hrs

Text Book

1. Donald D Givone, Digital Principles and Design, Tata McGraw Hill Edition, 2002.
2. John M Yarbrough, Digital Logic Applications and Design, Thomson Learning, 2001.
3. M. Raffiquzzman&Rajan Chandra, Modern Computer Architecture, Galgotia Publications, 1990.
4. David Patterson and John Hennessy, Computer Organization and Design, Elsevier, 2007.

References

1. Charles H Roth, Jr; Fundamentals of Logic Design, Thomson Learning, 2004.
2. ZviKohavi, Switching and Finite Automata Theory, 2ed, TMH
3. Mono and Kim, Logic and Computer Design Fundamentals, Pearson, 2ed, 2001
4. David Harris Money and Sarah Harris, Digital Design and Computer Architecture, Morgan Kaufman, 2007.

Course Code: 15EEEC204 **Course Title: Electrical Machines -I**

L-T-P : 3-0-0 **Credits: 3** **Contact Hrs: 40**

CIE Marks: 50 **SEE Marks: 50** **Total Marks: 100**

Teaching Hrs: 40 **Exam Duration: 3 hrs**

Content	Hrs
Unit - 1	
Chapter No. 1 Magnetic Circuits and Induction Introduction, Magnetic circuits, Magnetic Materials and Their Properties, Magnetically Induced EMF and Force, AC Operation of Magnetic Circuits, Hysteresis and Eddy – Current Losses, Permanent Magnets, Application of Permanent Magnet Materials.	5 hrs
Chapter No. 2 Single Phase Transformers Introduction, Transformer Construction and Practical Considerations, Transformer on No-Load, Ideal Transformer, real Transformer and Equivalent Circuit, Transformer Losses, Transformer Testing, The Per Unit System, Efficiency and Voltage Regulation, Excitation Phenomenon in Transformers, transformer as a Magnetically Coupled Circuit. Autotransformers.	10 hrs
Unit - 2	
Chapter No. 3 Three Phase Transformer Three Phase transformers, Parallel operation of transformers, Three – Winding transformers, Phase Conversion, Tap Changing Transformers, Voltage and Current Transformers.	5 hrs
Chapter No. 4 Principles of Electromechanical Energy Conversion Introduction, Energy in Magnetic System, Field Energy and Mechanical Force, Multiply – Excited Magnetic Field Systems, Forces/Torques in Systems with Permanent Magnets, Energy Conversion via Electric Field.	6 hrs
Chapter No. 5 DC Generators Introduction, Armature Winding and Commutator, EMF and Torque, Circuit Model, Armature Reaction, Compensating Winding, Commutation, Methods of Excitation, Operating Characteristics of dc generator, Self – Excitation, Characteristics of dc generator, Shunt Generator – Predetermination of External Characteristic, Parallel Operation of dc generators,	4 hrs
Unit - 3	
Chapter No. 6 DC Motors Characteristics of dc Motors, Starting of dc Motors, Braking of dc Motors, Efficiency and Testing, Testing of dc Machines, Permanent Magnet dc (PMDC) Motors, DC Machine Applications, Starters.	5 hrs
Chapter No. 6 Speed Control Speed control by varying armature circuit resistance, varying field current, varying armature terminal voltage.	5 hrs

Text Book:

1. A E Fizgerald , Charles Kingsley, Jr Stephen D. Umans , Electric machinery , 6th edition, TMH, 2012.
2. D. P. Kothari and I. J. Nararath, Electrical Machines, 4, MGH, 2011
3. P. C. Sen, Principles of Electric Machines and Power Electronics, 2, John Wiley, 2001

References

1. Bhimbra, Principles of Electric machinery, 3, Khanna, 2006

Course Title: Microcontroller Architecture & Programming **Course Code: 15EEEP201**

L-T-P: 0-1-1 **Credits: 2** **Contact Hours: 4Hrs/week**

CIE Marks: 80 **SEE Marks:20** **Total Marks: 100**

Teaching + Lab. Hours: 48Hrs **Examination Duration:3 Hrs**

1.	**Overview of Architecture of 8051:** • Processor Core and Functional Block Diagram • Description of memory organization • Overview of ALL SFR's and their basic functionality	02+02 Hrs
2.	**Low Level programming Concepts:** • Addressing Modes • Instruction Set and Assembly Language programming(ALP) • Developing, Building, and Debugging ALP's	02+02 Hrs
3.	**Middle Level Programming Concepts:** • Cross Compiler • Embedded C language implementation, programming, & debugging • Differences from ANSI-C • Memory Models • Library reference • Use of directives • Functions, Parameter passing and return types	04+04Hrs
4.	**On-Chip Peripherals Study,Programming, and Application:** • Ports: Input/Output • Timers & Counters • UART • Interrupts	04+04Hrs
5.	**External Interfaces Study,Programming and Applications :** • LEDS • Switches(Momentary type, Toggle type) • Seven Segment Display: (Normal mode, BCD mode,Internal Multiplexing & External Multiplexing) • LCD (8bit, 4bit, Busy flag, custom character generation) • Keypad Matrix	04+04Hrs
6.	**Selective Discussion during Project Development** • A/D & D/A Converter • Stepper Motor, DC Motor • ZIGBEE • GSM/GPS • USB • MMC & SD • Ethernet MAC	08+08Hrs

Text Book*Text Books:*

1. Kenneth J. Ayala ; "The 8051 Microcontroller Architecture, Programming & Applications" 2e, Penram International, 1996 / Thomson Learning 2005
2. Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D. McKinlay; "The 8051 Microcontroller and Embedded Systems – using assembly and C "- PHI, 2006 / Pearson, 2006

References Books:

1. Predko ; "Programming and Customizing the 8051 Microcontroller" –, TMH
2. Raj Kamal, "Microcontrollers: Architecture, Programming, Interfacing and System Design", Pearson Education, 2005
3. Ajay V.Deshmukh; "Microcontrollers- Theory and Applications",TMH,2005
4. Dr.RamaniKalpathi and Ganesh Raja; "Microcontroller and its applications", Sanguine Technical publishers,Bangalore-2005

Course Title: Analog Electronics Laboratory **Course Code: 15EEEP202**
L-T-P: 0-0-1 **Credits: 1** **Contact Hours: 2Hrs/week**
CIE Marks: 80 **SEE Marks: 20** **Total Marks: 100**
Laboratory Hours: 28Hrs **Examination Duration: 3Hrs**

List of Experiments:

1. Design &Testing of Diode Clipping (single/double ended) circuits
2. Design &Testing of Clamping circuits for Positive and Negative Clamping.
3. Design of RC Coupled single stage FET/BJT amplifier &determination of the gain – frequency response, I/P & O/P impedance.
4. MOSFET characteristics
5. Design of single stage CS (MOSFET) amplifier &determination of the gain – frequency response.
6. Design of source follower using MOSFET.
7. Design and testing Current mirror circuit MOSFET
8. Design of two stage voltage series feed-back amplifier & determination of the gain, frequency response, i/p &o/p impedance with &without feedback
9. Design and testing of Transformer-less push-pull class B power amplifier
10. Design of Darlington Emitter follower with and without Bootstrapping and determines the gain, i/p and o/p impedance.

Reference Books

1. “Electronic Devices & circuit Theory “ by Nashelsky & Boylstead,PHI,9th Ed
2. “Integrated Electronics“ By ‘Jacob Millman and Christos Halkias’,McGraw Hill,
3. “Electronic Principles” by A.P. Malvino, TaTa MGH,5th Ed

Course Title: Digital Electronics Laboratory **Course Code: 15EEEP203**
L-T-P: 0-0-1 **Credits: 1** **Contact Hours: 2Hrs/week**
CIE Marks: 80 **SEE Marks: 20** **Total Marks: 100**
Laboratory Hours: 28Hrs **Examination Duration: 3Hrs**

List of Experiments:

1. Characterization of TTL & CMOS Gates– Propagation delay, Fan-in, Fan-out and Noise Margin.
2. Design and implement binary to gray, gray to binary, BCD to Ex-3 and Ex-3 to BCD code converters.
3. Design and implement BCD adder and Subtractor using 4 bit parallel adder.
4. Design and implement given functionality using decoders and multiplexers.
5. Design and implement n bit magnitude comparator using 4- bit comparators.
6. Design and implement Ring and Johnson counter using shift register.
7. Design and implement mod-6 synchronous and asynchronous counters using flip flops.
8. Design and implement a digital system to display a 3 bit counter on a 7 segment display. Demonstrate the results on a general purpose PCB.
9. Design and implement 1-bit serial adder. Demonstrate the results on a general purpose PCB.

Reference Books

1. Books/References: 1. K.A.Krishnamurthy “Digital lab primer”, Pearson Education Asia Publications, 2003.
2. **“**Electronic Principles” by A.P. Malvino, TaTa MGH,5th ED

Course Code: 15EEEC205 **Course Title: Electrical machines-II**

L-T-P-SS: 3-0-0-0 **Credits: 3** **Contact Hrs: 40**

CIE Marks: 50 **SEE Marks: 50** **Total Marks: 100**

Teaching Hrs: 40 **Exam Duration: 3 hrs**

Content	Hrs
Unit - 1	
Chapter No. 1 Synchronous Machines Introduction, Basic Synchronous Machine Model, Circuit Model of Synchronous Machine, Determination of the Synchronous Reactance, MMF Method, Determination of Armature Reaction Ampere-Turns and Leakage Reactance of a Synchronous Machine – Potier Method, Nature of Armature Reaction, Synchronizing to Infinite Bus – Bars, Operating Characteristics, Efficiency of Synchronous Machines,	9 hrs
Chapter No. 2 Synchronous Machines - continued Power Flow (Transfer) Equations, Capability Curve of Synchronous Generator, Salient –Pole Synchronous Machine Two – Reaction Model, Staying in Synchronizm – The Synchronizing Power (Torque), Determination of X_D and X_Q – Slip Test, Parallel Operation of Synchronous Generators, Hunting in Synchronous Machines, Starting of Synchronous Motors, Short – Circuit transient in Synchronous Machine, Single – Phase Synchronous Generators, Brushless DC Motors	6 hrs
Unit - 2	
Chapter No. 3 Induction Machine Introduction, Construction, Flux and MMF Waves in Induction Motor – Principles of Operation, Development of Circuit Model (Equivalent Circuit), Power Across Air – Gap, Torque and Power Out Put, Tests to determine Circuit – Model Parameters, The Circle Diagram (Approximate),	09 hrs
Chapter No. 4 Speed Control of Induction Motors: Starting, Cogging and Crawling, Speed Control, Deep – bar/Double – Cage Rotor, Classes of Squirrel – Cage Motors, Induction Generator, Induction Machine Dynamics Acceleration Time, Inverted Induction machine, High Efficiency Induction Motors, Linear Induction Motor.	6 hrs
Unit - 3	
Chapter No. 5 Single Phase Induction Motor Introduction, Single Phase Induction Motors, Circuit Model of single – Phase Induction Motor, Types of single phase induction motors, Balanced 2-phase Motor Fed from Unbalanced Supply.	5 hrs
Chapter No. 6 Special Motors Stepper Motors, Series Motor (Universal Motor), Reluctance Motors, Hysteresis Motors, Speed Control.	5 hrs

Text Book:

1. A E Fizgerald , Charles Kingsley, Jr Stephen D. Umans, Electric machinery , 6th edition, TMH, 2012.
2. D. P. Kothari and I. J. Nararath, Electrical Machines, 4, MGH, 2011
3. P. C. Sen, Principles of Electric Machines and Power Electronics, 2, John Wiley, 2001

References

1. Bhimbra, Principles of Electric machinery, 3, Khanna, 2006

Course code: 15EEEC206 **L-T-P: 4-0-0**
Course title: Linear Control Systems **CIE: 50**
Teaching hours: 50 **SEE: 50**

	Unit-I	
1	**Introduction to control systems**: Open loop and closed loop control systems-definitions, salient features and simple examples	3 Hours
2	**Transfer function Models and block diagram representation:** Definition of transfer function, assumptions and properties, Block diagram representation**,** symbols used. Block-diagram of negative and positive feedback systems. Electrical systems: Derivation of transfer functions for electrical circuits. Mechanical translation and rotational systems: Basic elements of mechanical systems, Transfer functions of mechanical translation systems. Models of dc servomotors-armature and field control, block-diagram representation. Bock diagram reduction rules, Examples. Signal flow graphs-definition of terms, Mason's gain formula.	13 Hrs
3	**Introduction to Time-domain Analysis** Poles and Zeros, Type and order, Standard test signals. First order system: unit step response, importance of time constant.	4 Hrs
	Unit-1I	
4	**Time Response Specifications** Second order system: Standard T.F of second order system. Unit step response of 2nd order system Time response specifications-definition. Expressions for rise time, peak time, peak overshot and settling time, Static error constants and steady-state errors.	5 Hrs
5	**Stability Analysis of control systems:** Explanation of Routh-Hurwitz criterion-necessary and sufficient condition for stability, special cases, Absolute and Relative stability, relative stability analysis.	5 Hrs
6	**Controller design approaches:** Basic modes of controls and their features: On-Off, proportional, integral, PI, PD and PID, Controller design approaches- Zeigler Nichol's tuning method and Pole placement design method, design examples	5 Hrs
7	**Frequency response analysis:** Sinusoidal response: system response for sinusoidal inputs**,** sinusoidal transfer functions. Frequency response of a second order system, definitions and expressions of Frequency response specifications. Polar plot: method to draw approximate polar plot, definition of phase and gain margin.	5 Hrs
	Unit-III	
8	**Bode plot analysis of control systems:** Bode plots: asymptotic plots for basic factors, method to draw Bode asymptotic plot and phase plot, determination of gain and phase margins from Bode plot.	5 Hrs
9	**Root locus diagrams:** Basic principle – magnitude and angle criterion, Rules to construct root locus diagram (proof not required), method to construct root locus diagram.	5 Hrs

Text Books:

1. Nagarath and Gopal, *Control system Engineering*, Wiley Eastern Ltd., 1995, 2nd edition.
2. Katsuhiko Ogata, *Modern Control Engineering*, PHI, 2002, 4th edition

Reference Book:

1. M. Gopal, Control Systems-Principles and Design, TMH 2002, 2nd edition

Course Code: **15EEEC207** Course Title: **ARM Processor & Applications**
L-T-P-SS: **4-0-0-0** Credits: **4** Contact Hours:**4 Hrs/week**
CIE Marks: **50** SEE Marks:**50** Total Marks: **100**
Teaching Hours:**50Hrs** Examination Duration:**3Hrs**

Content	Hrs
Unit - 1	
Chapter No.1 Interrupt programming 8051-Interrupts and programming (both assembly and 'C'): Interrupts for timer and serial communication.	5 hrs
Chapter No.2 ARM Architecture The Acorn RISC machine, Architectural inheritance, Architecture of ARM7TDMI, ARM programmers model, ARM development tools, 3 stage pipeline ARM organization, ARM instruction execution.	5 hrs
Chapter No.3 Introduction to ARM instruction set Data processing instruction, Branch instruction, Load store instruction, Software interrupt instruction, Program status register instruction, Conditional execution, Example programs.	5 hrs
Unit - 2	
Chapter No.4 Introduction to THUMB instruction set The Thumb programmer model, ARM-Thumb interworking, other branch instructions, Data processing instructions, Single/Multiple register load store instruction, Stack operation, Software interrupt instructions, example programs.	2 hrs
Chapter No.5 Assembler rules and Directives Introduction, structure of assembly language modules, Predefined register names, frequently used directives, Macros, Miscellaneous assembler features. Example programs.	4 hrs
Chapter No.6 Exception handling Introduction, Interrupts, error conditions, processor exception sequence, the vector table, Exception handlers, Exception priorities, Procedures for handling exceptions.	4 hrs
Chapter No.7 Architectural support for high level languages Abstraction in software design, data types, floating point data types, The ARM floating point architecture, use of memory, run time environment.	5 hrs
Unit - 3	
Chapter No.8 LPC2148 Architecture and applications On-chip memory, GPIOs, Timers, UART, ADC, I2C, SPI , RTC, ARM interfacing techniques and programming: LED, LCD, Stepper Motor, Buzzer, Keypad, ADC and I2C	10 hrs

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Text Books (List of books as mentioned in the approved syllabus)

1.	Steve Furber, ARM System- on-Chip Architecture, 2nd, LPE, 2002
2.	William Hohl, ARM Assembly Language fundamentals and Techniques, 1st, CRC press, 2009

References

- “ARM system Developer’s Guide”- Hardbound, Publication date: 2004 Imprint: MORGAN KAUFFMAN
- User manual on LPC21XX.

Course Content

Course code: 15EEEC208 **L-T-P: 3-0-0**
Course title: Electrical Power Generation, Transmission & Distribution **CIE: 50**
Teaching hours: 40 **SEE: 50**

Chapter 1 : Selection of site, Classification, General arrangement and operation of Hydro electric plant with Components, General arrangement and operation of Thermal power plant with Components, General arrangement and operation of Nuclear power plant with Components, Safety of Nuclear power reactor, Storing and processing spent fuel	**5hrs**
Chapter 2: Substations: Types, bus-bar arrangement, schemes, location, substation equipments. **Economics:** Important terms and curves commonly used in system operation, Effect of Voltage and frequency on Loads, Scheduling of Generators, Choice of size and number of generator units, Interconnection of power stations.	**5hrs**
Chapter3: Introduction, electrical supply system, comparison of AC & D.C. Systems, Standard Voltages of Transmission & Distribution, Advantages of High Voltage Power Transmission, (effect of increase in voltage on weight of conductor, Line Efficiency & Line Voltage Drop). Feeders, Distributors & Service Mains, Conductors types.	**2hrs**
Chapter4: Line supports & placing of the conductors, single phase and three phase systems. Single circuit and double circuit, Spacing of conductors, Length of span & Sag in OH lines. Sag calculation in conductors (a) Suspended on level supports (b) Supports at different levels, Effect of wind and ice. Tension and sag. Corona: Phenomena, expression for disruptive and visual critical voltages and corona power loss.	**3hrs**
Unit – II	
Chapter 5:Line parameters Introduction to transmission line constants i.e. Resistance, Inductance and capacitance, Inductance of the single phase & three phase lines, Inductance calculation with equilateral and unsymmetrical spacing of the lines, Transposition of line conductors. Capacitance for single phase & three phase lines, Effect of earth on capacitance of the line, Numerical solutions on resistance calculations.	**7hrs**
Chapter 6: **Characteristics & Performance of Power transmission lines:** Introduction to Short transmission lines, calculations for short lines, Medium transmission lines, Nominal-T and ∏ representation for transmission lines, Long transmission lines, Long line solutions by Rigorous method, equivalent models, ABCD constants,	**8hrs**
Unit – III	
Chapter 7: Insulators: Types, potential distribution over a string of suspension insulators. String efficiency and methods of increasing string efficiency and methods of increasing string efficiency, testing of insulators.	**5 hrs**
Chapter 8:Underground Cables: Types, material used. Insulation resistance, thermal rating of cables, charging current. Grading of cables, capacitance grading and inter sheath grading, testing of cables.	**5 hrs**

Text Book:

1. Power Station Engineering and Economics by Skrotzki and Wavopat, McGraw Hill, 1995

Reference Books:

1. Principles of Power system By: V.K. Mehta & Rohit Metha. S. Chand & Company, LTD. 2014
2. A course in Electrical Power By: Soni, Gupta & Bhatnagar. Dhanpat rai Publications .2014
3. Transmission & Distribution of Electrical Power By J.B.Gupta. SK Kataria, Publication
4. Electric Power Generation Transmission and Distribution by S. M. Singh, by Prentice Hall of India, Regd. Office: d 13/12, Model Town, Delhi

Course Title: Machines lab **Course Code: 15EEEP204**
L-T-P: 0-0-1 **Credits: 1** **Contact Hours: 2Hrs/week**
CIE Marks: 80 **SEE Marks: 20** **Total Marks: 100**
Laboratory Hours: 28Hrs **Examination Duration: 3Hrs**

Category: Demonstration	
Expt. No.	**Experiment**
1	Introduction to meters and machines
Category: Exercise	
Expt. No.	**Experiments**
2	No Load/Load characteristics of DC Generators
3	Speed control of DC motor by armature voltage control and flux control
4	Three Phase transformer Bank with STAR-STAR connection mode demonstration
5	To Conduct Open Circuit and Short Circuit test on given single phase transformer and a) Calculate Voltage regulation at different loads & power factors. b) To represent the transformer by its equivalent circuit.
6	Speed control of Induction motor by a) Stator Voltage control. b) Rotor resistance control.(SRIM)
7	To Conduct NO – LOAD & BLOCKED ROTOR test on a given Induction motor and a) Represent the motor by its equivalent circuit referred to Stator or Rotor. b) To find the performance parameters
8	Performance study of synchronous motor with change in its excitation (V and Inverted V curves)
9	Voltage regulation of an Alternator by EMF method
Category: Open Ended	
Expt. No.	**Experiment**
1	Open delta connection of a three phase transformer **OR** Voltage regulation of an alternator by direct loading **OR** Load test on DC series motor **OR** Determination of x_d and x_q of synchronous machines

Course Title: ARM Microcontroller Lab **Course Code: 15EEEP205**
L-T-P: 0-0-1 **Credits: 1** **Contact Hours: 2Hrs/week**
CIE Marks: 80 **SEE Marks: 20** **Total Marks: 100**
Teaching Hours: 25Hrs **Examination Duration: 2 Hrs**

Chapter No.	**List of Experiments**
1	Write an ALP to achieve the following arithmetic operations: i. 32 bit addition ii. 64 bit addition iii. Subtraction iv. Multiplication v. 32 bit binary divide
2	Write an ALP for the following using loops: i. Find the sum of 'N' 16 bit numbers ii. Find the maximum/minimum of N numbers iii. Find the factorial of a given number with and without look up table.
3	Write an ALP to i. Find the length of the carriage r1eturn terminated string. ii. Compare two strings for equality. ii.
4	Write an ALP to pass parameters to a subroutine to find the factorial of a number or prime number generation.
5	Write a 'C' program to test working of LED's using LPC2148.
6	Write a 'C' program & demonstrate an interfacing of Alphanumeric LCD 2X16 panel to LPC2148 Microcontroller.
7	Write an ALP to generate the following waveforms of different frequencies i. Square wave ii. Triangular iii. Sine wave II.Write a 'C' program & demonstrate interfacing of buzzer to LPC2148(using external interrupt)
8	Write a program to set up communication between 2 microcontrollers using I2C.
9	Write a 'C' program & demonstrate an interfacing of ADC.
Structured Enquiry	
1	Write a program that displays a value of 'Y' at port 0 and 'N' at port 2 and also generates a square wave of 10Khz with Timer 0 in mode 2 at port pin p1.2 XTAL =22MHz
2	Write a C program that continuously gets a single bit of data from P1.7 and sends it to P1.0 in main, while simultaneously i. creating a square wave of 200us period on pin P2.5. ii. Sending letter 'A' to serial port. Use Timer 0to create square wave.
Open Ended	
1	Develop an ARM based application using i. sensors ii. Actuators iii. displays

Course Code: 17EEEC203 **Course Title: Digital Circuits**

L-T-P-SS: 3-0-0 **Credits: 3** **Contact Hrs: 40**

CIE Marks: 50 **SEE Marks: 50** **Total Marks: 100**

Teaching Hrs: 50 **Exam Duration: 3 hrs**

Unit I	
Chapter 1: Logic Families: Logic levels, output switching times, fan-in and fan-out, comparison of logic families	03Hrs
Chapter 2: **Principles of Combinational Logic:** Definition of combinational logic, canonical forms, Generation of switching equations from truth tables, Karnaugh maps-3,4 variables, Incompletely specified functions(Don't care terms),Simplifying Maxterm equations, Quine-McCluskey minimization technique- Quine-McCluskey using don't care terms, Decimal method, Reduced Prime Implicant Tables.	08 Hrs
Chapter 3: **Analysis and design of combinational logic:** General approach, Decoders-BCD decoders, Encoders, Digital multiplexers- Using multiplexers as Boolean function generators. Adders and subtractors-Cascading full adders, Look ahead carry adders, Binary comparators.	09 Hrs
Unit II	
Chapter 4: **Introduction to Sequential Circuits** : Basic Bistable Element, Latches, A SR Latch, Application of SR Latch, A Switch De bouncer, The SR Latch, The gated SR Latch, The gated D Latch, The Master-Slave Flip-Flops (Pulse-Triggered Flip-Flops): The Master-Slave SR Flip-Flops, The Master-Slave JK Flip-Flop, Edge Triggered Flip-Flop: The Positive Edge-Triggered D Flip-Flop, Negative-Edge Triggered D Flip-Flop; Characteristic Equations.	10Hrs
Chapter 5: Analysis of Sequential Circuits: Registers and Counters, Binary Ripple Counters, Synchronous Binary counters, Ring and Johnson Counters, Design of a Synchronous counters, Design of a Synchronous Mod-n Counter using clocked JK Flip-Flops Design of a Synchronous Mod-n Counter using clocked D, T or SR Flip-Flops.	10Hrs
Unit – III	
Chapter No. 6 Sequential Circuit Design Introduction to Sequential Circuit Design, Mealy and Moore Models, State Machine notations, Synchronous Sequential Circuit Analysis, Construction of state Diagrams and counter design.	05Hrs
Chapter 7: Introduction to Memories: Introduction and role of memory in a computer system, memory types and terminology, Read Only memory, MROM, PROM, EPROM, EEPROM, Random access memory, SRAM, DRAM, NVRAM.	05Hrs

Text Books (List of books as mentioned in the approved syllabus)

1. Donald D Givone, Digital Principles and Design, Tata McGraw Hill Edition, 2002
2. John M Yarbrough, Digital Logic Applications and Design, Thomson Learning, 2001
3. A Anand Kumar , Fundamentals of digital circuits, PHI, 2003

References

1. Charles H Roth, Fundamentals of Logic Design, Thomson Learning, 2004
2. Zvi Kohavi, Switching and Finite Automata Theory, 2nd, TMH
3. R.D. Sudhaker Samuel, Logic Design, Sanguine Technical Publishers, 2005
4. R P Jain, Modern Digital Electronics, 2nd, Tata McGraw Hill , 2000

Code: 17EEEC201 **L-T-P: 3-0-0**
Course Title: Electrical Machines. **CIE: 50**
Teaching Hours: 40 **SEE: 50**

Unit –I	
Chapter 1 : Transformer : Transformer construction and principle of operation, Ideal Transformer, Practical Transformer, Transformer phasor diagrams, Equivalent circuit of transformers, Open circuit and short circuit tests, Voltage regulation, transformer losses and efficiency, Testing of transformers, Three phase transformers, Auto-transformers.	**10 hours**
Chapter 2: DC Machines: Construction of DC machine and DC machine as generator, EMF equation of DC machine, Operating characteristics of types of DC generators, Operating characteristics of DC motors, DC motor starting, Speed control of DC motors.	**05 hours**
Unit – II	
Chapter 3: Induction (Asynchronous) Machines: Induction motor as transformer, Principle of operation, Rotor frequency, e.m.f, current and power, Losses and Efficiency, Equivalent circuit, Torque slip and Power-slip characteristics, Determination of equivalent circuit parameters. Circle diagram, Starting of polyphase induction motors.	**10 hours**
Chapter 4 : Synchronous Machines: Cylindrical and salient pole machines, Phasor diagram of cylindrical rotor alternator. AC armature winding, Voltage regulation of alternator using e.m.f method.	**05 hours**
Unit – III	
Chapter 5 : Synchronous Machines: Synchronous motor phasor, Power angle characteristic of synchronous machine, Measurement of Xd and Xq, Capability curves of synchronous generators, Power factor correction by synchronous motors.	**5 hours**
Chapter 6:Single phase induction machines:: Double field revolving theory, Equivalent circuit, Resistance split phase motors, capacitor start motor, permanent capacitor motor, two-value capacitor motor, shaded-pole motor. Performance and cost comparison and choice of single phase induction motors.	**5 hours**

Text Book

1. P. C. Sen, “Principles of Electric Machines and Power Electronics”, John Wiley & Sons Publications, Canada, 2nd Edition, 2001.

References

1. Bhimbra, “Principles of Electrical machinery”, Khanna Publishers.2006.
2. D. P. Kothari and I. J. Nagrath, “Electrical Machines”, MGH Publishers. 4th Edition, 2011.
3. Fitzgerald, Kingsly & Stephen, “Electric Machinery”, 5ed., McGraw Hill, 1992

Course Code: 17EEEC204 **Course Title: Linear Control Systems**

L-T-P: 3-0-0	Credits: 3	Contact Hrs: 40
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 50		Exam Duration: 3 hrs

Chapter No.	Unit-I	
1	**Introduction to control systems**: Open loop and closed loop control systems-definitions, salient features and simple examples	2 Hrs
2	**Transfer function Models and block diagram representation:** Definition of transfer function, assumptions and properties, Block diagram and signal flow graph representation**,** symbols used. Block-diagram of negative and positive feedback systems. Electrical systems: Derivation of transfer functions for electrical circuits, Models of dc servomotors-armature and field control, block-diagram representation. Block diagram reduction rules, Examples.	6 Hrs
3	**Time Response Analysis** Poles and Zeros, Type and order, Standard test signals. First order system: unit step response, importance of time constant, Second order system: Standard T.F of second order system. Unit step response of 2^{nd} order system Time response specifications-definition. Expressions for rise time, peak time, peak overshoot and settling time, Static error constants and steady-state errors.	7 Hrs
	Unit-II	
4	**Stability Analysis of control systems:** Explanation of Routh-Hurwitz criterion-necessary and sufficient condition for stability, special cases, Absolute and Relative stability, relative stability analysis.	5 Hrs
5	**Controller design approaches:** Basic modes of controls and their features: On-Off, proportional, integral, PI, PD and PID, Controller design approaches- Zeigler Nichol's tuning method and Pole placement design method, design examples	5 Hrs
6	**Frequency response analysis:** Sinusoidal response: system response for sinusoidal inputs**,** sinusoidal transfer functions. Frequency response of a second order system, definitions and expressions of Frequency response specifications. Polar plot: method to draw approximate polar plot, definition of phase and gain margin.	5 Hrs
	Unit-III	
7	**Bode plot analysis of control systems:** Bode plots: asymptotic plots for basic factors, method to draw Bode asymptotic plot and phase plot, determination of gain and phase margins from Bode plot.	5 Hrs
8	**Root locus diagrams:** Basic principle – magnitude and angle criterion, Rules to construct root locus diagram (proof not required), method to construct root locus diagram.	5 Hrs

Text Books

1 Nagarath and Gopal, *Control system Engineering*, Wiley Eastern Ltd., 1995, 2^{nd} edition.

2 Katsuhiko Ogata, *Modern Control Engineering*, PHI, 2002, 4^{th} edition

Reference Books:

1 M.Gopal, Control Systems-Principles and Design, 2, TMH, 2002.

Course Content

Course Code: 17EEEC301 **L-T-P-S: 3-0-0**
Course Title: Power Electronics **CIE: 50**
Teaching Hours: 40 **SEE: 50**

Unit–I

1	**Introduction** Power Electronics, Converter Classification, Power Electronics Concepts, Electronic Switches: The Diode, Thyristor, Transistors, switch Selection.	2 Hrs
2	**Power Computations** Introduction, Power and Energy, Instantaneous Power, Energy, Average Power, Inductors and Capacitors, Energy Recovery, Effective Values: RMS, Apparent Power and real Power, Power Factor, Power Computations for Sinusoidal AC Circuits, Power Computations for non-sinusoidal periodic waveforms, Fourier Series, Average Power, Non-sinusoidal Source and linear load, Sinusoidal Source and Nonlinear load.	4 Hrs
3	**DC-DC Converters** Linear voltage regulators, a basic switching converter, the buck converter, Voltage and Current Relationships, output voltage ripple, capacitor resistance—The Effect on Ripple Voltage Synchronous Rectification for the buck converter, design considerations, the boost converter, Voltage and Current Relationships, Output Voltage Ripple, Inductor Resistance, the Buck-Boost Converter, Voltage and Current Relationships, Output Voltage Ripple, Cuk and SEPIC converters.	9 Hrs
	Unit–II	
4	**Inverters** Introduction, the full-bridge converter, the square-wave inverter, Fourier series analysis, total harmonic distortion, amplitude and harmonic control, the half-bridge inverter, pulse-width-modulated output: bipolar switching, unipolar switching, three-phase inverters, the Six-Step Inverter, PWM three-phase inverters.	8 Hrs
5	**Controlled Rectifiers** The controlled half-wave rectifier, resistive load, RL load, RL-source load, commutation, the effect of source inductance, controlled full-wave rectifiers, resistive load, RL load, discontinuous current, RL load, continuous current, controlled rectifier with RL-Source Load, controlled single-phase converter operating as an inverter.	7 Hrs
	Unit–III	
6	**AC Voltage Controllers** Introduction, The Single-Phase AC Voltage, Controller, Basic Operation, Single-Phase Controller with a Resistive Load, Single-Phase Controller with an RL Load, Static VAR Control, AC Voltage Controllers.	5 Hrs
7	**Drive Circuits, Snubber Circuits and Heat Sinks** Introduction, MOSFET and IGBT drive circuits, low-side drivers, high-side drivers, transistor snubber circuits, heat sinks and thermal management, steady-state temperatures, time-varying temperatures.	5 Hrs

Text Book:

1. Daniel W Hart, Power Electronics, Tata McGraw-Hill Edition, New-Delhi, 2011.

References:

1. Rashid M. H, Power Electronics: Circuits, Devices and Applications, 3rd edition, PHI, New Delhi, 2000.
2. P. S. Bhimbra, Power Electronics, Khanna Publishers, 2007.
3. Umanand, Power Electronics, 2nd edition, Wiley-India Publications, New –Delhi, 2009.

L-T-P: 3-0-0

Course code: 17EEEC302
Course title: Power System Analysis & Stability **CIE Marks: 50**
Teaching hours: 40 **SEE Marks: 50**

Course Content	Hrs
Unit - 1	
Chapter No. 1: Power system representation Standard symbols of power system components, one-line diagram, impedance and reactance diagrams, per-unit quantity-definition, per-unit impedance of 3-phase component, change of base, equivalent load impedance, p.u impedance of two-winding transformer referred to primary and secondary, method to draw p.u impedance diagram, advantages of p.u system calculations, examples on obtaining per-unit reactance diagram and per-unit calculations	6 hrs
Chapter No. 2: Symmetrical fault analysis 3-Phase short circuit at the terminals of unloaded generator, definitions of sub-transient, transient and steady-state reactance, internal emf's of loaded machines, examples on short circuit calculations, selection of circuit breaker ratings-momentary current and interrupting capacity, examples on symmetrical fault calculations.	5 hrs
Chapter No. 3: Introduction to Symmetrical components and sequence networks Definition of sequence components as applied to 3-phase unbalanced systems, expressions for sequence components, examples on computations of sequence components.	4 hrs
Unit - 2	
Chapter No. 4 Sequence Networks Sequence impedance and sequence network, sequence networks of 3-phase generator, zero-sequence networks of 3-phase loads and transformers, Sequence network of power systems	4 hrs
Chapter No. 5: Unsymmetrical Fault Analysis Single line to ground, line to line and double line to ground fault with fault impedance at the terminals of unloaded generator- derivation of connection of sequence networks, Unsymmetrical faults on unloaded power systems, examples on unsymmetrical fault calculation for unloaded power systems.	7 hrs
Chapter No. 6: Introduction to power system Stability Power angle equation of SMIB system, steady-state analysis, M&H constants-definitions and relation, swing equation, equal area criterion (EAC),	4 hrs
Unit - 3	
Chapter No. 7: Stability analysis by EAC: EAC applications to to-sudden change in mechanical power input, 3-phase fault on transmission line, expression for critical clearing angle, examples on EAC applications	5 hrs
Chapter No. 8: Numerical solution of swing equation for stability analysis Point by point method of solving swing equation, applications of Euler, modified Euler and R-K numerical techniques for stability analysis, methods to improve transient stability, examples on stability analysis	5 hrs

Text Books

1. W.D. Stevenson, Elements of Power System Analysis, 4th Edition, McGraw Hill, 1982
2. I.J. Nagarath and D.P. Kothari, Power System Engineering, 2nd Edition, Tata McGraw Hill, 2010

Reference Books

1. Hadi Sadat, Power System Analysis, First Edition, Tata McGraw Hill, 2002
2. Nagarath and Kothari, Modern Power System Analysis, 2nd Edition, Tata McGraw Hill, 1993
3. J.J. Grainger and W.D. Stevenson, Power System Analysis, McGraw Hill (New York), 1994

Course Code: 17EEEC303 **Course Title: OS and Embedded Systems**
L-T-P-SS: 3-0-0 **Credits: 3** **Contact Hrs: 3 hrs/week**
CIE Marks: 40 **SEE Marks: 50** **Total Marks: 100**
Teaching Hrs: 40 hrs **Exam Duration: 3 hrs**

No	Content	Hrs
1	**Unit I** **Introduction and System structures** Operating system definition; Operating System operations; Different types of operating system – Mainframe systems, Multi programmed systems, Time sharing systems, Desktop systems, Parallel systems, Distributed systems, Real time systems. **Process Management** Process concept; Process scheduling; Operations on processes; Inter-process communication. Multi-Threaded Programming: Overview; Multi threading models; Thread Libraries; Threading issues. Process Scheduling: Basic concepts; Scheduling criteria; Scheduling algorithms; Multiple-Processor scheduling; Thread scheduling. **Memory Management** Memory Management Strategies: Background; Swapping; Contiguous memory allocation; Paging; Structure of page table; Segmentation. Virtual Memory Management: Background; Demand paging; Page replacement; Allocation of frames; Thrashing. **(Textbook: Galvin)**	03 Hrs 06 Hrs **06 Hrs**
Unit II		
4	**Introduction To Real-Time Operating Systems** Introduction To Real-Time Operating Systems: Introduction to OS, Introduction to real time embedded system- real time systems, characteristics of real time systems , the future of embedded systems. Introduction to RTOS, key characteristics of RTOS, its kernel, components in RTOS kernel, objects, scheduler, services, context switch, Scheduling types: Preemptive priority-based scheduling, Round-robin and preemptive scheduling. **Tasks, Semaphores and Message Queues:** Tasks, Semaphores and Message Queues: A task, its structure, A typical finite state machine, Steps showing the how FSM works. A semaphore, its structure, binary semaphore, mutual exclusion (mutex) semaphore, Synchronization between two tasks and multiple tasks, Single shared-resource-access synchronization, Recursive shared-resource-access synchronization. A message queue, its structure, Message copying and memory use for sending and receiving messages, Sending messages in FIFO or LIFO order, broadcasting messages. ***(Textbook: Qing Li with Caroline Yao, Real-Time Concepts for Embedded Systems, 1E, Published, 2011)***	08 Hrs 07 Hrs
3	**Unit III** **Typical Embedded System:** Classification and purposes of embedded system, Characters and Quality attributes of embedded system, Core and Supporting components of embedded system, Embedded firmware **(Text book: Shibu KV)** Wired and Wireless Protocols: **Bus communication protocol (USB,I^{2}C,SPI), Wireless and mobile system protocol (Bluetooth, 802.11 and its variants, ZigBee), Embedded design cycle-case study-ACVM** (Text book: Rajkamal)	05 Hrs **05 Hrs**

Course Code: 17EEEC304 **Course Title: Digital Signal Processing**
L-T-P: 3-0-0 **Credits: 3** **Contact Hrs: 3 hrs/week**
CIE Marks: 50 **SEE Marks: 50** **Total Marks: 100**
Teaching Hrs: 40 hrs **Exam Duration: 3 hrs**

Unit I		
No	**Content**	**Hrs**
1	**Introduction to Digital Signal Processing:** Signals, Systems, and Signal Processing, Classification of Signals, Basic operations on signals, Elementary signals.	07hrs
2	**Discrete Time Signals and Systems:** Properties of systems, representation of linear time in variant systems, Correlation of Discrete Time Signals.	08hrs
Unit II		
4	**Discrete Fourier Series and Fourier Transform Representation :** Fourier Series representation of discrete time signals and properties, Fourier Transform representation of discrete time signals and properties, Applications	04hrs
5	**The Discrete Fourier Transforms:** Frequency Domain Sampling, Properties	06hrs
6	**Efficient Computation of DFT:** Fast Fourier Transform Algorithms, Applications of FFT Algorithms, A linear Filtering Approach to Computation of the DFT.	05hrs
	Unit – III	
7	**Design of Digital IIR Filters:** Introduction, Impulse Invariant & Bilinear Transformations, analog filters – Butterworth , design of digital Butterworth, Chebyshev	05hrs
8	**Design of FIR Filters:** Introduction, windowing, rectangular, modified rectangular, Hanning, Hamming,	05hrs
	Text Book: 1. Digital Signal Processing, by John G. proakis & Dimitris G. Manolakis, Third Edition, prentice-Hall of India Pvt. Ltd.,ISBN 81-203-1129-9. References: [1] Discrete-Time Signal Processing, by Alan V Oppenheim & Ronald W. Schfer, Prentice-Hall of India Pvt. Ltd., ISBN 0-87692-720-7 [2] Digital Signal Processing- A computer based approach by Sanjit K. Mitra, Tata McGraw-Hill Publishing Company Limited, New Delhi,ISBN 0-07-463723-1. [3] A Student's Guide to Fourier Transforms With Applications in Physics and Engineering by J. F. James, Third Edition, www.cambridge.org/9780521176835	

Course Code: 17EEEP301 **Title: Data Structure Using C Lab**
L-T-P: 0-0-2 Credits:2 **Contact Hrs: 4 hrs/week**
CIE Marks: 80 SEE Marks: 20 **Total Marks: 100**
Teaching Hrs: 48hrs **Exam Duration: 3 hrs**

1.	**Programming on pointer concepts**: Pointer concepts,1D and 2D arrays, pointers to functions, memory management functions	02+02 Hrs
2.	**Programming on string handling functions using pointers, structures, bit-fields**: Perform string handling functions like String length, String concatenate, Strings compare, String copy and Strings reverse, Implementing Structures, union and bit-field.	02+02 Hrs
3.	**Programming on files:** Open, Close, Read, Write and Append the file.	02+02 Hrs
4.	**Programming on stack data structures and applications:** Insert delete and display an integer in a stack, Conversion from Infix to postfix & Infix to Prefix, Recursion.	02+02 Hrs
5.	**Programming on queue data structures:** Insert at rear end ,delete at front end and display the integers in queue, Deque and circular queue.	02+02 Hrs
6.	**Programming on linked lists:** Insert, delete and display a node in Singly Linked List, Doubly Linked List and Circular Linked List.	06+03 Hrs
7.	**Programming on trees:** Perform various operations on binary trees, find max, min value in a binary search trees, find the height of a tree, count nodes in a tree, delete a node in a tree.	02+02 Hrs
8.	**Programming on sorting:** Merge sort, Quick sort, Heap sort, Shell sort, Radix sort**.**	02+02 Hrs
9.	**Programming on graphs:** Compare Breadth First Sort Sort, and Depth First Sort	02+02 Hrs
10.	**Programming on hashing tables:** Implement different methods of hash tables.	02+02 Hrs
11.	**Open ended experiment:** Implement given Data structures.	02+02 Hrs

NOTE: The pseudo codes for different data structures and algorithms to be based on standard problems from geeksforgeeks website.

Text Book

1. Horowitz, Sahani, Anderson-Feed, “Fundamentals of Data Structures in C”, 2ed,Universities Press, 2008
2. Aaron M. Tenenbaum , “Data Structures Using C”, Pearson Education India, 2003
3. Richard F. Gilberg, Behrouz A. Forouzan “Data Structures: A Pseudocode Approach With C”, 2nd Edition , Course Technology, Oct 2009.

References

1. E Balaguruswamy, “The ANSI C programming Language”, 2ed., PHI, 2010.
2. Yashavant Kanetkar, “Data Structures through C”, BPB publications 2010

Course Code: 17EEEP302 **Title: Linear Integrated Circuits Lab**
L-T-P: 0-0-2 Credits:2 **Contact Hrs: 4 hrs/week**
CIE Marks: 80 SEE Marks: 20 **Total Marks: 100**
Teaching Hrs: 48hrs **Exam Duration: 3 hrs**

1.	Inverting & Noninverting summer	02+02 Hrs
2.	Conductance & Tansconductance Amplifier	02+02 Hrs
3.	Instrumentation Amplifier	02+02 Hrs
4.	High gain high input impedance amplifier	02+02 Hrs
5.	Op-amp Phase shifter	02+02 Hrs
6.	Non Inverting Integrator	06+03 Hrs
7.	Active Low pass filter	02+02 Hrs
8.	RC Phase shift Oscillator	02+02 Hrs
11.	**Open ended experiment:** Implement given LIC Circuit To design and implement Analog PI controller for single time constant system	02+02 Hrs

Text Book

1. Jacob Milman, “Microelectronics: Digital and Analog Circuits and Systems”, 6th edition McGrawhill,1984

Course Code: 17EEEP303	Course Title: Embedded and IOT Lab	
L-T-P: 0-0-1	**Credits: 1**	**Contact Hrs: 32**
CIE Marks: 20	**SEE Marks: 80**	**Total Marks: 100**
Teaching Hrs: 32		**Exam Duration: 2 hrs**

Chapter No.	**List of Experiments**
1	Write a C program to use on chip Timers in LPC2148 and generate required delay
2	Write a C program to demonstrate the concept of basic RTOS programming by using RTX RTOS
3	Write a ‘C’ program & demonstrate concept of Round Robin Task Scheduling.
	Write a C program to demonstrate the concept of basic preemptive scheduling algorithm by using RTX RTOS
4	Write a ‘C’ program & demonstrate concept of Events and Flags for inter task communication using RTX RTOS
5	Write a ‘C’ program & demonstrate concept of Mailbox.
6	Write a ‘C’ program & demonstrate concept of Semaphore.
7	Write a ‘C’ program & demonstrate concept of interrupts(hardware and software)
	Write a C program to interface I2C-RTC with LPC2148
8	Write a C program to interface SPI-EEPROM with LPC2148
	Structured Enquiry
	Real-Time OS Application which successfully demonstrates the use of various RTOS concepts

Course Code: 17EEEW301 **Title: Mini Project**
L-T-P: 0-0-3 Credits:3 **Contact Hrs: 3 hrs/week**
CIE Marks: 50 SEE Marks: 50 **Total Marks: 100**

Students are supposed to carry out the mini project based on the theme and guidelines as given below.

(I) Theme: A Computer Aided Solution to Electrical Engineering Problems

1. The work must involve designing and developing a computer solution to an electrical engineering problem with the help of a computer program written in C/C++.
2. Computer program must make use of data structures /algorithms suitable to the problem being solved.
3. The solution must involve mathematical modeling, mathematical solution and numerical methods.
4. Computer program design must be well documented through flowcharts.
5. Computer program must have a user manual and source code documentation.
6. Computer program must generate a clear, concise report that is useful for other users.
7. The solution must be documented in a report consisting of problem definition, methodology, modeling, solution, results and discussion and conclusions.

(II) Project batches and Guide:
Each project batch consists of 3 or 4 students. Students are informed to form their own batch based on the kind of project work and their interest. Each batch is supposed to give four faculty names as guides in the order of their preference. Guides will be allocated based on the preference given by the batch. The primary role of the guide is to supervise the work, provide appropriate guidance in successfully carrying out the project work.

(III) Project implementation
The principle steps in carrying out the project work are summarized below:
Step-1: Literature survey:
A literature survey with regard to the given theme is to be carried out in order to understand the state of the current research. Further, a critical review of the collected literature will facilitate to summarize key observations. Key observations will lead to identifying a specific problem for the project work in terms of alternate/new solution techniques, possible improvements, new formulations or models, hardware implementations etc.

Step-2: Prepare a synopsis:
A synopsis highlights the definition of identified problem and its significance. The synopsis will also contain detailed literature review giving the state of the current research on the selected specialized area.

It will also brief the problem formulation, solution methodology, tools employed and possible outcomes.

Step-3: Project implementation:

The work is to be carried out in phase wise manner, testing or analyzing the partial results obtained. Guide will periodically monitor the progress of the work done giving suitable suggestions as required.

(IV) Schedule:

Sl. No.	Activity	Week No.	Evaluation Objectives
1	Announcement for the formation of batches	At the end of the previous semester	NA
2	Allotment of guides	1st - 2nd	NA
3	Submission of Synopsis	3rd - 5th	Literature review, problem formulation, solution methodology, tools employed
4	Review-I	6th - 8th	Literature review, problem formulation, solution methodology, tools employed
5	Review-II	9th -10th	Analysis and implementation (partial)
6	Review-III	12th - 14th	Analysis, complete implementation and results.

Evaluation:

Evaluation of the project work carried out by each batch will be reviewed periodically by a review committee. Review committee consists of guide and two other faculty members who are guiding other batches. Generally, two to three reviews will be held during a semester. However, each project batch will be supervised by the guide on a weekly basis. Review committee will evaluate for 40% and guide will evaluate for 60% of the total marks.

Continuous Internal Evaluation (50%)	**Assessment**	**Weightage in Marks**
	Evaluation by Project Guide	30
	Project Review committee	20
Semester End Examination (50%)	Using SEE Rubrics	50
	Total	**100**

Passing: 40% both in CIE and SEE

Course Code: 17EEEC305 **Course Title: Electric Drives and Control**
L-T-P-S: 3-0-0 **CIE:50**
Teaching Hours: 40 **SEE:50**

Chapter 1. An introduction to Electrical Drives & its Dynamics: Electrical drives. Advantages of electrical drives. Parts of electrical drives, Choice of electrical drives, status of dc and ac drives, dynamics of electrical drives, fundamental torque equation, speed torque conventions and multi quadrant operation. Nature and classification of load torques, calculation of time and energy loss in transient operations..	**5 Hrs**
Chapter 2. D C Motor Drives: Starting braking, single phase fully controlled rectifier control of dc separately excited motor, Single-phase half controlled rectifier control of dc separately excited motor. Three phase fully controlled rectifier control of dc separately excited motor, three phase half controlled rectifier control of dc separately excited motor, multiquadrant operation of dc separately excited motor fed from fully controlled rectifier. Rectifier control of dc series motor, chopper controlled dc drives, chopper control of separately excited dc motor. Chopper control of series motor.	**10 Hrs**
Unit – II	
Chapter 3. Induction Motor Drives: Operation with unbalanced source voltage and single phasing, operation with unbalanced rotor impedances, analysis of induction motor fed from non-sinusoidal voltage supply, starting, braking, Stator voltage control, variable frequency control from voltage sources, voltage source inverter control, current source inverter control, current regulated voltage source inverter control, rotor resistance control, slip power recovery.	**10 Hrs**
Chapter 4. Synchronous Motor and Brushless dc Motor Drives: Operation from fixed frequency supply, synchronous motor variable speed drives, variable frequency control of multiple synchronous motors, self controlled synchronous motor drive, PMAC motor drives, brushless dc motor drives	**05 Hrs**
Unit – III	
Chapter 5. Stepper Motor and Swiched Reluctance Motor Drives: Stepper Motor: variable reluctance, permanent magnet, torque versus stepping rate characteristics drive circuits for stepper motors Switched Reluctance Motor: Operation and control requirements, converter circuits, modes of operation	**5 Hrs**
Chapter 6. Solar and Battery Powered Drives: Solar panels, motors suitable for pump drives, battery powered vehicles, solar powered electrical vehicles	**5 Hrs**

Text Book :

1. G. K Dubey, *"Fundamentals of Electrical Drives"*, 2nd ed., Narosa Publishing House, Chennai, 2002.

References:

Course code: 17EEEC306 **L-T-P: 3-0-0**
Course title: Power System Modeling, Operation & Control **CIE Marks: 50**
Teaching hours: 50 **SEE Marks: 50**

Unit - 1	Hrs
Chapter No. 1: Formation of network matrices : Multi-port power system representation, performance equations in bus frame of reference, definitions of Network models Ybus and Zbus, Primitive element representations, primitive performance equations,. Formation of Ybus by method of Inspection, Introduction to graph theory- definitions of terms, Bus incidence matrix, Ybus by the method of singular transformation, Examples on Ybus formation by singular transformation (with no mutual coupling) and Inspection method, Zbus building algorithm-addition of uncoupled branches and links, modification of Zbus for changes in elements not mutually coupled, Examples on Zbus formation	8 hrs
Chapter No. 2: Optimal load dispatch : Importance and objective of economic load dispatch, Fuel cost and Incremental fuel cost, Optimal load allocation between plants neglecting transmission losses, Examples on optimal load allocation with and without generation constraints, Optimal load allocation considering transmission losses, General transmission loss formula, Examples.	7 hrs
Unit - 2	
Chapter No. 3: Load flow analysis : Importance of Power flow, Classification of busses, General steps in load flow analysis, Off-nominal ratio tap changing ratio transformer representation. Bus voltage solution by Gauss and Gauss-Seidel methods without PV buses, Handling PV buses in Gauss-Seidel method, N-R load flow model in polar coordinates, formation of NR Jacobian, Introduction to FDLF load flow model, Comparison of Gauss-Seidel, NR and FDLF load flow methods, Examples on one iteration of load flow solution.	8 hrs
Chapter No. 4: Load frequency control : Introduction to load frequency control problem, Working principle of speed governor, Model of isolated power system area –block diagram representation, Expression for steady-state frequency deviation, Parallel operation of generators – expression for operating frequency and load sharing,, two area load frequency control, steady-state operation of multi-area system under free governor operation, Examples on load sharing between areas.	7 hrs
Unit - 3	
Chapter No. 5: Reactive power and voltage control : Power flow through a line, Relation between voltage, power and reactive power at a node, Brief descriptions of methods of voltage control-by injection of reactive power and tap changing transformer. Generator reactive power control by AVR-simplified AVR system model, AVR response.	5 hrs
Chapter No. 6:Power System Simulations: Simulation of automatic generation control, simulation of small signal stability of a SMIB power system, Transient stability simulation of SMIB power system using trapezoidal integration, simulation of classical economic load dispatch Algorithm	5 hrs

Text Books

1. Stagg and El-Abid, Computer Methods in power system analysis, First Edition, Mc-Graw Hill, 1968
2. Kothari and Nagarath, Modern power system analysis, 3rd Edition, Tata McGraw Hill, 2004

References :

1. P. Kundur, Power system stability and control, First Edition, Tata McGraw Hill, 2007
2. Hadi Sadat, Power System analysis, Ed. First Edition, Tata McGraw Hill, 2002
3. A.R. Bergen and Vijay Vittal, Power system analysis, Ed. First Edition, Pearson Ed, 2009

Course Code: 17EEEC307 | **Course Title: Automotive Electronics**
L-T-P-SS: 3-0-0 Credits:3 | **Contact Hrs: 3 hrs/week**
CIE Marks: 50 SEE Marks: 50 | **Total Marks: 100**
Teaching Hrs: 40hrs | **Exam Duration: 3 hrs**

Unit I		
No	**Content**	**Hrs**
1	**Automotive Systems, Design cycle and Automotive industry overview** Overview of Automotive industry, Vehicle functional domains and their requirements, automotive supply chain, global challenges. Role of technology in Automotive Electronics and interdisciplinary design. Introduction to modern automotive systems and need for electronics in automobiles and application areas of electronic systems in modern automobiles, Introduction to power train, Automotive transmissions system ,Vehicle braking fundamentals, Steering Control, Overview of Hybrid Vehicles **ECU Design Cycle :** Types of model development cycles(V and A) , Components of ECU, Examples of ECU on Chassis, Infotainment, Body Electronics and cluster	**8**
2	**Automotive Sensors and Actuators:** Sensor characteristics, Sensor response, Sensor error, Redundancy of sensors in ECUs, Avoiding redundancy, Smart Nodes , Examples of sensors : Accelerometer (knock sensors),wheel speed sensors, Engine speed sensor, Vehicle speed sensor, Throttle position sensor, Temperature sensor, Mass air flow (MAF) rate sensor, Exhaust gas oxygen concentration sensor, Throttle plate angular position sensor, Crankshaft angular position/RPM sensor, Manifold Absolute Pressure (MAP) sensor. **Actuators**: Engine Control Actuators, Solenoid actuator, Exhaust Gas Recirculation Actuator.	**7**
	Unit II	
3	**Embedded system in Automotive Applications & Automotive safety systems:** Review of microprocessor, microcontroller and digital signal processor within the automotive context. Criteria to choose the right microcontroller/processor for various automotive applications, Architectural attributes relevant to automotive applications Automotive grade processors ex: Renesas, Quorivva, Infineon. **EMS:** Engine control functions, Fuel control, Electronic systems in Engines , Development of control algorithm for EMS, Look-up tables and maps, Need of maps, Procedure to generate maps, Fuel maps/tables, Ignition maps/tables, Engine calibration, Torque table, Dynamometer testing **Safety Systems in Automobiles: Active and Passive safety systems:** ABS, TCS, ESP, Brake assist, Airbag systems etc.	**10**
4	**Automotive communication protocols :** Overview of Automotive communication protocols : CAN, LIN , Flex Ray, MOST	**5**
	Unit – III	
5	**Advanced Driver Assistance Systems (ADAS) and Functional safety standards:** Advanced Driver Assistance Systems (ADAS):Examples of assistance applications: Lane Departure Warning, Collision Warning, Automatic Cruise Control, Pedestrian Protection, Headlights Control, Connected Cars technology and trends towards Autonomous vehicles. **Functional Safety:** Need for safety standard-ISO 26262, safety concept, safety process for product life cycle, safety by design, validation	**5**

6	**Diagnostics:** Fundamentals of Diagnostics: Basic wiring system and Multiplex wiring system, Preliminary checks and adjustments, Self-diagnostic system. Fault finding and corrective measures, Electronic transmission checks and Diagnosis, Diagnostic procedures and sequence, On board and off board diagnostics in Automobiles, OBDII, Concept of DTCs, DLC, MIL, Freeze Frames, History memory, Diagnostic tools, Diagnostic protocols : KWP2000 and UDS	**5**

Text Book:

1. Ribbens – Understanding of Automotive electronics
2. Denton.T – Automobile Electrical and Electronic Systems.
3. Denton.T – Advanced automotive fault diagnosis

References:

1. Ronald K Jurgen: "Automotive Electronics Handbook, 2nd Edition, McGraw-Hill, 1999
2. James D Halderman: -Automotive electricity and Electronics", PHI Publication
3. Terence Rybak. Mark Stefika: Automotive Electromagnetic Compatibility (EMC), Springer. 2004
4. Allan Bonnick.: “Automotive Computer Controlled Systems” Diagnostic Tools and Techniques". Elsevier Science, 2001
5. William T.M – Automotive Electronic Systems.
6. Nicholas Navet – Automotive Embedded System Handbook 2009.
7. BOSCH Automotive Handbook, 6th Edition.

Course code: 17EEEC308 **L-T-P: 2-0-1**

Course title: Machine Learning **CIE Marks: 50**

Teaching hours: 40 **SEE Marks: 50**

Chapter No.	Unit-I	
1	**Introduction** Introduction to Machine Learning, Applications of Machine Learning, Types of Machine Learning: Supervised, Unsupervised and Reinforcement learning, Dataset formats, Basic terminologies.	5 hrs
2	**Supervised Learning** Linear Regression, Logistic Regression Linear Regression: Single and Multiple variables, Sum of squares error function, The Gradient descent algorithm, Application, Logistic Regression, The cost function, Classification using logistic regression, one-vs-all classification using logistic regression, Regularization.	10 hrs
	Unit-II	
3	**Supervised Learning: Neural Network** Introduction to perception learning, Implementing simple gates XOR, AND, OR using neural network. Model representation, Gradient checking, Back propagation algorithm, Multi-class classification, Application- classifying digits, SVM.	10 hrs
4	**Unsupervised Learning: Clustering** Introduction, K means Clustering, Algorithm, Cost function, Application.	5 hrs
	Unit-III	
5	**Unsupervised Learning: Dimensionality Reduction** Dimensionality reduction, PCA- Principal Component Analysis. Applications, Clustering data and PCA.	4 hrs
6	**Introduction to Deep Learning** What is deep learning?, Difference between machine learning and deep learning, Convolution Neural Networks (CNN), Recurrent Neural Networks(RNN), When to use deep learning?	8 hrs

Text Books

1 Tom Mitchell, Machine Learning, 1, McGraw-Hill. , 1997

2 Christopher Bishop, Pattern Recognition and Machine Learning, 1, Springer, 2007

Reference Books:

1 Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning : Data Mining, Inference and Prediction, 2, Springer, 2009

Laboratory Title: Power Electronics & Drives Lab **Lab. Code: 17EEEP304**
Total Hours: 36 Hrs **Duration of Exam: 03 Hrs**
Total Exam Marks: 100 **Total CIE. Marks: 80**

S No	**Experiment list**
	Demonstration
1	Forward and Flyback DC-DC Converter
2	Single phase full bridge inverter
3	Half controlled Rectifier feeding R and RL load
4	Fully controlled bridge rectifier feeding R and RL load
	Exercises
1	Three phase full bridge controlled rectifier fed DC motor drive.
2	Class AB chopper fed DC Motor drive.
3	Four Quadrant Closed loop control of DC motor drive
4	VSI based open loop volts/hertz control of three phase induction motor drive.
	Structured Enquiry
1	Title: Each batch (consisting of 4 students) will work on one hard ware circuit out of the below mentioned circuits, obtain the simulation results, and experimentally verify the working principle and prepare a report. To design and implement closed loop DC motor/Induction motor drive to meet defined specifications.

Laboratory Title: Automotive Electronics Lab **Lab. Code: 17EEEP305**
Total Hours: 36 Hrs **Duration of Exam: 03 Hrs**
Total Exam Marks: 100 **Total CIE. Marks: 80**

Sl. No.	Name of Experiment
	Demonstration Experiment
1	Electronic engine control system: Injection and Ignition control system, Transmission trainer modules
	Exercise Experiment
2	Simulation of an automobile engine
3	Modeling a vehicle motion on a flat surface during hard acceleration, deceleration and steady acceleration.(ABS and suspension system)
4	Basic gate logic simulation and modeling using Simulink and realization on the hardware platform.
5	Modeling Seat belt warning system, and Vehicle speed control based on the gear input.
6	EGAS modeling and simulation using Simulink and realization on the hardware platform.
7	Interior lighting control modeling with state flow
8	Gear input transmission over CAN bus using ARM Cortex m3 and signal analysis using CANalyzer/BusMaster software. Code driven and Model driven integration for Vehicle speed control function based on the gear input.
	Structured Enquiry
1	Develop Matlab code for stepper motor control and convert it to Simulink model and port it on to an embedded hardware
2	Develop a C code for LCD display device and convert it to Simulink model and port it to embedded hardware/FPGA

Laboratory Title: Minor Project **Lab. Code: 17EEEW302**

Total Hours: 36 **Duration of SEE Hours: 3**

SEE Marks: 50 **CIE Marks: 50**

Students are supposed to carry out the minor project based on the theme and guidelines as given below.

(I) Theme:

Hardware Design and Implementation of Electrical and / or Electronics System for application in Controls, Measurement and Instrumentation, Power Electronics and Drives, Relays, Renewable Energy Systems etc using specialized ICs /Microcontrollers /DSPs.

(II) Project batches and Guide:

Each project batch consists of 3 or 4 students. Students are informed to form their own batch based on the kind of project work and their interest. Each batch is supposed to give four faculty names as guides in the order of their preference. Guides will be allocated based on the preference given by the batch. The primary role of the guide is to supervise the work, provide appropriate guidance in successfully carrying out the project work.

(III) Project implementation

The principle steps in carrying out the project work are summarized below:

Step-1: Literature survey:

A literature survey with regard to the given theme is to be carried out in order to understand the state of the current research. Further, a critical review of the collected literature will facilitate to summarize key observations. Key observations will lead to identifying a specific problem for the project work in terms of alternate/new solution techniques, possible improvements, new formulations or models, hardware implementations etc.

Step-2: Prepare a synopsis:

A synopsis highlights the definition of identified problem and its significance. The synopsis will also contain detailed literature review giving the state of the current research on the selected specialized area. It will also brief the problem formulation, solution methodology, tools employed and possible outcomes.

Step-3: Project implementation:

The work is to be carried out in phase wise manner, testing or analyzing the partial results obtained. Guide will periodically monitor the progress of the work done giving suitable suggestions as required.

(IV) Schedule:

Sl. No.	Activity	Week No.	Evaluation Objectives
1	Announcement for the formation of batches	At the end of the previous semester	NA
2	Allotment of guides	1st - 2nd	NA
3	Submission of Synopsis	3rd - 5th	Literature review, problem formulation, solution methodology, tools employed
4	Review-I	6th - 8th	Literature review, problem formulation, solution methodology, tools employed
5	Review-II	9th -10th	Analysis and implementation (partial)
6	Review-III	12th - 14th	Analysis, complete implementation and results.

Evaluation:

Evaluation of the project work carried out by each batch will be reviewed periodically by a review committee. Review committee consists of guide and two other faculty members who are guiding other batches. Generally, two to three reviews will be held during a semester. However, each project batch will be supervised by the guide on a weekly basis. Review committee will evaluate for 40% and guide will evaluate for 60% of the total marks.

	Assessment	Marks
Continuous Internal Evaluation (50%)	Evaluation by Project Guide	30
	Project Review committee	20
Semester End Examination (50%)	Using SEE Rubrics	50
	Total	**100**

Passing: 40% both in CIE and SEE

Course Code: 18EEEP201 **Title: Data Structure Using C Lab**
L-T-P: 0-0-3 **Credits:3** **Contact Hrs: 4 hrs/week**
CIE Marks: 80 SEE Marks: 20 **Total Marks: 100**
Teaching Hrs: 48hrs **Exam Duration: 3 hrs**

Chapter No.	**Unit-I**	
1	**Programming on pointer concepts**: Pointer concepts,1D and 2D arrays, pointers to functions, memory management functions	02+02 Hrs
2	**Programming on string handling functions using pointers, structures, bit-fields**: Perform string handling functions like String length, String concatenate, Strings compare, String copy and Strings reverse, Implementing Structures, union and bit-field.	02+02 Hrs
3	**Programming on files:** Open, Close, Read, Write and Append the file.	02+02 Hrs
4	**Programming on stack data structures and applications:** Insert delete and display an integer in a stack, Conversion from Infix to postfix & Infix to Prefix, Recursion.	02+02 Hrs
5	**Programming on queue data structures:** Insert at rear end ,delete at front end and display the integers in queue, Deque and circular queue.	02+02 Hrs
6	**Programming on linked lists:** Insert, delete and display a node in Singly Linked List, Doubly Linked List and Circular Linked List.	06+03 Hrs
7	**Programming on trees:** Perform various operations on binary trees, find max, min value in a binary search trees, find the height of a tree, count nodes in a tree, delete a node in a tree.	02+02 Hrs
8	**Programming on sorting:** Merge sort, Quick sort, Heap sort, Shell sort, Radix sort**.**	02+02 Hrs
9	**Programming on graphs:** Compare Breadth First Sort Sort, and Depth First Sort	02+02 Hrs
10	**Programming on hashing tables:** Implement different methods of hash tables.	02+02 Hrs
11	**Open ended experiment:** Implement given Data structures.	02+02 Hrs

Text Books

1 Horowitz, Sahani, Anderson-Feed, “Fundamentals of Data Structures in C”, 2ed,Universities Press, 2008
2 Aaron M. Tenenbaum , “Data Structures Using C”, Pearson Education India, 2003
3 Richard F. Gilberg, Behrouz A. Forouzan “Data Structures: A Pseudocode Approach With C”, 2nd Edition , Course Technology, Oct 2009.

Reference Books:

1 E Balaguruswamy, “The ANSI C programming Language”, 2ed., PHI, 2010.
2 Yashavant Kanetkar, “Data Structures through C”, BPB publications 2010

Course Code: 18EEEC201 **Course Title: Electrical Machines**

L-T-P : 3-0-0 Credits: 3 Contact Hrs: 40

ISA Marks: 50 ESA Marks: 50 Total Marks: 100

Teaching Hrs: 40 Exam Duration: 3Hrs

Chapter No.	**Unit-I**	
1	Transformer : Transformer construction and principle of operation, Ideal Transformer, Practical Transformer, Transformer phasor diagrams, Equivalent circuit of transformers, Open circuit and short circuit tests, Voltage regulation, transformer losses and efficiency, Testing of transformers, Three phase transformers, Auto-transformers.	10 hrs
2	DC Machines: Construction of DC machine and DC machine as generator, EMF equation of DC machine, Operating characteristics of types of DC generators, Operating characteristics of DC motors, DC motor starting, Speed control of DC motors.	05 hrs
	Unit-II	
3	Induction (Asynchronous) Machines: Induction motor as transformer, Principle of operation, Rotor frequency, e.m.f, current and power, Losses and Efficiency, Equivalent circuit, Torque slip and Power-slip characteristics, Determination of equivalent circuit parameters. Circle diagram, Starting of polyphase induction motors.	10 hrs
4	Synchronous Machines: Cylindrical and salient pole machines, Phasor diagram of cylindrical rotor alternator. AC armature winding, Voltage regulation of alternator using e.m.f method.	05 hrs
	Unit-III	
5	Synchronous Machines: Synchronous motor phasor, Power angle characteristic of synchronous machine, Measurement of Xd and Xq, Capability curves of synchronous generators, Power factor correction by synchronous motors.	5 hrs
6	Single phase induction machines: Double field revolving theory, Equivalent circuit, Resistance split phase motors, capacitor start motor, permanent capacitor motor, two-value capacitor motor, shaded-pole motor. Performance and cost comparison and choice of single phase induction motors.	5 hrs

Text Books

1 P. C. Sen, “Principles of Electric Machines and Power Electronics”, John Wiley & Sons Publications, Canada, 2nd Edition, 2001.

Reference Books:

1 Bhimbra, “Principles of Electrical machinery”, Khanna Publishers.2006.

2 D. P. Kothari and I. J. Nagrath, “Electrical Machines”, MGH Publishers. 4th Edition, 2011.

3 Fitzgerald, Kingsly & Stephen, “Electric Machinery”, 5ed., McGraw Hill, 1992

Laboratory Title: Control System Lab **Lab. Code: 18EEEP202**
Total Hours: 32 **Duration of Exam: 02**
Total Exam Marks: 20 **Total ISA. Marks: 80**

Category: Demonstration	**Total Weightage: 10.00 No. of lab sessions: 2.00**
Expt./ Job No.	**Experiment/job Details**
1	Demonstration of heat tank simulator without controller using Labview Interactive learning model
2	Demonstration of temperature control of liquid tank simulator using Labview Interactive learning model
Category: Exercises	**Total Weightage: 40.00 No. of lab sessions: 5.00**
Expt./ Job No.	**Experiment/job Details**
1	Time response specifications of second order system
2	Frequency response of second order system
3	P,PI and PID controllers-effect on plant step response
4	Lag and Lead Compensators- determination of frequency response
5	Determination of Phase and Gain margin
Category: Structured Enquiry	**Total Weightage: 30.00 No. of lab sessions: 4.00**
Expt./ Job No.	**Experiment/job Details**
1.	Each batch consisting of 4 students work on a given design problem- To employ MATLAB to design compensator/controller for a system to meet given specifications and analyze the performance by simulating the time and frequency responses. To submit a technical report (consisting of objectives, specifications set, list of assumptions, design formulation, design calculations, simulation results, design validation)

Course Title: Digital System Design using Verilog **Course Code: 18EEEP203**
L-T-P: 0-0-2 **Credits: 2** **Contact Hours: 4Hrs/week**
ISA Marks: 80 **SEA Marks:20** **Total Marks: 100**
Teaching + Lab. Hours: 48 Hrs **Examination Duration: 2 Hrs**

1.	Chapter No. 1. Architecture of FPGA Architecture of FPGS: Spartan 3, What Is HDL, Verilog HDL Data Types and Operators.	4hrs
2.	Chapter No. 2. Data Flow Descriptions Highlights of Data-Flow Descriptions, Structure of Data-Flow Description, Data Type – Vectors, Testbench.	6 hrs
3.	Chapter No. 3. Behavioral Descriptions Behavioral Description highlights, structure of HDL behavioral Description, The VHDL variable –Assignment Statement, sequential statements, Tasks and Functions	10 hrs
4.	Chapter No. 4. Structural Descriptions Highlights of structural Description, Organization of the structural Descriptions, Binding, state Machines, Generate, Generic, and Parameter statements	10 hrs
5.	Chapter No. 5:Finite State Machine: Moore Machines, Mealy Machines	4hrs
6.	Chapter No. 6:Timing Issues in Digital Circuits: Setup Time Constraints, Hold Time Constraints, Static Time analysis, Critical Path, Clock Skew.	6hrs
7.	Chapter No. 7. Advanced HDL Descriptions File operations in Verilog, Memories: RAM, ROM, Block Memories(Xilinx IP)	8hrs

Course Code: 18EEEC301 **Course Title: Linear Integrated Circuits**

L-T-P: 3-0-0 Credits: 3 Contact Hrs: 40

CIE Marks: 50 SEE Marks: 50 Total Marks: 100

Teaching Hrs: 40 Exam Duration: 3 hrs

Chapter No.	Unit-I	
1	**Current Mirrors** Current Mirror circuits and Modeling, Figures of merit (output impedance, voltage swing), Widlar, Cascode and Wilson current Mirrors, Current source and current sink.	05 Hrs
2	**Basic OPAMP architecture** Basic differential amplifier, Common mode and difference mode gain, CMRR, 5-pack differential amplifier, 7-pack operational amplifier, Slew rate limitation, Instability and Compensation, Bandwidth and frequency response curve	06 Hrs
3	**OPAMP characteristics** Ideal and non-ideal OPAMP terminal characteristics, Input and output impedance, output Offset voltage, Small signal and Large signal bandwidth.	04 Hrs
	Unit-II	
4	**OPAMP with Feedback** OPAMP under Positive and Negative feedback, Impact Negative feedback on linearity, Offset voltage, Bandwidth, Input and Output impedances,Follower property, Inversion property	05Hrs
5	**Linear applications of OPAMP** DC and AC Amplifiers, Voltage Follower, Summing, Scaling and Averagingamplifiers (Inverting, Non-inverting and Differential configuration), Integrator, Differentiator, , Currentamplifiers, Instrumentation amplifier,Phase shifters, Voltage to current converter, Phase shift oscillator, Weinbridge oscillator, Active Filters –First and second order Low pass & High pass filters.	10 Hrs
	Unit-III	
6	**Nonlinear applications of OPAMP** Crossing detectors (ZCD. Comparator),Schmitt trigger circuits, Monostable & Astable multivibrator, Triangular/rectangular wave generators, Waveform generator, Voltage controlled Oscillator,Precisionrectifiers, Limiting circuits.Clamping circuits, Peak detectors, sample and hold circuits, Log and antilog amplifiers, Multiplier and divider Amplifiers, Voltage Regulators.	10 Hrs

Text Books

1 Sedra and Smith, “Microelectronics ”, 5th edition , Oxford University Press.

2 Ramakant A. Gayakwad, “Op - Amps and Linear Integrated Circuits”, 4th edition, PHI.

Reference Books:

1 Robert. F. Coughlin &Fredrick F. Driscoll, “Operational Amplifiers and Linear Integrated Circuits”, PHI/Pearson, 2006.

2 James M. Fiore, “Op - Amps and Linear Integrated Circuits”, Thomson Learning, 2001

3 Sergio Franco, “Design with Operational Amplifiers and Analog Integrated Circuits”, TMH, 3e, 2005

4 David A. Bell, “Operational Amplifiers and Linear IC’s”, 2nd edition, PHI/Pearson, 2004

Course Code: 18EEEP301 **Course Title: Data Structure Using C Lab**

L-T-P: 0-0-3 Credits: 3 Contact Hrs: 48

CIE Marks: 20 SEE Marks: 80 Total Marks: 100

Teaching Hrs: 48 Exam Duration: 2 hrs

Chapter No.	**Unit-I**	
1	**Programming on pointer concepts**: Pointer concepts,1D and 2D arrays, pointers to functions, memory management functions	02+02 Hrs
2	**Programming on string handling functions using pointers, structures, bit-fields**: Perform string handling functions like String length, String concatenate, Strings compare, String copy and Strings reverse, Implementing Structures, union and bit-field.	02+02 Hrs
3	**Programming on files:** Open, Close, Read, Write and Append the file.	02+02 Hrs
4	**Programming on stack data structures and applications:** Insert delete and display an integer in a stack, Conversion from Infix to postfix & Infix to Prefix, Recursion.	02+02 Hrs
5	**Programming on queue data structures:** Insert at rear end ,delete at front end and display the integers in queue, Deque and circular queue.	02+02 Hrs
6	**Programming on linked lists:** Insert, delete and display a node in Singly Linked List, Doubly Linked List and Circular Linked List.	06+03 Hrs
7	**Programming on trees:** Perform various operations on binary trees, find max, min value in a binary search trees, find the height of a tree, count nodes in a tree, delete a node in a tree.	02+02 Hrs
8	**Programming on sorting:** Merge sort, Quick sort, Heap sort, Shell sort, Radix sort**.**	02+02 Hrs
9	**Programming on graphs:** Compare Breadth First Sort Sort, and Depth First Sort	02+02 Hrs
10	**Programming on hashing tables:** Implement different methods of hash tables.	02+02 Hrs
11	**Open ended experiment:** Implement given Data structures.	02+02 Hrs

NOTE: The pseudo codes for different data structures and algorithms to be based on standard problems from geeksforgeeks website.

Laboratory Title: Control System Lab **Lab. Code: 18EEEP302**
Total Hours: 32 **Duration of Exam: 02**
Total Exam Marks: 20 **Total ISA. Marks: 80**

Category: Demonstration	**Total Weightage: 10.00 No. of lab sessions: 2.00**
Expt./ Job No.	**Experiment/job Details**
1	Demonstration of heat tank simulator without controller using Labview Interactive learning model
2	Demonstration of temperature control of liquid tank simulator using Labview Interactive learning model
Category: Exercises	**Total Weightage: 40.00 No. of lab sessions: 5.00**
Expt./ Job No.	**Experiment/job Details**
1	Time response specifications of second order system
2	Frequency response of second order system
3	P,PI and PID controllers-effect on plant step response
4	Lag and Lead Compensators- determination of frequency response
5	Determination of Phase and Gain margin
Category: Structured Enquiry	**Total Weightage: 30.00 No. of lab sessions: 4.00**
Expt./ Job No.	**Experiment/job Details**
1.	Each batch consisting of 4 students work on a given design problem- To employ MATLAB to design compensator/controller for a system to meet given specifications and analyze the performance by simulating the time and frequency responses. To submit a technical report (consisting of objectives, specifications set, list of assumptions, design formulation, design calculations, simulation results, design validation)

Course Code: 17EEEP306 **Course Title: RTOS Lab**
L-T-P: 0-0-1 **Credits: 1** **Contact Hrs: 32**
CIE Marks: 20 **SEE Marks: 80** **Total Marks: 100**
Teaching Hrs: 32 **Exam Duration: 2 hrs**

Expt No.	List of Experiments
1	Write a C program to use on chip Timers in LPC2148 and generate required delay
2	Write a C program to demonstrate the concept of basic RTOS programming by using RTX RTOS
3	Write a 'C' program & demonstrate concept of Round Robin Task Scheduling.
	Write a C program to demonstrate the concept of basic preemptive scheduling algorithm by using RTX RTOS
4	Write a 'C' program & demonstrate concept of Events and Flags for inter task communication using RTX RTOS
5	Write a 'C' program & demonstrate concept of Mailbox.
6	Write a 'C' program & demonstrate concept of Semaphore.
7	Write a 'C' program & demonstrate concept of interrupts(hardware and software)
	Write a C program to interface I2C-RTC with LPC2148
8	Write a C program to interface SPI-EEPROM with LPC2148
	Structured Enquiry
9	Real-Time OS Application which successfully demonstrates the use of various RTOS concepts

Course Code: 18EEEC302 **Course Title: Electric Drives & Control**
L-T-P: 2-0-1 **Credits: 3** **Contact Hrs: 30**
ISA Marks: 50 **ESA Marks: 50** **Total Marks: 100**
Teaching Hrs: 30 **Exam Duration: 3 hrs**

Content	Hrs
Unit 1	
Chapter 1: Introduction to electric drives: Fundamental torque equation, speed toque conventions and multi-quadrant operation, components of load torque, nature and classification of load torques **Control of electric drives:** Closed loop control of drives: current limit control, closed loop torque control, closed loop speed control.	04Hrs
Chapter 2: DC motor drives: DC motor and their performance: shunt and separately excited motors, series motors, permanent magnet motors. Braking: regenerative braking, dynamic braking, plugging. Speed control, methods of armature control, chopper controlled dc drives, chopper control of separately excited dc motors, chopper control of series motor.	06 hrs
Unit 2	
Chapter 3: Induction motor drives: Three phase induction motor: analysis and performance, Braking: regenerative braking, Plugging or reverse voltage braking, speed control, variable frequency control from voltage sources, Voltage Source Inverter (VSI) Control: VSI induction motor drives, braking and multi-quadrant operation of VSI induction motor drives. Closed loop speed control and converter rating of VSI induction motor drives.	10 hrs
Unit 3	
Chapter 4: Permanent magnet synchronous machines and BLDC drives: Permanent magnet synchronous motors, Electromotive force EMF (voltage induced), Electromagnetic (developed) torque, Vector control concepts, drive system schematics, control strategies, Permanent magnet DC brushless motors and its working principle.	05 hrs
Chapter 5: Switched Reluctance Motor drives: What is a switched reluctance machine, Aligned and unaligned positions, Electromagnetic torque, Power electronics converters for SRMs: Current hysteresis control, Voltage PWM control.	05 hrs

Text Book

1. G. K Dubey, “Fundamentals of Electrical Drives”, 2, Narosa Publishing House, Chennai, 2002
2. R. Krishnan, Permanent Magnet Synchronous and Brushless DC Motor Drives, CRC Press, Taylor & Francis Group, 2010.

References

1. T. J. E.Miller, “Brushless Permanent-Magnet and Reluctance Motor Drives”, Oxford Science Publications, 1989.
2. Jacek F. Gieras, “Electrical Machines: Fundamentals of Electromechanical Energy Conversion”, CRC Press, Taylor & Francis Group, 2017.

Course Title: Digital System Design using Verilog **Course Code: 18EEEP303**
L-T-P: 0-0-2 **Credits: 2** **Contact Hours: 4Hrs/week**
ISA Marks: 80 **SEA Marks:20** **Total Marks: 100**
Teaching + Lab. Hours: 48 Hrs **Examination Duration: 2Hrs**

1.	Chapter No. 1. Architecture of FPGA Architecture of FPGS: Spartan 3, What Is HDL, Verilog HDL Data Types and Operators.	4hrs
2.	Chapter No. 2. Data Flow Descriptions Highlights of Data-Flow Descriptions, Structure of Data-Flow Description, Data Type – Vectors, Testbench.	6 hrs
3.	Chapter No. 3. Behavioral Descriptions Behavioral Description highlights, structure of HDL behavioral Description, The VHDL variable –Assignment Statement, sequential statements, Tasks and Functions	10 hrs
4.	Chapter No. 4. Structural Descriptions Highlights of structural Description, Organization of the structural Descriptions, Binding, state Machines, Generate, Generic, and Parameter statements	10 hrs
5.	Chapter No. 5:Finite State Machine: Moore Machines, Mealy Machines	4hrs
6.	Chapter No. 6:Timing Issues in Digital Circuits: Setup Time Constraints, Hold Time Constraints, Static Time analysis, Critical Path, Clock Skew.	6hrs
7.	Chapter No. 7. Advanced HDL Descriptions File operations in Verilog, Memories: RAM, ROM, Block Memories(Xilinx IP)	8hrs

Course Code:17EEEC401 **Course Title: Switched Mode Power Converters**

L-T-P-SS: 3-0-0 Credits: 3 Contact Hrs: 40

CIE Marks: 50 SEE Marks: 50 Total Marks: 100

Teaching Hrs: 40 Exam Duration: 3 hrs

Chapter No.	Unit-I	
1	**Chapter No. 1.DC Power Supplies:** Introduction, transformer models, the flyback converter: Continuous Current Mode, Discontinuous Current Mode, Summary of flyback converter operation, the forward converter, summary of forward converter, operation, the doubly ended (two switch)forward converter, the push-pull converter, summary of push-pull converter operation, full-bridge and half-bridge DC-DC converters, multiple outputs, converter selection, power factor correction, simulation of DC power supplies, pwm control circuits, the Ac line filter, the complete DC power supply .	15 hrs
	Unit-II	
2	**Chapter No. 2. DC-AC Switched Mode Inverters** Introduction, basic concepts of switch-mode inverters, single phase inverters, three phase inverters, effect of blanking time on output voltage in inverters, other inverter switching schemes, rectifier mode of operation.	15 hrs
	Unit-III	
3	**Chapter No. 3. Multilevel Converters:** Introduction, Generalized topology with a Common DC Bus, Converters Derived from the Generalized Topology, Diode Clamped Topology, Flying Capacitor Topology,	05 hrs
4	**Diode Clamped Multilevel Converters:** Introduction, Converters structure and Functional description: voltage clamping, switching logic, Modulation of multilevel converters, Multilevel space vector modulation	05 hrs

Text Books

1 Ned Mohan, T. M. Undeland and W. Robbins, Power Electronics: Converters, Applications and Design, 2, John Wiley and Sons, 1995

2 Daniel W Hart, Power Electronics, 1, Tata McGRAW-HILL, 2011

3 YorkSergio Alberto González, Santiago Andrés Verne, María Inés Valla, Multilevel converters for Industrial Applications, CRC Press, 2014 .

Reference Books:

1 Rashid M. H, Power Electronics: Circuits, Devices and Applications, 3, PHI, 2005

2 Bose B. K., , Power Electronics and AC Drives, 5, PHI, 2003

3 Rashid M. H, Digital Power Electronics and Applications, 1, Elsevier, 2005

4 V. Ramanarayanan, Switched Mode Power Converters Notes, IISC, Bangalore, 2008

Laboratory Title: **Soft Computing Lab** Lab. Code: 17EEEP401

Total Hours: **32** Credits: L-T-P**: 0-0-1** Credits: **1** Duration of SEE Hours: 2

SEE Marks: **20** CIE Marks: **80**

Category: Demonstration	
Expt./ Job No.	**Experiment / Job Details**
1	Demonstration of Fuzzy, Genetic and PSO programs/tool-box of MATLAB
Category: Exercise	
2	Fuzzy based Automatic Generation controllers for isolated and two-area power system.
3	GA, DE and PSO optimization of PI/PID controllers for AGC
4	GA, DE and PSO based optimal load dispatch for multi-machine power systems.
Category: Structured Enquiry	
1.	Formulation and Simulation of Fuzzy logic based PSS for SMIB power system
2.	PSS Design for SMIB power system using GA/ PSO/ DE algorithms

Laboratory Title: **Relay & High Voltage Engineering Lab** Lab. Code: 17EEEP402
Total Hours: **32** Credits: L-T-P**: 0-0-2** Credits: 2 Duration of SEE Hours: 2
SEE Marks: **20** CIE Marks: **80**

Expt./ Job No.	**Experiment / Job Details**	
Category: Exercise		
1	Introduction Session	2 hrs
2	To obtain the inverse time characteristics of a given fuse wire and wires of different lengths.	2hrs
3	To obtain the inverse time characteristics of an electromagnetic over current relay	2hrs
4	To obtain the operating characteristics of microprocessor based differential relay.	2hrs
5	To obtain the operating characteristics of microprocessor based directional over current relay.	2hrs
6	To obtain the breakdown strength of air using Copper sphere gap with HVAC and HVDC.	2hrs
7	a) To obtain the breakdown strength of air using different pairs of electrode gap with HVAC and HVDC. b) To obtain the breakdown voltage of a solid dielectric. c) To obtain the breakdown voltage of a liquid dielectric.	2hrs
Category: Structured Enquiry		
1.	To develop microcontroller based overcurrent, over voltage and impedance relay using CT /PT giving details of program and demonstrate it's working output.	4hrs

Laboratory Title: **Capstone Project** Lab. Code: 18EEEW401

Credits: L-T-P**: 0-0-14** Credits: 14 Duration of SEE Hours: 3

SEE Marks: **50** CIE Marks: **50**

Capstone Project Guidelines

(I) Preamble

A project work essentially gives the students a platform to integrate the concepts studied during the study, enhance their analytical capabilities and develop abilities to effectively communicate technical information in multiple formats. During the course of projects, students are asked to follow the research methodology in identifying a problem of their interest though literature survey, carry-out feasibility study, formulate the problem, develop mathematical models, select suitable solution technique etc. Students are also encouraged to develop new formulations, alternate solution techniques, study and apply new optimization algorithms, develop new simulation models and use modern engineering/simulation tools.

(II) Project batch and Guide

Each project batch consists of 3 or 4 students. Students will be informed to form their own batch based on the kind of project work and their interest. Each batch is supposed to give four faculty names as guides based on faculty expertise in the order of their preference. Guides will be allocated based on the preference given by the batch. The primary role of the guide is to supervise the work, give appropriate guidance in successfully carrying out the project work.

(III) Project implementation

The principal steps in carrying out the project work are summarized below:

Step-1: Selection of a specialized area for the project work

A specialized area in which the project work is to be carried out depends on the interest and specialized skills acquired by the project team. This includes areas such as power system analysis, power system dynamics, renewable energy, electric drives, VLSI & Embedded system, Power quality issues etc. The proposed work may include simulation studies, hardware implementation or both.

Step-2: Selection of topic based on literature survey

A literature survey in the selected specialized area is to be carried out in order to understand the state of the current research. Further, a critical review of the collected literature will facilitate to summarize key observations. Key observations will lead to identifying a specific problem for the project work in terms of alternate/new solution techniques, possible improvements, new formulations or models, hardware implementations etc.

Step-3: Prepare a synopsis

A synopsis highlights the definition of identified problem and its significance. The synopsis will also contain detailed literature review giving the state of the current research on the selected specialized area. It will also brief the problem formulation, solution methodology, tools employed and possible outcomes.

Step-4: Project implementation

The work is to be carried out in phase wise manner, testing or analyzing the partial results obtained. Guide will periodically monitor the progress of the work done giving suitable suggestions as required.

(IV) Schedule

Sl. No.	Activity	Week No.	Evaluation Objectives
1	Announcement to form the batches	At the end of the previous 7^{th} sem	NA
2	Allotment of guides	1^{st} - 2^{nd}	NA
3	Submission of Synopsis	4^{th}- 5^{th}	Literature review, problem formulation, methodology by respective Guides
4	Review-I	6^{th} - 8^{th}	Literature review, problem formulation, methodology, tools used in the presence Review Committee
5	Review-II	9^{th} -10^{th}	Implementation and analysis done
6	Review-III	12^{th} - 14^{th}	Completion along with Hardware/ Software/ Report. Results and Conclusions.

(V) Evaluation

Evaluation of the project work carried out by each batch will be reviewed periodically by a review committee. Review committee consists of guide and two/ three other faculty members who are guiding other batches. Generally, two to three reviews will be held during a semester. However, each project batch will be supervised by the guide on a weekly basis. Review committee will evaluate for 40% and guide will evaluate for 60% of the total marks.

Activity	Assessment	Marks
ISA (50%)	Project Review committee	20
	Evaluation by Project Guide	30
ESA (50%)	Using ESA Rubrics	50
	Total	**100**

Passing: 40% both in ISA and ESA

Review Committee Evaluation Schedule

Activity	Week	Marks
Review I: Problem Definition	6^{th}	05
Review II: Progress	8^{th}	05
Review III: Results & Conclusions	12^{th}	10
Guide Evaluation	12^{th}	30
Total		**50**

In Semester Assessment (ISA)

Review	Phases of the project	PI	Marks
1	Identification of problem, Literature survey, Methodology	2.4.1	10 Marks
	Relevance of project topic literature review	2..4.1	
	Tools/ Software/ Hardware using	2.2.3	
	Team and Individual Work	9.2.1	
2	Develop models and simulate power/ energy/ electronics systems using appropriate engineering tools	13.1.1	10 Marks
	Presentation and communication skills	10.3.2	
	Design/ Development of solutions	3.4.1	
	Investigation of complex problems	4.3.4	
	Work done	2.2.3	
	Team and Individual Work	9.2.1	
3	Develop models and simulate power/ energy/ electronics systems using appropriate engineering tools	13.1.1	30 Marks
	Work done	2.2.3	
	Design/ Development of solutions	3.4.1	
	Investigation of complex problems	4.3.4	
	Analysis and Results	3.4.1	
	Team and Individual Work	9.2.1	
Total (Average of three reviews)			50 Marks

End Semester Assessment (ESA)

CAPSTONE PROJECT					
End Semester Assessment (ESA)	**Group Evaluation**		**PO Assessed**	**PI Assessed**	**Weightage**
	Relevance of project topic and Literature review	• Problem identification • Problem objectives and scope	2	2.2.3 2.4.1	30%
	Quality and Quantity of work reported	• Problem formulation • Contribution to the field of knowledge • Experimentation/simulation • Analysis of results • Drawing conclusions • Assumptions and justifications	2 3 4 13	2.4.2 13.1.1 3.4.1 4.3.4	40%
	Quality of presentation and report	• Organization of the report/presentation • Clarity of language • Clarity of illustrations and Tables	10	10.3.2	20%
	Individual Evaluation				
	Presentation/ Communication skills	• Clarity of language • Technical Knowled	10	10.3.2	5%
	Viva Voce	• Demonstration of clear understanding of the concept	10	10.3.2	5%

Course Code: 19EEEC202

Course Title: Electrical Power Generation, Transmission & Distribution

L-T-P-Self Study: 3-0-0-0 | **Credits: 3** | **Contact Hrs: 40**

ISA Marks: 50 | **ESA Marks: 50** | **Total Marks: 100**

Teaching Hrs: 40 | **Exam Duration: 3 hrs**

Content	Hrs
Unit - 1	
Chapter No. 1. Generating Stations. selection of Site, Classification, General arrangement and operation of Hydroelectric plant with components, General arrangement and operation of Thermal power plant with components, General arrangement and operation of Nuclear power plant with components, Safety of Nuclear power reactor, storing and processing of spent fuel.	5 hrs
Chapter No. 2. Substations and Economic operations Sub stations : Types, Bus-bar arrangement Schemes, location and substation equipment's Economics :Important terms and curves commonly used in system operation, effect of Voltage and frequency on loads , Scheduling of generators, Choice of size and number of generator units, Interconnection of power stations	5 hrs
Chapter No. 3.Typical Transmission & distribution systems Introduction, electric supply system, comparison of AC and DC systems, Standard Voltages of Transmission & Distribution. . Advantages of High Voltage Power Transmission. (effect of increase in voltage on weight of conductor, Line Efficiency & Line Voltage Drop) Feeders, Distributors & Service Mains. Conductor types.	2 hrs
Chapter No. 4. Overhead Transmission Line (Mechanical Design) Overhead transmission lines: introduction, components of a typical OH system. Line supports & placing of the conductors, single phase and three phase systems. Single circuit and double circuit.. Spacing of conductors, Length of span & Sag in OH lines. Sag calculation in conductors. (a) Suspended on level supports. (b) Supports at different levels. Effect of wind and ice. Tension and sag at erection. Corona Phenomena & Factors affecting corona in OH lines Expressions for Critical disruptive & visual critical voltage. and corona power loss	3 hrs
Unit - 2	
Chapter No. 5. Line parameters (Electrical Design) Introduction to transmission line constants i.e. Resistance, Inductance and capacitance . Distributed resistance of the transmission line, skin effect and proximity effect. Inductance of the single phase & three phase lines. Inductance calculation with equilateral and unsymmetrical spacing of the lines. Transposition of line conductors. Capacitance for single phase & three phase lines. Effect of earth on capacitance of the line. Numerical solutions on resistance calculations. Inductance & Capacitance calculations.	7 hrs
Chapter No. 6. Characteristics & Performance of Power transmission lines:	8 hrs

Introduction to Short transmission lines, calculations for short lines. Medium transmission lines. Nominal-T and representation for transmission lines Long transmission lines. Long line solutions by Rigorous method, equivalent models, ABCD constants. .	
Unit - 3	
Chapter No. 7. Insulators Materials of insulators. Different types of insulators. Potential distribution over a string of suspension insulators. String efficiency and methods of increasing string efficiency. Testing of insulators.	5 hrs
Chapter No. 8. Underground Cables Underground Cables: Types of cables & material used for Insulation. Resistance, thermal rating of cables & charging current, Grading of cables Capacitance grading and inter sheath grading, testing of cables.	5 hrs

Text Books

1. Skrotzki and Wavopat, Power station Engineering and economics ., McGraw Hill, 1995

References

1. Soni, Gupta and Bhatnagar, A Course in Electrical Power, Dhanpatrai, 2014
2. S M Singh, Electric Power generation , transmission and Distribution., Prentice Hall of India., 2012
3. J B Gupta., Transmission and Distribution of Electrical power., Kataria, 2012

V K Metha and Rohit Metha., Principles of Power System., S Chand & Company Ltd.,

Course Code: 19EEEC201 **Course Title: Circuit Analysis**
L-T-P-SS: 4-0-0 **Credits: 4** **Contact Hrs: 50**
CIE Marks: 50 **SEE Marks: 50** **Total Marks: 100**
Teaching Hrs: 50 **Exam Duration: 3 hrs**

Chapter No.	Unit-I	Hrs
1	**Network Equations :**Source Transformation, Star Delta transformation, Nodal Analysis, Super node, Mesh Analysis, Super mesh, Duality, Network Topology, Tie Set and Cut Set matrix formulation, Dot convention.	8 hrs
2	**Network Theorems :**Homogeneity, Superposition and Linearity, Thevenin's & Norton's Theorems, Maximum Power Transfer Theorem, Milman's theorem, Reciprocity principle, Application of theorems to both ac and dc networks	8 hrs
3	**Two Port Networks :**Two port variables, Z,Y, H,G, A- Parameter representations, Input and output impedance calculation, Series, Parallel and Cascade network connections, and their (suitable) models.	4 hrs
	Unit-II	
4	**First order circuits :**Order of a system, Concept of Time constant, System Governing equation, System Characteristic equation, Basic RL & RC circuit, Transient response with initial conditions , Frequency response characteristics, R-C , R-L circuits as differentiator and integrator models, time and frequency domain responses R-C , R-L circuits as Low pass and high pass filters	8 hrs
5	**Higher order circuits:** Higher order R-C, R-L, and R-L-C networks, time domain and frequency domain representation, Series R-L-C circuit, Transient response, Damping factor, Quality factor, Frequency response curve , Peaking of frequency curve and its relation to damping factor, Resonance Parallel, R-L-C circuit, Tank circuit, Resonance, Quality factor and Bandwidth	12 hrs
	Unit-III	
6	**Sinusoidal Steady state analysis :** Characteristics of sinusoids, Forced response to sinusoidal functions, The complex forcing function, Phasors & Phasor diagrams.	5 hrs
7	**Polyphase Circuits :** Polyphase systems, Single Phase three wire system, Three phase Y-Y connection, Delta connection, Analysis of balanced & unbalanced three phase circuits.	5 hrs

Text Books

1 W H Hayt, J E Kemmerly, S M Durban, Engineering Circuit Analysis, 6th, McGraw Hil, 2006
2 M E. Van Valkenburg, Network Analysis, 3rd, Pearson Ed, 2006

Reference Books:

1 Joseph Edminister, Mahmood Nahavi, Electric Circuits, 3rd, Tata McGra, 1991
2 Bruce Carlson, Circuits, 3rd, Thomson Le, 2002
3 V. K. Aatre, Network Theory and Filter Design, 2nd, Wiley West, 2002
4 Anant Agarwal and Jeffrey H Lang, Foundations of Analog & Digital Electronics Circuits, 3rd, Morgan Kau, 2006
5 Muhammad H . Rashid, Introduction to PSPICE using OrCAD for circuits and Electronics, 3rd, Pearson Ed, 2005

Course Code: 19EEEC203 **Course Title: Digital Circuits**

L-T-P-Self Study: 4-0-0 **Credits: 4** **Contact Hrs: 50**

ISA Marks: 50 **ESA Marks: 50** **Total Marks: 100**

Teaching Hrs: 50 **Exam Duration: 3 hrs**

Content	Hrs
Unit – 1	
Chapter No. 1. Logic Families Logic levels, output switching times, fan-in and fan-out, comparison of logic families	2 hrs
Chapter No. 2.Principles of Combinational Logic Definition of combinational logic, canonical forms, Generation of switching equations from truth tables, Karnaugh maps-3,4 variables, Incompletely specified functions(Don't care terms),Simplifying Maxterm equations, Quine-McCluskey minimization technique- QuineMcCluskey using don't care terms, Reduced Prime Implicant Tables.	8 hrs
Chapter No. 3.Analysis and design of combinational logic General approach, Decoders-BCD decoders, Encoders, Digital multiplexers- Using multiplexers as Boolean function generators. Adders and subtractors-Cascading full adders, Look ahead carry adders, Binary comparators.	10 hrs
Unit – 2	
Chapter No. 4.Introduction to Sequential Circuits Basic Bistable Element, Latches, A SR Latch, Application of SR Latch, A Switch De bouncer, The SR Latch, The gated SR Latch, The gated D Latch, The Master-Slave FlipFlops (Pulse-Triggered Flip-Flops): The Master-Slave SR Flip-Flops, The Master-Slave JK Flip-Flop, Edge Triggered Flip-Flop: The Positive Edge-Triggered D Flip-Flop, Negative- Edge Triggered D Flip-Flop; Characteristic Equations	10 hrs
Chapter No. 5. Analysis of Sequential Circuits Registers and Counters, Binary Ripple Counters, Synchronous Binary counters, Ring and Johnson Counters, Design of a Synchronous counters, Design of a Synchronous Mod-n Counter using clocked JK Flip-Flops Design of a Synchronous Mod-n Counter using clocked D, T or SR Flip-Flops.	10 hrs
Unit – 3	
Chapter No. 6. Sequential Circuit Design Introduction to Sequential Circuit Design, Mealy and Moore Models, State Machine notations, Synchronous Sequential Circuit Analysis, Construction of state Diagrams and counter design.	5 hrs

Chapter No. 7. Introduction to memories Introduction and role of memory in a computer system, memory types and terminology, Read Only memory, MROM, PROM, EPROM, EEPROM, Random access memory, SRAM, DRAM, NVRAM.	5 hrs

Text Books (List of books as mentioned in the approved syllabus)

1. Donald D Givone, Digital Principles and Design, Tata McGraw Hill, 2002
2. John M Yarbrough, Digital Logic Applications and Design, Thomson Learning, 2001
3. A Anand Kumar, Fundamentals of Digital Circuits, PHI, 2003

References

1. Charles H Roth, Fundamentals pf Logic Design, Thomson Learning, 2004
2. R.D.Sudhaker Samuel, Logic Design, Sanguine Technical Publishers, 2005
3. R P Jain, Modern Digital Electronics, Tata McGraw, 2000

Course Code: 19EEEC204 **Course Title: Electrical Machines**
L-T-P : 4-0-0 **Credits: 3** **Contact Hrs: 50**
ISA Marks: 50 **ESA Marks: 50** **Total Marks: 100**
Teaching Hrs: 50 **Exam Duration: 3Hrs**

Content	Hrs
Unit – 1	
Chapter 1: Transformers: Single phase transformer- Principle of operation and construction, Ideal transformer, Real transformer, Phasor diagrams, Equivalent circuit, Open-circuit test, Short-circuit test, Voltage regulation, Efficiency, Three phase transformers.	**09 hours**
Chapter 2: Three Phase Induction Machines: Principle of energy conversion in machines, Construction, Fundamental relationships- Slip, Rotor speed, Input power, Electromagnetic power, Electromagnetic (developed) torque, Mechanical power, Efficiency, Shaft torque. , Equivalent circuit, Analogies between induction machine and transformer, No-load and locked-rotor tests, Torque-speed characteristics, Starting, Speed control. Inverter fed induction motor.	**11 hours**
Unit – 2	
Chapter 3: DC Machines: Principle of operation, Construction of DC machine, Fundamental equations, Armature reaction, Classification of DC machines, DC generators, DC motors, Starting, Speed control of DC motors ,Braking, Switched Reluctance Machines- Construction, principle of operation , Aligned and unaligned positions, Electromagnetic torque, Advantages, disadvantages and Applications of SRMs, Steady state analysis of SRM. BLDC motor Construction and operation.	**12 hours**
Chapter 4: Synchronous Machines: Construction, Classification of synchronous machines, Electromotive force induced in armature winding, Generator and motor operation, Phasor diagrams of synchronous machine with Non-salient pole rotor and salient pole rotor, Voltage regulation calculation by EMF and MMF method, Synchronous motor, Synchronous motor as a synchronous condenser, Study of V and inverted V curves.	**08 hours**
Unit – 3	
Chapter 5: Synchronous Machines: Permanent magnet synchronous motors, Air gap magnetic flux density, Equivalent circuit of PM synchronous machine, Phasor diagram, Performance Characteristics of PM synchronous machine, Starting.	**05 hours**
Chapter 6: Single phase induction motors: Double revolving field theory, Equivalent circuit, Split-phase induction motor, Capacitor-start induction motor, Permanent split capacitor induction motor, Capacitor start capacitor-run induction motor, and Shaded pole induction motor.	**05 hours**

Text Book

1. Jacek F. Gieras, “Electrical Machines: Fundamentals of Electromechanical Energy Conversion”, CRC Press, Taylor & Francis Group, 2017.

References

1. P. C. Sen, “Principles of Electric Machines and Power Electronics”, John Wiley & Sons Publications, Canada, 2nd Edition, 2001.

2. Bhimbra, “Principles of Electrical machinery”, Khanna Publishers.2006.
3. Mehrdad Ehsani…[et al.],“Modern electric, Hybrid electric, and Fuel Cell Vehicles: fundamentals, theory, and design.”, CRC Press, 2005.
4. T. J. E.Miller, “Brushless Permanent-Magnet and Reluctance Motor Drives”, Oxford Science Publications, 1989.

Course Title: Signals and Systems		**Course Code: 19EEEC205**	**Teaching Hrs.**
L-T-P: 3-0-0	**Credits:3**	**Contact Hours: 3Hrs/week**	
ISA Marks: 50	**SEA Marks:50**	**Total Marks: 100**	
Teaching Hours: 40 Hrs	**Examination Duration: 3 Hrs**		

1.	**Chapter No. 1. Introduction and Classification of signals:** Definition of signal and systems. Sampling of analog signals, Continuous time and discrete time signal, Classification of signals as even, odd, periodic and non-periodic, deterministic and non-deterministic, energy and power. Elementary signals/Functions: exponential, sine, impulse, step and its properties, ramp, rectangular, triangular. Operations on signals: Amplitude scaling, addition, multiplication, differentiation, integration, time scaling, time shifting and time folding. Systems: Definition, Classification: linear and nonlinear, time variant and invariant, causal and non-causal, static and dynamic, stable and unstable, invertible.	8hrs
2.	**Chapter No. 2. Time domain representation of LTI System:** Definition of impulse response, convolution sum, convolution integral ,computation of convolution sum using graphical method for unit step to unit step, unit step to exponential, exponential to exponential, unit step to rectangular and rectangular to rectangular only. Properties of convolution.	7hrs
3.	**Chapter No. 3. Fourier Representation of Periodic Signals:** Fourier Representation of Periodic Signals: Introduction to CTFS and DTFS, definition, properties and basic problems.	5hrs
4.	**Chapter No. 4. Fourier Representation of aperiodic Signals:** FT representation of aperiodic CT signals, definition, FT of standard CT signals, Properties and their significance. FT representation of aperiodic discrete signals DTFT, definition, DTFT of standard discrete signals, Properties and their significance, Impulse sampling and reconstruction: Sampling theorem and reconstruction of signals.	10hrs
5.	**Chapter No. 5: Z-Transforms:** Introduction, the Z-transform, properties of the Region of convergence, Properties of the Z-Transform, Inversion of the Z-Transform, Implementation of discrete time of LTI systems.	10hrs

Text Book

Simon Haykin and Barry Van Veen, Signals and Systems –2nd Edition, John Wiley, 2004 .

Course code: 19EEEC301 **L-T-P: 2-0-1**
Course title: Machine Learning **CIE Marks: 50**
Teaching hours: 40 **ESA Marks: 50**

Chapter No.	**Unit-I**	
1	**Introduction** Introduction to Machine Learning, Applications of Machine Learning, Types of Machine Learning: Supervised, Unsupervised and Reinforcement learning, Dataset formats, Basic terminologies.	5 hrs
2	**Supervised Learning** Linear Regression, Logistic Regression Linear Regression: Single and Multiple variables, Sum of squares error function, The Gradient descent algorithm, Application, Logistic Regression, The cost function, Classification using logistic regression, one-vs-all classification using logistic regression, Regularization.	10 hrs
	Unit-II	
3	**Supervised Learning: Neural Network** Introduction to perception learning, Implementing simple gates XOR, AND, OR using neural network. Model representation, Gradient checking, Back propagation algorithm, Multi-class classification, Application- classifying digits, SVM.	10 hrs
4	**Unsupervised Learning: Clustering** Introduction, K means Clustering, Algorithm, Cost function, Application.	5 hrs
	Unit-III	
5	**Unsupervised Learning: Dimensionality Reduction** Dimensionality reduction, PCA- Principal Component Analysis. Applications, Clustering data and PCA.	4 hrs
6	**Introduction to Deep Learning** What is deep learning?, Difference between machine learning and deep learning, Convolution Neural Networks (CNN), Recurrent Neural Networks(RNN), When to use deep learning?	8 hrs

Text Books

1 Tom Mitchell, Machine Learning, 1, McGraw-Hill. , 1997
2 Christopher Bishop, Pattern Recognition and Machine Learning, 1, Springer, 2007

Reference Books:

1 Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning : Data Mining, Inference and Prediction, 2, Springer, 2009

Course Title: Machines lab **Course Code: 19EEEP301**
L-T-P: 0-0-1 **Credits: 1** **Contact Hours: 2Hrs/week**
CIE Marks: 80 **SEE Marks: 20** **Total Marks: 100**
Laboratory Hours: 28Hrs **Examination Duration: 3Hrs**

Category: Demonstration	
Expt./ Job No.	**Experiment / Job Details**
1	Star and Delta Connected Lighting Loads
2	Open circuit characteristics of DC machine
3	Speed control of separately excited DC motor by armature voltage control and flux control
4	Synchronization of Alternator with Bus bar/ Parallel operation of Alternator
Category: Exercise	
Expt./ Job No.	**Experiment / Job Details**
1	To Conduct NO – LOAD & BLOCKED ROTOR test on a given Induction motor to a) Find the performance parameters b) Represent the motor by its equivalent circuit model referred to Stator or Rotor.
2	To Conduct Open Circuit and Short Circuit test on given single phase transformer to a) Calculate efficiency and voltage regulation at different loads & power factors. b) Draw the transformer equivalent circuit model.
3	Load test on 3Ø Induction motor
4	Three phase Transformer bank using three single phase transformers with different configurations of primary and secondary windings.
5	Speed control of Induction motor by V/f method
6	Performance study of synchronous motor with change in its excitation (V and Inverted V curves)
7	Voltage regulation of an Alternator by EMF and MMF method
Category: Structured Enquiry	
Expt./ Job No.	**Experiment / Job Details**
1	To develop the second order response surface methodology (RSM) based speed prediction model of DC shunt motor by conducting experiments as per Design of Experiments.(DOE)

Course Content Course Code: 19EEEC302 **Course Title: Electric Drives and Control**
L-T-P-S: 3-0-0 **CIE:50**
Teaching Hours: 40 **SEE:50**

Chapter 1. An introduction to Electrical Drives & its Dynamics: Electrical drives. Advantages of electrical drives. Parts of electrical drives, Choice of electrical drives, status of dc and ac drives, dynamics of electrical drives, fundamental torque equation, speed torque conventions and multi quadrant operation. Nature and classification of load torques, calculation of time and energy loss in transient operations..	**5 Hrs**
Chapter 2. D C Motor Drives: Starting braking, single phase fully controlled rectifier control of dc separately excited motor, Single-phase half controlled rectifier control of dc separately excited motor. Three phase fully controlled rectifier control of dc separately excited motor, three phase half controlled rectifier control of dc separately excited motor, multiquadrant operation of dc separately excited motor fed from fully controlled rectifier. Rectifier control of dc series motor, chopper controlled dc drives, chopper control of separately excited dc motor. Chopper control of series motor.	**10 Hrs**
Unit – II	
Chapter 3. Induction Motor Drives: Operation with unbalanced source voltage and single phasing, operation with unbalanced rotor impedances, analysis of induction motor fed from non-sinusoidal voltage supply, starting, braking, Stator voltage control, variable frequency control from voltage sources, voltage source inverter control, current source inverter control, current regulated voltage source inverter control, rotor resistance control, slip power recovery.	**10 Hrs**
Chapter 4. Synchronous Motor and Brushless dc Motor Drives: Operation from fixed frequency supply, synchronous motor variable speed drives, variable frequency control of multiple synchronous motors, self controlled synchronous motor drive, PMAC motor drives, brushless dc motor drives	**05 Hrs**
Unit – III	
Chapter 5. Stepper Motor and Swiched Reluctance Motor Drives: Stepper Motor: variable reluctance, permanent magnet, torque versus stepping rate characteristics drive circuits for stepper motors Switched Reluctance Motor: Operation and control requirements, converter circuits, modes of operation	**5 Hrs**
Chapter 6. Solar and Battery Powered Drives: Solar panels, motors suitable for pump drives, battery powered vehicles, solar powered electrical vehicles	**5 Hrs**

Text Book :
1. G. K Dubey, *"Fundamentals of Electrical Drives"*, 2nd ed., Narosa Publishing House, Chennai, 2002.

References

1. N. K. De and P. K. Sen, Electrical Drives, PHI, 2007
2. S. K. Pillai, A First Course On Electric Drives, Wiley Eastern Ltd, 1990
3. V. R. Moorthi, Power Electronics, Devices, Circuits & Industrial Applications, Oxford University Press, 2005

Course Code: 19EEEC303 **Course Title: Object Oriented Programming using C++**

L-T-P: 2-0-1	Credits: 3	Contact Hrs: 3
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 40		Exam Duration: 03 hrs

Content	Hrs
Unit - 1	
Chapter 01: Introduction Principles of Object Oriented Programming, Procedure oriented and Object oriented Programming, Basic Concepts of OOP, Benefits and Applications of OOP, Beginning with C++, Simple C++ program, C++ with classes, Structure of C++ program, Creating, compiling and linking C++ programs.	4 hrs
Chapter 02: Classes and Objects Structures and Classes, Specifying a Class, Defining Member functions, C++ program with class, Access Specifiers, Scope Resolution Operators, Inline functions, Static Data Members, Static Member Functions, Friend Functions.	7 hrs
Chapter 03: Constructors and Destructors Introduction, Parameterized Constructors, Multiple Constructors, Copy Constructor, Dynamic Constructor, Destructors, Dynamic allocation of objects - new and delete operators.	4 hrs
Unit - 2	
Chapter 04: Inheritance Introduction, Defining Derived Classes, Types of Inheritance, Virtual Base Classes, Abstract Classes, Constructors in Derived Classes, Nesting of Classes.	6 hrs
Chapter 05: Virtual Functions and Polymorphism Pointers to objects, this pointer, Pointers to Derived classes, Virtual Functions. Pure Virtual Functions.	5 hrs
Chapter 06: Exception Handling Basics, Exception Handling Mechanism, Throwing, Catching and Rethrowing Exceptions.	4 hrs
Unit - 3	
Chapter 07: Function Overloading, Operator Overloading Function Overloading, Overloading Constructors, Defining operator Overloading, Unary and Binary operator overloading, Rules for overloading operators.	5 hrs
Chapter 08: Templates, STL Class Templates, Function Templates, Overloading of Template functions, Components of STL, Containers, Iterators, Application of Container Classes.	5 hrs

Text Books (List of books as mentioned in the approved syllabus)

1. E.Balagurusamy, Object Oriented Programming with C++, 4th edition, Tata McGrawHill, 2008
2. Herbert Schildt, C++ The Complete Reference, Fourth Edition, Tata McGrawHill, 2003

References

1. Yashavant P. Kanetkar, Let Us C++, 1st, BPB Publications,
2. Stanley B.Lippmann, Josee Lajore, Barbara E. Moo, C++ Primer, 4th Edition, Pearson Education, 2005

Laboratory Title: **Power Electronics & Drives Laboratory** Lab. Code: **19EEEP302**

Total Hours: **24** Duration of SEE Hours: 3

SEE Marks: **20** CIE Marks: **80**

Category: Demonstration	
Expt./ Job No.	**Experiment / Job Details**
1	Forward and Flyback DC-DC Converter
2	Single phase full bridge inverter
3	Half controlled Rectifier feeding R and RL load
4	Introduction to STEmbed Model based design and C-code generation for Power Electronics & Drives Application using TI's DSPs.
Category: Exercise	
Expt./ Job No.	**Experiment / Job Details**
1	Three phase full bridge controlled rectifier fed DC motor drive.
2	Fully controlled bridge rectifier feeding R and RL load
3	VSI based open loop volts/hertz control of three phase induction motor drive.
4	ADC, PWM pulse Generation and PI Controller design for PE and Drives application using STEmbed and TI's DSPs.
Category: Structured Enquiry	
Expt./ Job No.	**Experiment / Job Details**
1	To design, simulate and experimentally verify given drive system to meet defined specifications.

Course Code: 19EEEC401 **Course Title: Power System Modeling, Operation & Control**

L-T-P: 3-0-0	Credits: 3	Contact Hrs: 40
CIE Marks: 50	SEE Marks: 50	Total Marks: 100
Teaching Hrs: 40		Exam Duration: 3 hrs

Chapter No.	**Unit-I**	
1	**Formation of network matrices :** Multi-port power system representation, performance equations in bus frame of reference, definitions of Network models Y_{bus} and Z_{bus}, Primitive element representations, primitive performance equations,. Formation of Ybus by method of Inspection, Introduction to graph theory-definitions of terms, Bus incidence matrix, Ybus by the method of singular transformation, Examples on Ybus formation by singular transformation (with no mutual coupling) and Inspection method, Zbus building algorithm-addition of uncoupled branches and links, modification of Zbus for changes in elements not mutually coupled, Examples on Zbus formation	8 hrs
2	**Optimal load dispatch :** Importance and objective of economic load dispatch, Fuel cost and Incremental fuel cost, Optimal load allocation between plants neglecting transmission losses, Examples on optimal load allocation with and without generation constraints, Optimal load allocation considering transmission losses, General transmission loss formula, Examples.	7 hrs
	Unit-II	
3	**Load flow analysis :** Importance of Power flow, Classification of busses, General steps in load flow analysis, Off-nominal ratio tap changing ratio transformer representation. Bus voltage solution by Gauss and Gauss-Seidel methods without PV buses, Handling PV buses in Gauss-Seidel method, N-R load flow model in polar coordinates, formation of NR Jacobian, Introduction to FDLF load flow model, Comparison of Gauss-Seidel, NR and FDLF load flow methods, Examples on one iteration of load flow solution.	8 hrs
4	**Load frequency control :** Introduction to load frequency control problem, Working principle of speed governor, Model of isolated power system area –block diagram representation, Expression for steady-state frequency deviation, Parallel operation of generators –expression for operating frequency and load sharing,, two area load frequency control, steady-state operation of multi-area system under free governor operation, Examples on load sharing between areas.	7 hrs
	Unit-III	
5	**Reactive power and voltage control :** Power flow through a line, Relation between voltage, power and reactive power at a node, Brief descriptions of methods of voltage control-by injection of reactive power and tap changing transformer. Generator reactive power control by AVR-simplified AVR system model, AVR response.	5 hrs
6	**Power System Simulations:** Simulation of automatic generation control, simulation of small signal stability of a SMIB power system, Transient stability simulation of SMIB power system using trapezoidal integration, simulation of classical economic load dispatch Algorithm	5 hrs

Text Books

1 Stagg and El-Abid, Computer Methods in power system analysis, First Edition, Mc-Graw Hill, 1968

2 Kothari and Nagarath, Modern power system analysis, 3rd Edition, Tata McGraw Hill, 2004

Reference Books:

1 P. Kundur, Power system stability and control, First Edition, Tata McGraw Hill, 2007

2 Hadi Sadat, Power System analysis, Ed. First Edition, Tata McGraw Hill, 2002

3 A.R. Bergen and Vijay Vittal, Power system analysis, Ed. First Edition, Pearson Ed, 2009

Laboratory Title: Power System Simulation Lab **Lab. Code: 19EEEP401**

Credits: L-T-P: 0-0-1 **Credits: 1** **Duration of SEE Hours: 2**

SEE Marks: 20 **CIE Marks: 80**

Experiment wise Plan

List of experiments/jobs planned to meet the requirements of the course.

Category: Demonstration	
Expt./ Job No.	Experiment / Job Details
1	To use interactive simulation software “SofTCAPS” for the simulation of (i)Load flow analysis by Gauss-Seidel and NR models (ii) Voltage control analysis by shunt capacitor and tap changing transformer (iii) P-V Curve at a load bus
2	To use interactive software "SofTCAPS" for the simulation of Economic load dispatch problem with and without coordinating the transmission losses
Category: Exercise	
Expt./ Job No.	Experiment / Job Details
3	To form bus admittance matrix [Ybus] by singular transformation.
4	To form [Ybus] by the method of inspection
5	ABCD constants and line performance using short and medium π/T models
Category: Structured Enquiry	
Expt./ Job No.	Experiment / Job Details
6	Each batch (consisting of 4 students) will work on one problem from the below mentioned sets, obtain the simulation results, carry out the analysis, interpret the results, draw practical conclusions from them and prepare a report. (a) To formulate and develop MATLAB/Scilab program/ SIMULINK model on one of the power problem which include, but not limited to - Load frequency control method, Study to determine the effect of excitation on dynamic stability, Comparison of various numerical techniques for stability study, Multimachine transient stability study, Load flow model development, (b) To employ an interactive power system software to simulate a given problem such as multimachine transient stability, multimachine small signal stability, contingency analysis, performance comparison of various load flow models, economic load dispatch etc.

Laboratory Title: Relay and High Voltage Engineering lab **Lab. Code: 19EEEP402**

Total Hours: **32** **Credits: L-T-P: 0-0-1** **Credits: 1** **Duration of SEE Hours: 2**

SEE Marks: 20 **CIE Marks: 80**

Expt./ Job No.	Experiment / Job Details	
Category: Exercise		
1	Introduction Session	2 hrs
2	To obtain the inverse time characteristics of a given fuse wire and wires of different lengths.	2hrs
3	To obtain the inverse time characteristics of an electromagnetic over current relay	2hrs
4	To obtain the operating characteristics of microprocessor based differential relay.	2hrs
5	To obtain the operating characteristics of microprocessor based directional over current relay.	2hrs
6	To obtain the breakdown strength of air using Copper sphere gap with HVAC and HVDC.	2hrs
7	a) To obtain the breakdown strength of air using different pairs of electrode gap with HVAC and HVDC. b) To obtain the breakdown voltage of a solid dielectric. c) To obtain the breakdown voltage of a liquid dielectric.	2hrs
Category: Structured Enquiry		
1.	To develop microcontroller based overcurrent, over voltage and impedance relay using CT /PT giving details of program and demonstrate it's working output.	4hrs

B.E. (Civil Engineering)

Curriculum Syllabus

2015 – 19 Batch

(2015-16 Admission)

3rd Semester

Course Title: Building Technology and Services **Course Code: 15ECVC201**

L-T-P: 3-0-0 **Credits: 3** **Contact Hours: 3 Hrs/ week**

ISA Marks: 50 **ESA Marks: 50** **Total Marks: 100**

Teaching Hours: 40 **Examination Duration: 3 Hrs**

Unit I

1. Building Materials

Introduction. Properties of building stones, Clay products, Bricks and tiles; Timber, Plywood, Allied products, Plastics and glass, Paints, Steel, Gypsum and Allied products, Adhesives. **08 hrs**

2. Types of Foundations

Preliminary investigations of soil, Presumptive bearing capacity of soils, Masonry footings, Isolated footings, Grillage footings, Strap footings, Raft foundations, Pile foundations. **05 hrs**

Unit II

3. Stone and Brick Masonry

Rubble masonry, Ashlar masonry, Bonds in brick work (English and Flemish bond). Load bearing and partition walls. Damp proof construction. **03 hrs**

4. Floors and Roofs **03 hrs**

Types of flooring (Materials and method of laying), Granolithic, Mosaic, Ceramic, Marble, Polished Granite, Industrial flooring. Flat Roof (R.C.C.), Sloped roof (R.C.C. and Tile roof), Lean to roof, Steel trusses, Water and Weather proof course.

6. Stairs, Doors and Windows **05 hrs**

Types (Classifications) and Technical terms in stairs, Requirements of a good stair. Geometric Design of RCC Dog Legged and open well stairs. (Plan and sectional elevation of stairs) Paneled doors, Glazed doors, Flush doors, Collapsible and rolling shutters, Louvered doors, Revolving, sliding and swing doors, Windows, Types, Paneled, Glazed, Bat window, Dormer window, Louvered and corner window, Ventilators

Unit III

7. Plastering and Painting

Purpose of Plastering, Materials of plastering, Lime mortar, Cement Mortar, Methods of plastering, Stucco plastering, Lath plastering, Purpose of Painting, Distemper, Plastic emulsion, Enamel, Powder coated painting to walls and iron and steel surfaces, Polishing of wood surface. **03 hrs**

8. Introduction to cost effective construction and services

Necessity, Advantages, Pre fabrication techniques, Pre cast doors and windows (Pre cast frames and shutters), Alternative Building Materials, Hollow concrete blocks, Stabilized mud blocks, Micro concrete tiles, Precast roofing elements. Water supply and sanitation. Electricity illuminated. Modern services & Air condition **03 hrs**

Text Books

1. Bhavikatti S.S., *Materials of Construction, Vol-1*, I.K. International Pvt. Ltd., New Delhi, 2013
2. Bhavikatti S.S., *Materials of Construction, Vol-II*, I.K. International Pvt. Ltd., New Delhi, 2014.
3. Punmia, B.C., Jain A.K., *Building Construction*, 10ed., Lakshmi Publications, New Delhi, 2008.
4. Rai, M. and Jai Sing, *Advanced Building Materials and Construction*, CBRI Publications, Roorkee, 2014
5. Rangwala, S.C., *Building Construction*, 31st Edition Charotar Publishing House, Anand, India, 2014.
6. Sushilkumar, *Building Construction*, 20ed., Standard Publisher and Distributors, Delhi, 2014.

Reference Books:

1. Arora, S.P. and Bindra, S.P., *A Text Book of Building Construction Technology*, Dhanapat Rai Publications (P) Ltd., New Delhi, 2014.
2. Bhavikatti S.S., Chitawadagi M.V., *Building Planning and Drawing*, IK International Publishing House Pvt. Ltd., New Delhi., 2014
3. Jagadeesh, K.S., Venkatarama Reddy B.V. and Nanjunda Rao K.S., *Alternative Building Materials and Technologies*, New Age International (P) Ltd., New Delhi, 2007.

Course Title: Surveying		**Course Code: 15ECVC202**
L-T-P: 4-0-0	**Credits: 4**	**Contact Hours: 4 Hrs / week**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 40	**Examination Duration: 3 Hrs**	

Unit I

1. Overview and Measurement of directions **05 hrs**

Basic principle of surveying, classification of surveys Measurement of distance: chain surveying Methods of measurements: Direct and indirect chain and their types, tapes and their types, Ranging – direct and indirect, errors in chain surveying and tape corrections.

Compass surveying prismatic and surveyor's compass, bearing and their types. Calculation of included angles from bearings. Corrections to measured bearings – local attraction. Plottng a traverse, closing error and its adjustment by Bowditch's rule. Traverse computations – Latitude and departure (omitted measurements).

2. Measurement of elevations and contouring **09 hrs**

Levelling terms used in levelling, Types of levelling instruments viz Dumpy level, Auto level, electronic or digital level and their temporary adjustments, taking observations.

Methods of calculating reduced levels – HI method and rise and fall method.

Types of leveling curvature and refraction correction, sensitiveness of bubble tube.

Contours and contouring, characteristics of contours, contour interval, Contouring methods – Direct and indirect. Interpolation of contours. Preparation of contour maps. Uses of contour maps.

Plane table surveying: Methods of plane tabling, Two point problem, Three point problem. Merits and demerits of plane tabling.

3. Theodolite surveying and Trigonometric levelling 06 hrs

Theodolite surveying, terminologies used in theodolite, parts of a vernier theodolite, temporary adjustments. Measurement of horizontal angle, vertical angle and other theodolite applications. Theodolite traversing, locating landscape details. Fundamental lines of a theodolite and their desired relationships, errors, precision, upkeep and maintenance of theodolites.

Basic principles, calculation of heights and distances when instrument stations and object in SAME vertical plane (single plane method) and when instrument stations and object NOT in same vertical plane (double plane method).

Unit II

4. Tacheometric Surveying **04 hrs**

Basic principle of stadia tacheometry; tacheometric equations for horizontal line of sight, inclined line of sight (LOS), when staff vertical to LOS and when staff normal to LOS; Anallactic lens, tangential method of tacheometry, subtense bar, and Beaman's stadia arc; determination of tacheometric constants.

5. Curve surveying **08 hrs**

Types of curves, circular curve-terminologies, elements of a simple curve, methods of setting out simple curve- linear method, angular method; compound curves- elements of a compound curve, setting out of compound curve; Reverse curve-element of elements of a reverse curve, setting out of reverse curve; Transition curve- requirements of a transition curve, elements of transition curve, setting out of transition and composite curve;

6. Modern Surveying Instruments: Theodolite, EDM and Total Station **08 hrs**
Modern theodolites- micro-optic theodolites, electronic theodolites, digital theodolites
Electromagnetic spectrum radar, electromagnetic distance measurement (EDM), EDM equipment- geodimeter, tellurometer, mekenometer, distomat. Corrections to measurements; Total station- principles and working, temporary adjustments, application- angle measurement, distance measurement (horizontal, vertical and slope); major function performed with total station, various types of total station (viz. Sokkia, Leica, Pentax, Nikon, South, etc)

Unit III

7. Areas and Volumes **03 hrs**

Computation of areas: Area from co-ordinates, latitude and departures, Mid-ordinate method, average ordinate method, Trapezodial rule, Simpson's rule, Area from digital planimeter.

Computation of volumes: Volumes from cross sections, Prismoidal formula, and Trapezoidal formula capacity of reservoirs volume of borrow pits, Mass-Haul diagram.

8. Construction surveying / setting out works: **03 hrs**

Prerequisites, instruments and methods.

Laying out buildings

Settingout of culverts

Settingout bridges – locating the centre line – locating bridge piers

Settingout tunnels – Transferring alignment, Transferring bench marks or levels

Setting out Sewer lines

9. Modern methods of Surveying **04 hrs**

Satellite based positioning system, Global Positioning System (GPS), basic principals of GPS, satellite configuration, positioning using satellite signals, GPS receivers;Functions of GPS- determining position, navigation, tracking, mapping, precise time determination; Application in survey- surveying with GPS, surveying with hand held GPS; Introduction to GIS- Geographic Information System, definition of GIS, component of GIS, hardware for GIS, software for GIS, data, users, features of GIS, GIS subsystems, data acquisition, data processing and analysis, communication, management of GIS, GIS capabilities, operations of GIS, Applications of GIS. Introduction and applications of LIDAR.

Text Books

1. Alak, D., *Plane Surveying*, S. Chand & Co., 2000.
2. Bhavikatti S.S., *Surveying and Leveling Vol-I & II,* I.K. International Publishers, 2008.
3. Chandra, A.M., *Higher Surveying*, 3ed. New Age India Ltd. 2015.
4. Chandra, A.M., *Plane Surveying*, 3ed. New Age India Ltd. 2015.
5. Punmia, B.C., Jain, Ashok.K. Jain, Arun.K. *Surveying Vol. 1*, 11ed., Lakshmi Publishers, 2015.
6. Punmia, B.C., Jain, Ashok.K. Jain, Arun.K. *Surveying Vol. 2*, 15ed., Lakshmi Publishers, 2012.
7. Punmia, B.C., Jain, Ashok.K. Jain, Arun.K., *Surveying Vol. 3*, 15ed., Lakshmi Publishers, 2005.

Reference Books:

1. Anderson, J. M. and Mikhail E. M., *Introduction to Surveying, TMH, New York, 1985*
2. Basak, *Text Book of Surveying*, 2010
3. Duggal, S.K., *Text Book of Surveying*, 2013
4. Roy, S.K., *Fundamentals of Surveying*, Prentice Hall of India, 2010.

Course Title: Mechanics of Fluids **Course Code: 15ECVF201**

L-T-P: 4-0-0 **Credits: 4** **Contact Hours: 4 Hrs/ week**

ISA Marks: 50 **ESA Marks: 50** **Total Marks: 100**

Teaching Hours: 50 Hrs **Examination Duration: 3 Hrs**

Unit I

1. Fluid Properties and Classification of Fluid

Introduction, to fluid mechanics; Systems of units; Properties of fluid; Mass density; Specific Volume, Specific Weight, Relative density; Viscosity, Newton's law of viscosity, Newtonian and Non-Newtonian Fluids; Ideal and Real fluids; Compressibility; Vapour pressure; Surface tension; capillarity; Problems on above topics. **05 hrs**

2. Fluid Pressure and its Measurement

Definition of pressure, units and dimensions, pressure at a point, Pascal's law, Hydrostatic pressure law, Different types of pressures, Measurement of pressure-Classification- Simple manometers, Differential manometer and Micro Manometer **05 hrs**

3. Hydrostatics

Definition of total pressure, Center of pressure, Centroid; Centroidal depth, depth of center of pressure, Hydrostatic force on plane surface submerged horizontally, vertically and inclined inside a liquid; Hydrostatic force on submerged curved surface. Archimedes principle and centre of buoyancy **05 hrs**

4. Kinematics of Fluids

Description of fluid flow, Lagrangian and Eulerian approaches. Classification of flow; Definition of path line, streamline, streak line, stream tube; Acceleration of flow in one dimensional flow; Derivation of continuity equation in differential form; Definition of velocity potential, stream functions, stream line, equipotential line; Relation between velocity potential and stream function; Laplace equation. Problem on above. **05 hrs**

Unit II

5. Dynamics of Fluid Flow

Definitions, concept of inertia force and other forces causing motion; Derivation of Euler's equation and Bernoulli's equation with assumption and limitation; Problems on applications of Bernoulli’s equation (with and without losses); Application of Bernoulli’s equation on Venturimeter, Orificemeter, Pitot tube. Impulse- Momentum equation and its application on direct and oblique impact of a jet on a stationary flat plate, Direct impact on a moving plate. **10 hrs**

6. Flow through Pipes and open Channels **10 hrs**

Introduction; Reynolds number; Classification of flow; Definition of hydraulic gradient. energy gradient; Major and minor losses in pipe flow, Equation for head loss due to friction (Darcy's-Weishbach equation).Moody's diagram. Uniform flow in open channels, Geometric properties of Rectangular, Triangular, Trapezoidal and Circular channels. Chezy's equation, Manning's equation (theory and problems). Most economical open channels. Specific energy of flowing liquid and critical depth of flow, type of flows, hydraulic jump.

Unit III

7. Dimensional Analysis and Model Studies

Introduction, Systems of units, Dimensions of quantities, Dimensional Homogeneity of an equation. Analysis- Raleigh's method, Buckingham's Π theorem- problems. Model Studies, Similitude, Non-dimensional numbers: Froude models-Undistorted and Distorted models. Reynold's models **05 hrs**

8. Discharge Measurements

Flow through orifices; classification, hydraulic coefficients and their relationship, Flow through mouthpieces: classification, classification of notches and weirs, derivation of discharge equation for rectangular, triangular and trapezoidal notches or weirs, Cipolletti notch or weir, discharge over a broad crested weir, Ogee weir and submerged weir. **05 hrs**

Text Books

1. Arora, K. R., *Fluid Mechanics, Hydraulic and Hydraulics*, Standard Book House, New Delhi, 1993.
2. Bansal, R. K., *Fluid Mechanics and Hydraulic Machines*, 9ed. Lakshmi Publications, New Delhi, 2005.
3. Jain, A. K., *Fluid Mechanics*, Khanna Publications, New Delhi, 1998.
4. Modi, P.N. and Seth S.M., *Hydraulics and fluid mechanics*, 2ed., Standard book house, New Delhi, 2010.
5. Streeter, V.L. and Wylie, E. B., *Fluid Mechanics* , McGraw-Hill, London, 1998.
6. Ven Te Chow,Open Channel Hydraulics McGraw Hill,New York 1959.

Reference Books:

1. Daugherthy, R.L., Franzini, J.B., Finnemore, E.J. *Fluid Mechanics with Engineering Applications*, McGraw Hill, New York, 1985.
2. John, F. D., *Fluid Mechanics*, Pearson Education, India, 2002.
3. Modi, P.N. and Seth S.M., *Hydraulics and fluid mechanics*, 2ed., Standard book house, New Delhi, 2002.
4. Shames, I.H., *Mechanics of Fluids*, McGraw Hill, New York, 1992.

Course Title: Mechanics of Materials **Course Code: 15ECVF202**

L-T-P: 4-0-0 **Credits: 4** **Contact Hours: 4 Hrs/ week**

ISA Marks: 50 **ESA Marks: 50** **Total Marks: 100**

Teaching Hours: 50 **Examination Duration: 3 Hrs**

Unit I

1. Simple Stress and Strain **06 hrs**

Introduction, Properties of Materials, Stress, Strain, Hooke's law, Poisson's Ratio, Stress – Strain Diagram for structural steel and non ferrous materials, Principles of superposition, Total elongation of tapering bars of circular and rectangular cross sections. Elongation due to self – weight

2. Simple Stress and Strain continued… **06 hrs**

Composite section, Volumetric strain, expression for volumetric strain, Elastic constants, relationship among elastic constants, Thermal stresses (including thermal stresses in compound bars).

3. Bending moment and shear force in beams **06 hrs**

Introduction, Types of beams loadings and supports, Shearing force in beam, Bending moment, Sign convention, Relationship between loading, shear force and bending moment, Shear force and bending moment equations, SFD and BMD with salient values for cantilever beams, simply supported beams and overhanging beams considering point loads, UDL, UVL and Couple.

Unit II

4. Bending stress, shear stress in beams **06 hrs**

Introduction – Bending stress in beam, Assumptions in simple bending theory, Pure bending derivation of Bernoulli's equation, Modulus of rupture, section modulus, Flexural rigidity, Expression for horizontal shear stress in beam, Shear stress diagram for rectangular, symmetrical 'I' and 'T' section.

5. Deflection of beams **06 hrs**

Introduction – Definitions of slope, deflection, Elastic curve derivation of differential equation of flexure, Sign convention, Slope and deflection for standard loading classes using Macaulay's method for prismatic beams and overhanging beams subjected to point loads, UDL and Couple.

6. Columns and struts

Introduction – Short and long columns, Euler's theory on columns, Effective length, slenderness ration, radius of gyration, buckling load, Assumptions, derivations of Euler's Buckling load for different end conditions, Limitations of Euler's theory, Rankine's formula and problems. **06 hrs**

Analysis and sketching of various stresses in beams (2-D and 3-D) **02 hrs**

Unit III

7. Torsion of circular shafts **05 hrs**

Introduction – Pure torsion-torsion equation of circular shafts, Strength and stiffness, Torsional rigidity and polar modulus, Power transmitted by shaft of solid and hollow circular sections, Torsion of Rectangular shaft (only Explanar)

8. Compound stresses **07 hrs**

Introduction, Stress components on inclined planes, General two dimensional stress system, Principal planes and stresses, Mohr Circle, thin cylinders subjected to pressure, change in length, diameter and volume, Thick cylinders - Lame's equations (excluding compound cylinders).

Text Books:

1. Basavarajaiah, B.S. and Mahadevappa, P., *Strength of Materials*, 3ed., CBS Publishers, New Delhi, 2010.
2. Beer, F. and Johnston, R., *Mechanics of Materials*, 5ed., Tata Mac Graw Hill – 2007.
3. Bhavikatti, S.S., *Strength of Materials*, 3ed., Vikas Publishers, 2009
4. Hibbeler, R.C., *Mechanics of Materials*, 9ed., Pearson Education Ltd., 2014.
5. Punmia, B.C., Jain, A. and Jain, A., *Mechanics of Materials*, 10ed., Lakshmi Publications, New Delhi, 2013.
6. Stephen Crandall, Thomas Lardner, *An Introduction to the Mechanics of Solids* 3rd Ed., with SI Units, Tata McGraw Hill, 2007.

Reference Books:

1. Beer and Johnson, *Strength of Materials,* Tata McGraw-Hill Education, 2004.
2. James, M. Gere, *Mechanics of Materials*, 8ed., Thomson Learning, 2012.
3. Nash W.A., *Strength of Materials*, 4ed., Schaum's Outline Series, 2007
4. Popov E.P., *Engineering Mechanics of Solids,* PHI, 2012.
5. Singer Harper, *Strength of Materials*, Row Publications, 2007.

Course Title: Survey Practice - I		**Course Code: 15ECVP201**
L-T-P: 0-0-1	**Credits: 1**	**Contact Hours: 2 Hrs / Week**
ISA Marks: 80	**ESA Marks: 20**	**Total Marks: 100**
Teaching Hours: 30	**Examination Duration: 3 Hrs**	

1. a)To measure distance between two points using direct ranging

   b) To set out perpendiculars at various points on given line using cross staff, optical square and tape.
2. Setting out of rectangle, pentagon, hexagon using chain and tape only
3. To set out rectangle, hexagon, pentagon using chain, tape and compass.
4. To determine the distance between two inaccessible points using chain & compass.
5. To locate points using radiation & intersection method of plane tabling
6. To determine difference in elevation between two points using fly leveling technique & to conduct fly back leveling using HI & Rise & Fall methods.
7. To determine difference in elevation between two points using reciprocal leveling & determine the collimination error.
8. To conduct profile leveling for water supply / sewage line & to draw the longitudinal section to determine the depth of cut & depth of filling for a given formation level.
9. To solve 3-point problem in plane tabling using Bessel's graphical solution
10. To locate the Contours by Direct contouring
11. To locate the Contours by Indirect contouring
12. Use of planimeter and demonstration of minor instruments like clinometer, hand level, box sextant.

Text Books

Reference Books:

1. Bhavikatti S.S., *Surveying and Leveling Vol-I & II,* I.K. International Publishers, 2008.
2. Punmia, B.C., Jain, Ashok.K., Jain, Arun.K., *Surveying Vol. l & 2*, 15ed., Lakshmi Publishers, 2005.

Course Title: Building Engineering Drawing **Course Code: 15ECVP202**

L-T-P: 0-0-2 **Credits: 2** **Contact Hours: 4 Hrs/ week**

ISA Marks: 80 **ESA Marks: 20** **Total Marks: 100**

Teaching Hours: 40 Hrs **Examination Duration: 3 Hrs**

Unit I

1. To prepare working drawing of components of building i) Stepped wall footing and isolated RCC column footing, ii) Fully paneled and flush doors, iii) Half paneled and half-glazed window, iv) RCC dog legged and open well stairs, v) Steel truss	**10 hrs**
2. Functional design of building (Residential, Public and Industrial), positioning of various components of building, orientation of building, building standards, bye laws, set back distances and calculation of carpet area, plinth area and floor area ratio.	**03 hrs**
3. Development of plan, elevation, section and schedule of openings from the given line diagram of residential buildings, i) Two bed room building, ii) G +1 storey buildings (Two Drawings will be done by using ZWCAD)	**18 hrs**

Unit II

4. Functional design of building using inter connectivity diagrams, development of line diagram only for Residential and Office building (One Drawing will be done by using ZWCAD)	**05 hrs**
5. Line diagram of water supply, sanitary and electrical layouts (One Drawing will be done by using ZWCAD)	**04 hrs**

Text Books

1. Bethune, J. D., *Engineering Graphics with Auto CAD* 3ed., Pearson Education Publishers, 1998.
2. Chandra, A.M and Chandra, S., *Engineering Graphics with Auto CAD*, 2ed., Pearson Education Publishers, 2004.
3. Gurcharan Singh., *Civil Engineering Drawing*, 5ed., Standard Publishers Distributors Nai Sarak, Delhi, 1998.
4. National Building Code of India 2005, Bureau of Indian Standards, Manak Bhavan, 9 Bahadur Shah Zafar Marg, Newdelhi-110028
5. Shah, M.H and Kale, C.M, *Building Drawing*, Tata Mc Graw Hill Publishing Co. Ltd., New Delhi, 2002.

4th Semester

Course Title: Structural Analysis-I **Course Code: 15ECVC203**

L-T-P: 3-0-0 **Credits: 3** **Contact Hours: 3 Hrs/ week**

ISA Marks: 50 **ESA Marks: 50** **Total Marks: 100**

Teaching Hours: 40 Hrs **Examination Duration: 3 Hrs**

Unit I

1. Structural Systems

Forms of structures, Conditions of equilibrium, Degree of freedom, Linear and Non linear structures, one, two, three dimensional structural systems, Static and Kinematics determinate and indeterminate structures. Structural Symmetry **04 hrs**

2. Plane Trusses

Introduction, Assumptions, Analysis by method of joints, Analysis by method of sections. **06 hrs**

3. Deflection of Beams **07 hrs**

Moment area method, Conjugate beam method, Deflection of beams.

Unit II

4. Strain Energy

Strain energy and complimentary strain energy, Strain energy due to axial load, bending and shear, Principle of virtual work, The first theorem of Castigliano, Betti's law, Clarke - Maxwell's theorem of reciprocal deflection, Problems on beams and trusses. **08 hrs**

5. Arches and cables **07 hrs**

Three hinged circular and parabolic arches with supports at same levels and different levels. Determination of thrust, shear and bending moment, Analysis of cables under point loads and UDL, length of cables - Supports at same levels and at different levels.

Unit III

6. Influence Lines Diagrams

Influence line diagrams for simply supported, cantilever and over hanging beams, Influence line diagrams for girders supporting floor beams, Use of Influence line diagrams, Maximum S.F. and B.M. values due to moving loads. **08 hrs**

Text Books

1. Bhavikatti, S. S., *Structural Analysis-I*, Vikas Publishing House Pvt. Ltd., New Delhi, 2003.
2. Punmia, B. C. and Jain, A. K., *Strength of Materials and Theory of Structures*,

Vol. I & II, Laxmi Publication, New Delhi, 2000.

3. Reddy, C. S., *Basic Structural Analysis*, 2ed., Tata McGraw- Hill Publishing Company, New Delhi, 2007.

Reference Books:

1. Noris, C.H. and Wilber, J., *Elementary Structural Analysis*, 4ed., McGraw- Hill Book Company, 2003.
2. Pandit, G. S., Gupta, S. P. and Gupta, R., *Theory of Structures*, Vol. I, Tata McGraw- Hill Publishing Company, New Delhi, 1999.
3. Prakash Rao D. S., *Structural Analysis, A unified approach*, 1ed., University Press Limited, Hyderabad, 1996.
4. Ramamruthum, S. and Narayan, R., *Theory of Structures*, Dhanpat Rai Publishing Company, New Delhi, 1998.
5. Timoshenko, S. P. and Young, D. H., *Theory of Structures*, McGraw- Hill Book Company, New York, 1965.

Course Title: Environmental Engineering		**Course Code: 15ECVC204**
L-T-P: 4-0-0	**Credits: 4**	**Contact Hours: 4 Hrs/ week**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 50 Hrs	**Examination Duration: 3 Hrs**	

Unit I

1. Demand and conveyance of water

Human activities and environmental pollution need for protected water supply. Types of water demands, population forecasting- arithmetical, geometrical, incremental increase and simple graphical method. Surface and subsurface sources Intake structures. Design of the economical diameter of the rising main, **06 hrs**

2. Quality of Water

Concept of safe wholesome and palatability of water, Sampling of water, Examination of Water–Physical, chemical and Biological Examinations. Drinking water standards BIS & WHO guidelines. Health significance of Fluoride, Nitrates and heavy metals like Mercury, Cadmium, Arsenic etc **04hrs**

3.Water Treatment

Treatment flow-charts. Aeration- Principles, types of Aerators. Sedimentation aided Coagulant, design, jar test, Theory of filtration, slow sand, rapid sand and pressure filters, design – excluding under drainage system .Theory of disinfection, types of disinfection. **10 hrs**

Unit II

4.Miscellaneous Treatment and Distribution of Water

Softening methods of removal of hardness by lime soda process and zeolite process. Adsorption technique, reverse osmosis technique, fluoridation and defluoridation. **05 hrs**

System of supply, service reservoirs and their capacity determination, methods of layout of distribution systems. Valves in pipe network and type of fire hydrants.

5. Sewerage systems

Types of sewerage systems. DWF, estimation of storm flow, design of storm water drain. Design of sewers - self cleansing and non-scouring velocities. Design of hydraulic elements for circular sewers flowing full and flowing partially full **05 hrs**

6. Sewage characteristics **03 hrs**

Physical, Chemical and Biological characteristics, CNS cycle. BOD and COD their significance

7. Disposal of Sewage **03 hrs**

Self-purification phenomenon, Zones of purification, Oxygen sag curve. Sewage sickness Sewage farming. Numerical Problems on Disposal of Effluents using Streeter Phelps equation.

8. Sewage Treatment **03 hrs**

Flow diagram of municipal waste water treatment plant. Preliminary & Primary treatment: Screening, grit chambers, primary sedimentation tanks – Design.

Unit III

9.Secondary treatment **09 hrs**

Theory and design of biological unit operation- Trickling filter and Activated sludge process and its modifications.
Miscellaneous treatment – Oxidation pond – design, concepts of UASB, RBC and sequential batch reactor.

10.Sludge Disposal **02 hrs**

Digestion of sludge, Sludge drying beds.

Text Books

1. Birdie, G.S., *Water Supply and Sanitary Engineering*, Dhanpath Rai and Son Publishers, New Delhi, 2003
2. *CPHEEO: Manual on water supply and treatment*, Ministry of Urban Development
3. Garg, S.K., *Sewage disposal and Air Pollution Engg*., Khanna Publishers, 2003.
4. Garg, S.K., *Water supply Engineering*, 7ed., Khanna Publishers, New Delhi, 2005.
5. Modi, P.N., *Sewage Treatment and Disposal Engg.,* 15ed., Std. Book House, New Delhi, 2015.
6. Punima, B. C., and Jain Ashok, *Environmental Engineering-I,* 2ed., Laxmi Publications, New Delhi., 2008
7. Punmia, B. C., Jain Ashok K and Arun Kumar Jain, *Wastewater Engineering*, Laxmi Publications, New Delhi, 2016.

Reference Books:

1. AWWA, *Standard Methods Examination of Water and Wastewater*, Water Environment Federation, 2004
2. Clair N. Sawyer and L. Perry McCarty, Parkin, G. F., *Chemistry for Environmental Engineers*, McGraw-Hill, 2004
3. Davis, M.L. and Cornwell, D.A., *Introduction to Environmental Engineering*, Tata McGraw Hill. 2010
4. Fair, G.M., Geyer J.C., Okan D.A., *Elements of Water Supply and Wastewater Disposal*, John Wiley and Sons Inc. 2000
5. Hammer M.J., *Water and Waste Water Technology*, John Wiley and Sons, New York , 2000

6. Howard S. Peavy, Donald R. Rowe, George Techno Bano Glous, *Environmental Engineering*, McGraw Hill International, 1995.
7. IS:10500-2012,Drinking water- Specification
8. Metcalf & Eddy, *Wastewater Treatment Engg. & Reuse*, Tata McGraw Hill Publications, 2003.
9. *Ministry of Urban Development, Manual on Waste Water Treatment - CPHEEO*, New Delhi.
10. Srinivasan, D., *Environmental Engineering*, PHI Learning Pvt. Ltd., New Delhi, 2008.
11. W.K. Berry, *Water Pollution*, CBS Publishers Pvt. Ltd ,New Delhi, 2016

Course Title: Concrete Technology		**Course Code: 15ECVC205**
L-T-P: 3-0-0	**Credits: 3**	**Contact Hours: 3 Hrs /Week**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 40 Hrs	**Examination Duration: 3 Hrs**	

Unit I

1. Concrete Ingredients

Cement, Chemical composition, hydration of cement, Types of cement, manufacture of OPC by wet and dry process. Testing of cement - Field testing, Fineness by sieve test and Blame's air permeability test, Normal consistency, setting time, soundness. Compression strength of cement and grades of cement, quality of mixing water. Fine aggregate - grading, analysis, Specific gravity, bulking, moisture content, deleterious materials. Coarse aggregate - Importance of size, shape and texture. Grading of aggregates - Sieve analysis, specific gravity. Flakiness and elongation index, crushing, impact and abrasion tests. **08 hrs**

2. Fresh concrete

Workability - factors affecting workability, Measurement of workability - slump, flow tests. Compaction factor and vee-bee consistometer tests. Segregation and bleeding. Process of manufacture of concrete: Batching, Mixing, Transporting, Placing, Compaction, Curing. Chemical admixtures-plasticizers, accelerators, retarders and air entraining agents. Mineral admixtures - Fly ash, Silica fume and rice husk ash. **08 hrs**

Unit II

3. Hardened concrete

Factors affecting strength, w/c ratio, gel/space ratio, maturity concept. Effect of aggregate properties, relation between and compressive strength, and tensile strength, bond strength, modulus of rupture. Accelerated curing. Elasticity - Relation between modulus of elasticity and strength, factors affecting modulus of elasticity, Poisson ratio. Shrinkage - plastic shrinkage and drying shrinkage, factors affecting shrinkage, Creep - Measurement of creep, factors affecting creep, effect of creep. Durability - definition, significance, permeability, sulphate attack. Chloride attack, carbonation, freezing and thawing. Factors contributing to cracks in concrete settlement cracks, construction joints. Thermal expansion, Testing of hardened concrete - compressive strength, split tensile strength. Flexural strength, factors influencing strength test results **10 hrs**

4. Concrete Mix design **06 hrs**

Concept of Mix design, variables in proportioning exposure conditions. Procedure of mix design as per IS 10262-2009,Numerical examples of Mix design

Unit III

5. Special concretes and concreting methods

Constituents, properties and applications: of Light weight concrete, High density concrete, High strength and high performance concrete, Self Compacting Concrete, Fiber reinforced concrete and Ready mixed concrete. Ferro cement - Constituents, properties and applications. Guniting and shotcreting	**04 hrs**

6. Non destructive testing of concrete

Principles, applications and limitation of Rebound hammer lest and Ultrasonic pulse velocity test, interpretation of test values. Profometer - Principles, applications and limitations	**04 hrs**

Text Books

1. Shetty M.S., Concrete technology - Theory and practice, 1ed., S.Chand and company, New Delhi, 2008

Reference Books:

1. Gambhir, M.L, Concrete manual, 4ed , Dhanpat Rai & Sons, 2005
2. IS-10262-2007, Recommend guidelines for concrete mix.
3. IS-383:1970, specifications for Concrete mix aggregates from natural resources for concrete (second revision).
4. P. Kumar Mehta, Paulo J. M. Monteiro,- Concrete: Microstructure, Properties, and Material McGraw Hill publications, 2013

Course Title: Construction Project Management		**Course Code: 15ECVC206**
L-T-P: 3-0-0	**Credits: 3**	**Contact Hours: 3Hrs / Week**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 40 Hrs	**Examination Duration: 3 Hrs**	

Unit I

1 Introduction to Construction Project Management

Phases of construction project, importance of construction and construction industry, Indian construction Industry, Construction project management and its relevance, stakeholders of a construction project. **04 hrs**

2 Drawings and Specifications **05 hrs**

Types of Drawings-Architectural and Structural, Study of Scales Used, sequence of dimensioning, dimension lines and figures, Importance of Specifications, General specifications of 1st, 2nd, 3rd and 4th Class building, Detailed specifications of a typical building. Scope definition using drawings and specifications.

3 Work Breakdown Structure

Concept of WBS, Common usage of terms, Preparing a WBS, Factors to be considered, WBS measurement considerations, Challenges to be considered, WBS level of Detail, WBS life-cycle considerations, Project risk and the WBS, Resource planning and management with WBS, Problems – Detailed WBS of a residential building. **06 hrs**

Unit II

4 Project Management through Networks

Introduction, project feasibility, planning methods of projects– Objectives, planning stages. Scheduling, Bar charts and mile stone charts. Introduction, Terms & definitions, Elements of network, types of network, drawing the network. CPM – Event times, Activity times, floats, critical activity and critical path. Problems. PERT – Introduction, time estimates, expected time, earliest expected time, latest allowable occurrence time, slack, critical path. Probability of completing the project. Problems. Updating of network. Problems. Contraction of network. Problems. Resource Allocation. Problems (Resource smoothening and resource levelling). **11 hrs**

5 Construction Safety Management **06 hrs**

Introduction, evolution of safety, Accident causation theories, unsafe conditions and acts, health and safety act and regulations, role of safety personal, causes of accidents, principles of safety, safety and health management system.

Unit III

6 Construction Equipment

Introduction, standard and special equipment, factor for selecting equipment, cost of owning and operating, economic life of an equipment. Earth moving equipment (Bull Dozers, Scrapers, Loaders and Excavators). Hoisting equipment, concrete mixer and plants, conveyors and rollers, trenching machines, equipment for highway construction. Live projects for course project. **08 hrs**

Text Books

1. Kumar Neeraj Jha, Construction Project Management: Theory and Practice, 2nd Edition, Pearson Publications, 2015.

Reference Books:

1. Robert. L Peurifoy and William B. Ledbetter, Construction planning and Equipment& methods, Mc. Graw Hill Publication, 3rd edition, 2010.
2. Verma Mahesh, Construction planning and Management, Metropolitan Book co. Delhi, 1982.

Course Title: Hydrology & Irrigation Engineering **Course Code: 15ECVC207**

L-T-P: 3-0-0 **Credits: 3** **Contact Hours: 3Hrs / Week**

ISA Marks: 50 **ESA Marks: 50** **Total Marks: 100**

Teaching Hours: 40 Hrs **Examination Duration: 3 Hrs**

Unit I

1. Introduction & Precipitation

Introduction, Hydrologic cycle (Horton's representation). Water budget equation Precipitation: introduction, forms of precipitation, types of precipitation, measurement of precipitation (Simon's gauge & Syphon gauge only), selection of rain gauge station. Adequacy of rain gauges, methods of computing average rainfall ,interpolation of missing data, adjustment of missing data by double mass curve method. Hyetograph and mass curve of rainfall. **05 hrs**

2. Losses From Precipitation

Evaporation: Definition, factors affecting, measurement (Class A pan). Estimation using empirical methods (Meyer's and Rohwer's equation). Evapo-transpiration: Definition, factors affecting, measurement, estimation (Blaney criddle method) Infiltration: Definition, factors affecting, measurement (double ring infiltrometer), infiltration indices, Horton's equation of infiltration. Runoff and its estimation **04 hrs**

3.Hydrographs **04 hrs**

Definition. Components of Hydrograph. Base flow separation, Unit hydrograph and its derivation from simple storm hydrographs, S – curve and its computation.

4. Reservoirs **03 hrs**

Definitions. Investigation for reservoir sites. Storage zones. Determination of storage capacity and yield of a reservoir using mass curve.

Unit II

5. Introduction

Definition. Benefits and ill effects of irrigation. Sources of water for irrigation. Systems of irrigation: Surface and ground water, flow irrigation, Lift irrigation, Bhandhara irrigation. Methods of applying water to crops in India – Potential and development **04 hrs**

6. Irrigation and Water Requirements of Crops **04 hrs**

Definition of duty, Delta and Base period, Relationship between Duty, Delta and Base period, Factors affecting duty of water. Crops and crop seasons in India, Crops Grown in Karnataka, their seasons, Irrigation efficiency, Frequency of irrigation, Definition of gross commanded area, culturable commanded area, culturable cultivated area, etc.

7. Canals: **04 hrs**

Definition, Types of canals, Alignment of canals and Canal regulator. Design of canals by and Kennedy's and Lacey's methods- Problems. Cross drainage works: Classifications. Diversion Works definition, layout, types of weirs and Barrages. Design of Impermeable floors – Bligh's and Lane's theories – Simple design problems. Khosla's theory

8. Gravity Dams

Definition, Forces acting on a Gravity dam, Modes of failures, Elementary and practical profile, Low and high gravity dams, Stability analysis problems, Principle stresses, Drainage **04 Hrs**

9. Earthen Dams

Introduction. Types of earthen dams. Failure of earthen dams. Preliminary design. Drainage arrangements. Determination of Phreatic line.

04 hrs

9. Spillways

Definition. Types of Spillways. Design Principles for an Ogee Spillway. Energy dissipaters: Types and introduction to IS Stilling basins (No design problems). **04 hrs**

Text Books

1. H.M. Raghunath, *Hydrology*, New Age International (P) Ltd., Publication, New Delhi, 2004.
2. Jayarami Reddy, *A Text Book of Hydrology*, Lakshmi Publications, New Delhi, 2007.
3. Modi, P.N., *Irrigation, Water Resources, and Water Power Engineering*, Standard Book House, New Delhi, 2004.
4. Punmia, B.C. and Pande Lal, *Irrigation and Water Power Engineering*, Laxhmi Publications, New Delhi, 2000
5. Sharma, R.K., *Text Book of Irrigation Engineering and Hydraulic Structures*, S. Chand, New Delhi, 2002.
6. Subramanya K, *Engineering Hydrology*, 2ed., Tata McGraw Hill, New Delhi, 2005.

Reference Books:

1. Garg, S.K., Irrigation Engineering and Hydraulic Structures, Khanna Publications, New Delhi, 2005.
2. Linsley, Kohler and Paulhus, Applied Hydrology, Wiley Eastern Publication, New Delhi, 1988
3. Michael, A.M., Irrigation Theory and Practices, Vikas Publications, New Delhi, 2004.

4. R.K. Sharma and Sharma, Hydrology and Water Resources Engineering, Oxford and IBH, New Delhi, 2000.
5. Sahasra Budhe, Irrigation Engineering and Hydraulic Structures, Dhanpath Rai Publications, New Delh
6. Ven Te Chow, Hand Book of Hydrology, Tata McGraw Hill, New Delhi, 1964.

Course Title: Survey Practice - II		**Course Code: 15ECVP204**
L-T-P: 0-0-1	**Credits: 1**	**Contact Hours: 2 hr / week**
ISA Marks: 80	**ESA Marks: 20**	**Total Marks: 100**
Teaching Hours: 30	**Examination Duration: 3Hrs**	

1. Measurement of horizontal angles with method of repetition and reiteration using theodolite. Measurement of vertical angles using theodolite.
2. To determine the elevation of an object using single plane method when base is accessible and inaccessible.
3. To determine the distance and difference in elevation between two inaccessible points using double plane method.
4. To determine the tachometric constants a) using horizontal line of sight. b) Inclined line of sight.
5. To set out simple curves using linear methods perpendicular offsets from long chord.
6. To set out simple curves using linear methods by offsets from chords produced.
7. To set out simple curves using Rankine's deflection angles method.
8. To set out compound curve with angular methods with suing theodolite only
9. To set out reverse curve between two parallel line with angular methods with using theodolite only.
10. To set out the center line of a simple rectangular room using offset from base line
11. To set out the center line of columns of a building using two base lines at right angles
12. To determine height of a remote object, horizontal distance and coordinates of points using Total Station Instruments
13. Introduction to GPS

Text Books

Reference Books:

1. Bhavikatti S.S., *Surveying and Leveling Vol-I & II,* I.K. International Publishers, 2008.
2. BVB Lab Manual.
3. Punmia, B.C., Jain, Ashok.K., Jain, Arun.K., *Surveying Vol. l & 2*, 15ed., Lakshmi Publishers, 2005.

Course Title: Material Testing Lab | **Course Code: 15ECVP205**

L-T-P: 0-0-2	**Credits: 2**	**Contact Hours: 4 Hrs/ Week**
ISA Marks: 80	**ESA Marks: 20**	**Total Marks: 100**
Teaching Hours: 40 Hrs	**Examination Duration: 3 Hrs**	

Unit I

Tests on cement and concrete

1. Standard consistency (Normal consistency) for different cements.
2. Setting times: for different cements.
3. Specific gravity of cement
4. Specific surface of cement by Blaine's air permeability apparatus: for different cements.
5. Compressive strength of cement: for different cements.
6. Soundness of cement
7. Durability of Concrete
8. Permeability of Concrete

Tests on green concrete

9. Workability of concrete by slump test, compaction factor test and Vee-Bee test.

Open end experiment - Concrete mix design

Mechanical properties of materials

1. Test on Bricks
2. Tension test on Mild steel and HYSD bars.
3. Compression test of Mild Steel, Cast Iron and HYSD.
4. Impact test on Mild Steel (Charpy & Izod)
5. Shear Test on Mild steel.
6. Hardness tests on ferrous and non-ferrous metals – Brinell's and Rockwell
7. Torsion test on Mild Steel circular sections
8. Bending Test on Wood Under two point loading
9. Non destructive Testing - Demonstration

Tests on hardened concrete

1. Compressive strength of cement concrete for mix 1:2:4 and 1:1.5:3.
2. Split tensile strength of cement concrete for mix 1:2:4 and 1:1.5:3
3. Modulus of rupture – 2 pt loading method

Note:

1. Casting of concrete cubes, cylinders and beams shall be done in

concrete lab and testing will be done in strength of material testing lab

2. All tests to be carried out as per relevant BIS Codes

Text Books

Reference Books:

For Concrete Lab:

1. For PPC - IS 1489:91 – I
1. For OPC 33 Grade cement - IS 269:1989 Soundness of cement
2. IS 4031-1996 (Part-I)
3. For OPC 43 Grade cement - IS 8112: 1989
4. For OPC 53 Grade cement - IS 12269 :1987
5. For PBSC cement - IS 455: 1989
6. For SRC cement - IS 12330 :1988
7. For Concrete Mix Design – IS 10262 – 1984(Reaffirmed)
8. SP:23 – 1982, A hand book on Concrete Mixes based on IS.

For Material testing lab

1. Davis, Troxell and Hawk, *Testing of Engineering Materials*, International Student Edition – McGraw Hill Book Co. New Delhi.
2. Fenner, *Mechanical Testing of Materials*, George Newnes Ltd. London.
3. Holes, K. A., *Experimental Strength of Materials*, English Universities Press Ltd. London.
4. IS Codes ; IS : 432 - 1982 (Part-I) , IS : 1608 – 1960 , IS : 1500 – 1968, IS : 5652 – 1981.
5. Kukreja, C. B., Kishore K. Ravi Chawla, *Material Testing Laboratory Manual* Standard Publishers & Distributors 1996
6. Suryanarayana, A.. K., *Testing of Metallic Materials*, Prentice Hall of India Pvt. Ltd. New Delhi

5th Semester

Course Title: Structural Analysis-II		**Course Code: 15ECVC301**
L-T-P: 3-0-0	**Credits: 3**	**Contact Hours: 3 Hrs/ week**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 40	**Examination Duration: 3 Hrs**	

Unit I

1. Slope Deflection Method

Introduction, Assumptions, Sign conventions, Derivation of slope deflection equation, Analysis of continuous beams, Analysis of portal frames with and without lateral sway.	**15 hrs**

Unit II

2. Stiffness Method

Degree of kinematic indeterminacy of one and two dimensional structures, Generalized coordinates, Analysis of continuous beams with and without sinking of supports and portal frames.	**15 hrs**

Unit III

3. Plastic Analysis

Introduction, plastic hinge and plastic moment capacity, Assumptions, Shape factor for general sections, Collapse load, Basic theorems for finding collapse loads, Methods of plastic analysis, Kinematic method applied to beams and frames, Beam mechanism, Sway mechanism, Combined mechanism. Push over analysis.	**10 hrs**

Text Books

7. Bhavikatti S.S., *Structural Analysis-Vol. II* , 4ed , Vikas Publishers, 2013
8. Pandit, G.S. and Gupta, R., *Structural Analysis-A Matrix Approach*, Tata McGraw Hill Publishing Co Ltd, 2013

Reference Books:

2. Leet, E.M.and Uang, C. M., *Fundamentals of Structural Analysis*, Tata McGraw Hill Publishing Company, New Delhi, 2003.
3. Noris, C.H. and Wilbur, J., *Elementary Structural Analysis,* 4ed., Tata McGraw Hill Publishing Company, New Delhi, 2003
4. Reddy, C.S., *Basic Structural Analysis*, 3ed., Tata McGraw Hill Publishing Company, New Delhi, 2010.
5. Timoshenko, S.P., and Young, D.H., *Theory of Structures*, McGraw Hill

Company, New York, 1965.

Course Title: Geotechnical Engineering		**Course Code: 15ECVC302**
L-T-P: 3-0-0	**Credits: 3**	**Contact Hours: 3 Hrs/ week**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 40	**Examination Duration: 3 Hrs**	

Unit I

1. Introduction

Introduction to soil mechanics, Phase Diagram, Voids ratio, Porosity, Percentage air voids, Degree of saturation, Moisture content, Specific gravity , Bulk density, Dry density, Saturated density, Submerged density and their inter relationships. **04 hrs**

2. Index Properties of Soils

Index Properties of soils- Water content, Specific Gravity, Particle size distribution, Relative density, Consistency limits and indices, insitu density, Activity of Clay, Laboratory methods of determination of index properties of soils: Moisture content, Specific gravity, Particle size distribution, Liquid limit- Casagrande and cone penetration methods, Plastic limit and shrinkage limit determination. **05 hrs**

3. Classification of Soils

Purpose of soil classification, basis for soil classification, Particle size classification – MIT classification and IS classification, Unified soil classification and IS classification - Plasticity chart and its importance, Field identification of soils. **03 hrs**

4. Clay Mineralogy and Soil Structure

Single grained, honey combed, flocculent and dispersed structures, Valence bonds Soil-Water system, Electrical diffuse double layer, adsorbed water, base-exchange capacity, Isomorphus substitution. Common clay minerals in soil and their structures- Kaolinite, Illite and Montmorillonite. **03 hrs**

Unit II

5. Flow of Water through Soils

Darcy's law- assumption and validity, coefficient of permeability and its determination, factors affecting permeability, permeability of stratified soils, Seepage velocity, Superficial velocity and coefficient of percolation, effective stress concept-total stress and effective stress, quick sand phenomena, Capillary Phenomena. Laplace equation- assumptions and limitations, Characteristics and uses of flownets, Methods of drawing flownets for Dams and sheet piles. Estimating quantity of seepage and Exit gradient. Determination of phreatic line in earth dams with and without filter. Piping and protective filter, graded filter	**06 hrs**

6. Compaction of Soils

Definition, Principle of compaction, Standard and Modified proctor's compaction tests, factors affecting compaction, effect of compaction on soil properties, Field compaction control, Proctor needle. Compacting equipments.	**04 hrs**

7. Shear Strength of Soils

Concept of shear strength, Mohr's strength theory, Mohr-coulomb theory, conventional and modified failure envelops, Total and effective shear strength parameters, Concept of pore pressure, factors affecting shear strength of soils, Sensitivity and Thixotropy of clay. Measurement of shear parameters- Direct shear test, unconfined compression test, Triaxial compression test and vane shear test, Test under different drainage conditions.	**06 hrs**

Unit III

8. Stresses in Soils

Boussinesq's and Westergaard's theories for concentrated, circular, rectangular, line and strip loads. Comparison of Boussinesq's and Westergaard's analysis. Pressure distribution diagrams, contact pressure, Newmark's chart. **04 hrs**

9. Consolidation of Soils

Definition, Mass-spring analogy, Terzaghi's one dimensional consolidation theory-assumption and limitations. Normally consolidated, under consolidated and over consolidated soils, pre-consolidation pressure and its determination by Casagrande's method. Consolidation characteristics of soil, Time rate of consolidation. Laboratory one dimensional consolidation test, Determination of consolidation characteristics of soils-compression index, and coefficient of consolidation, determination of coefficient of consolidation by square root of time fitting method, logarithmic time fitting method. **05 hrs**

Text Books

a. Alam Singh and Chowdhary G.R, *Soil Engineering in Theory and Practice,* CBS Publishers and Distributors Ltd., New Delhi, 1994.
b. Braja M Das, *Principles of Geotechnical Engineering*, 8ed., Cenage Learning India (P) Ltd., India, 2014.
c. Punmia B C., *Soil Mechanics and Foundation Engineering.*, 17ed., Laxmi Publications Co., New Delhi, 2005.

Reference Books:

1. Craig, R.F., *Soil Mechanics*, Spon Press Publishers, New York ,2004.
2. Gopal Ranjan and Rao A.S.R., *Basic and Applied Soil Mechanics*, New Age International (P) Ltd., New Delhi, 2000.
3. Murthy V.N.S., *Soil Mechanics and Foundation Engineering*, CBS Publishers & Distributors Pvt. Ltd., New Delhi, 2016.
4. Venkatrahmaiah C., *Geotechnical Engineering,* 3ed., New Age International (P) Ltd., New Delhi, 2006.

Course Title: Design of RCC Structures		**Course Code: 15ECVC303**
L-T-P: 4-0-0	**Credits: 4**	**Contact Hours: 4 Hrs/ week**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 50	**Examination Duration: 4 Hrs**	

Unit I

1. General Features of Reinforced Concrete

Introduction, Philosophies of design (Brief on Working Stress method). Limit State Method of Design: Design Loads, Materials for Reinforced Concrete, Codal provisions, Concept of Safety. Design Philosophy – Limit State Design principles. Principles of limit states, Factor of Safety, Characteristic design loads, and Characteristic design strength. **05 hrs**

2. Ultimate Strength of R.C. Sections

General aspects of Ultimate strength, Stress block parameters for limit state of collapse, Ultimate flexural strength of singly reinforced and doubly reinforced rectangular sections, Ultimate flexural strength of flanged sections, Ultimate shear strength of RC sections, Concept of development length and anchorage. **11 hrs**

3. Flexure and Serviceability Limit States

General Specifications for design of beams for flexure -practical requirements, size of beam, cover to reinforcement-spacing of bars. General aspects of serviceability-Deflection limits in IS: 456 – 2000-Calculation of deflection, Cracking in structural concrete members, Calculation of deflections and crack width. **04 hrs**

Unit II

4. Design of Slabs

General consideration of design of slabs, Rectangular slabs spanning one direction, Rectangular slabs spanning in two directions for various boundary conditions. Design of simply supported, cantilever slabs. **08 hrs**

5. Design of Beams

Design procedures for critical sections for moment and shear. Anchorages of bars, check for development length, Reinforcement requirements, Slenderness limits for beams to ensure lateral stability, Design examples for Simply supported and Cantilever beams for rectangular and flanged sections. **10 hrs**

Unit III

6. Design of Columns

General aspects, effective length of column, loads on columns, slenderness ratio for columns, minimum eccentricity, design of short axially loaded columns, design of column subject to combined axial load and uniaxial moment using SP – 16 charts. **07 hrs**

7. Design of Staircase

General features, types of staircase, loads on stairs, effective span as per IS codal provisions, distribution of loading on different types of stairs, Design of stairs. **05 hrs**

Text Books

1. Jain, A.K., *Limit State method of design*, 7ed., Nemichand and Bros., Roorkee, 2012.
2. Krishnaraju, N., *Design of Reinforced concrete structures (IS: 456 – 2000)*, 3ed., CBS Publishers, New Delhi, 2016.

Reference Books:

1. Bhavikatti, S. S., *Design of RCC Structural Elements Vol-I,* New Age International Publications, New Delhi, 2016.
2. Robert Park & Thomson, *Reinforced Concrete*, John Wiley & Bros, 1975
3. M. L Gambhir, '*Fundamentals of Reinforced Concrete Design'*, PHI Learning Pvt. Ltd., 2009, 1st ed.
4. Punmia, B.C., Ashok Kumar Jain & Arun Kumar Jain, *Limit State design of Reinforced concrete*, Laxmi Publication, New Delhi, 2007.

IS Codes

1. IS:456-2000, Plain and Reinforced Concrete – Code of Practice, BIS, New Delhi, 2000
2. IS:875 (Part 1 & 2) - 1987, Code of Practice for Design Loads (Other than earthquake) for building and structures, BIS, 1987
3. SP 16: Design Aids for Reinforced Concrete to IS 456:2000.

Course Title: Transportation Engineering		**Course Code: 15ECVC304**
L-T-P: 4-0-0	**Credits: 4**	**Contact Hours: 4 Hrs/ week**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 50	**Examination Duration: 3 Hrs**	

Unit I

1. Introduction to Transportation Engineering

Importance of Transportation systems, Different modes, characteristics, their integration and comparison, Road types and classification, road patterns, phasing road development in India, salient features of 3rd and 4th twenty-year road development plans, Present scenario of road development in India and in Karnataka.	**04 hrs**

2. Highway Alignment and Surveys

Guidelines for selection of alignment, engineering surveys, steps involved in alignment of new highway and realignment of highway. Design features of Rural / low volume roads, Expressways and Urban Roads.	**04 hrs**

3. Geometric Design of Highways

Functional design of highways, cross section elements- camber, width of carriageway, shoulder width, formation width, right of way, typical cross section of roads in embankment and cutting, sight distance, design of horizontal and vertical curves-features involved in highway safety and traffic efficiency.	**08 hrs**

4. Traffic Engineering

Sampling in Traffic Studies, Objectives, methods of traffic study, equipment, data collection, analysis and interpretation of (i) Spot speed (ii) Speed and delay (iii) Volume (iv) Origin - Destination (v) Parking (vi) Accident studies. Traffic flow, Roadway capacities.	**05 hrs**

Unit II

5. Pavement Materials

Basic road construction materials such as soils, aggregates, bitumen-tar-emulsion-cutback and Portland cement, bituminous mixes – types, source, functions, requirements, properties, tests and specifications for use in various components of road.	**04 hrs**

6. Pavement design

Flexible pavement design: Empirical, semi empirical and theoretical design approaches, principle, advantages and application. Design as per IRC guidelines, outline of other common design methods such as	**09 hrs**

AASHTO and Asphalt Institute methods

Rigid pavement design: Determination of ESWL, Axle load distribution studies, Stresses due to wheel loads and temperature variations, Design of cement concrete pavements as per IRC guidelines.

7. Highway Construction

Steps for the construction of road formation in embankment and cut, construction steps for subgrade (preparation of subgrade) in cutting, filling and at grade, Different types of granular base course- WBM, WMM, CRM - specifications, construction method and quality control tests, Different types of bituminous layers for binder and surface courses- specifications construction method and quality control tests, Different types of sub-base and base course for cement concrete pavement and construction method. **08 hrs**

Unit III

8. Introduction to Intelligent Transportation Systems (ITS)

Definition, Objectives, Historical Background, Benefits of ITS -ITS Data collection techniques – Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), Geographic Information Systems (GIS), video data collection. **08 hrs**

Text Books

1. Khanna, S.K., and C.E.G. Justo, & A. Veeraragavan, *Highway Engineering,* 10ed., Nem Chand and Bros. Publishers, Roorkee, 2015.
2. Kadiyali, L.R., *Traffic Engineering and Transportation Planning*, 7ed., Khanna Publishers, New Delhi, 2011.
3. Kadiyali L.R.., *Principles and Practices* of *Highway Engineering*, Khanna Publishers, New Delhi, 2005.
4. Papacostas, C.S. and Prevedourous, P.D., *Transportation Engineering and Planning*, 3 ed., Prentice-Hall India, New Delhi, 2002.

Reference Books:

1. Eldon J. Yoder and Mathew W., Witczak, *Principles of Pavement Design*, 2ed. Tata McGraw Hill Publishing Co Ltd., Delhi, 1975.
2. Huang, Yang, H., *Pavement Analysis and Design*, 2ed., Prentice-Hall, 1993.
3. M A Chowdhary and A Sadek. *Fundamentals of Intelligent Transportation systems planning*. Artech House Inc., US, 2003.
4. *IRC: 37-2012, Guidelines for the Design of Flexible Pavements (Third Revision)*, Indian Roads Congress, New Delhi.
5. IRC: 58-2015*, 'Guidelines for the Design of Plain jointed Rigid pavements for highway'*, Indian Roads Congress, New Delhi.
6. IRC-SP-72-2007, '*Guidelines for the Design of Flexible Pavements for Low Volume*

Rural Roads', Indian Roads Congress, New Delhi.
7. MORTH Specifications for Road and Bridge Works, IRC Publication.

Course Title: Advanced Project Management		**Course Code: 15ECVC305**
L-T-P: 3-0-0	**Credits: 3**	**Contact Hours: 3 Hrs/ week**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 40	**Examination Duration: 3 Hrs**	

Unit I

1. Introduction to Advanced Project Management

Introduction, Importance of advanced project management, the project management institute and PMBOK, the role of a project manager, project management in India. **05 hrs**

2. Work Breakdown Structure

Concept of WBS, Common usage of terms, Preparing a WBS, Factors to be considered, WBS measurement considerations, Challenges to be considered, WBS level of Detail, WBS life-cycle considerations, Project risk and the WBS, Resource planning and management with WBS, Problems – Detailed WBS of residential, commercial, industrial and Highway Road etc. CPM and PERT. **12 hrs**

Unit II

3. Cost Loaded Scheduling and Project Controls

Determination of unit costs and total cost of a typical construction project. Project Controls - Introduction, Project life cycle, Overview of project life cycle, earned value management, Cost performance Index, Schedule performance index, forecasting methods and problems, resource utilization and cumulative curves, Cost loaded Schedules. **10 hrs**

5. Contractor's Estimation of cost and Bidding Strategy

Pre-qualification process, study of tender documents, preparation of construction schedule, determination of bid price. **06 hrs**

Bidding and Estimation practices in Indian Construction Industry.

Unit III

6. Risk analysis and Project Close out

Risks involved in projects – determination and mitigation. Closing out of project, Lessons learned, historical data - creation and uses. **03 hrs**

7. Labour Laws and Quality Control

Need for inspection and Quality Control, principles of inspection, Stages of inspection and quality control. Status of construction labour, wages of construction workers, unions, different labour acts. **04 hrs**

Text Books

1. James Lewis, *Project Planning, Scheduling, and Control*, 3ed.,2009.

Reference Books:

1. P. Harris, *Planning and Scheduling Using MS Project* 2010.
2. Ursula Kuehn, *Integrated Cost and Schedule Control in Project Management,* 2ed.,2011.

Course Title: Highway Engineering Laboratory **Course Code: 15ECVP301**

L-T-P: 0-0-1 **Credits: 1** **Contact Hours: 2 Hrs/ week**

ISA Marks: 80 **ESA Marks: 20** **Total Marks: 100**

Teaching Hours: 30 **Examination Duration: 3 Hrs**

Unit I

Test on coarse aggregate:

1. Impact test
2. Crushing test
3. Los Angeles Abrasion test
4. Shape test (Flakiness & elongation index and Angularity number)
5. Specific gravity and water absorption test
6. Gradation test
7. Bulk density and voids ratio test

Tests on Bitumen:

1. Penetration test
2. Specific gravity test
3. Ductility test
4. Softening point test
5. Viscosity test
6. Flash and fire point test
7. Stripping value test
8. Marshall stability test

Test on subgrade soil:

1. CBR Test – soaked

Traffic and pavement performance studies:

1. Traffic studies
2. Intersection studies
3. Bump indicator studies

Reference Books:

1. Khanna, S.K., Justo, C.E.G., and Veeraragavan, A., *Highway Materials and Pavement Testing*, Nem Chand and Bros, Roorkee
2. IS : 2386 (part 4) (Reaffirmed 2011)- Impact & Crushing test.
3. IS : 2386 (part 5)-Los Angeles abrasion test
4. IS : 2386 (part 5)-Shape Test
5. IS : 2386 (Part 3)-Specific gravity and Porosity
6. IS 2720 (Part 16)-1997, Laboratory Determination of CBR, Rev.2. Indian standard method of test for soils
7. IS : 6241-1971- Stripping value of aggregate
8. IS 383-1997 ‘Indian standard specifications for coarse and fine aggregates from natural sources’.

9. IS: 73-2013, Rev.3. Indian standard specifications for paving bitumen'.

Course Title: Environmental Engineering Laboratory **Course Code: 15ECVP302**

L-T-P: 0-0-1	**Credits: 1**	**Contact Hours: 2 Hrs/ week**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 30	**Examination Duration: 3 Hrs**	

1. Determination of Solids in Sewage: Total Solids, Suspended Solids, Dissolved Solids, Volatile Solids, Fixed Solids, Settleable Solids.
2. Electrical conductivity and pH.
3. Determination of Calcium, Magnesium and Total Hardness
4. Determination of Alkalinity, Acidity
5. Determination of Sulphates, Chlorides
6. Determination of Dissolved Oxygen and BOD.
7. Determination of COD.
8. Determination of Residual Chlorine.
9. Jar Test for Optimum Dosage of Alum, Turbidity determination
10. Determination of Iron.
11. Determination of Fluorides.
12. Determination of MPN

Reference Books:

1. *Standard Methods for Examination of Water and Wastewater*, 22^{nd} American Publication – Association, Water Pollution Control Federation, American Water Works Association, Washington DC., 2012
2. IS 10500:2012, Drinking Water Specification, BIS, New Delhi
3. IS 3025 (Part 62) : 2006 Methods of Sampling and Test (Physical & Chemical) for water and waste water, BIS, New Delhi
4. IS 3307:1977, Tolerance Limits For Industrial Effluents Discharged on Land and Irrigation Purpose, BIS, New Delhi

Course Title: Engineering Computation Laboratory		**Course Code: 15ECVP303**
L-T-P: 0-0-1	**Credits: 1**	**Contact Hours: 2 Hrs/ week**
ISA Marks: 80	**ESA Marks: 20**	**Total Marks: 100**
Teaching Hours: 30	**Examination Duration: 3 Hrs**	

Students must be able to write coding in python, compile it and run as applied to the elemental numerical on engineering mathematics and civil engineering subjects like Mechanics of materials, Surveying, transportation, Fluid Mechanics, Structural Dynamics, etc. They should be able to document the lab work in the form of Flow-charts, Algorithms, coding output of results in tabular/graphical formats.

Following is the list of experiments:

1. Introduction to Python programming language: Data types, Operators, Program flow control, User defined functions
2. Working with Arrays, Array operators, Array indexing and slicing, and Plotting graphs
3. Developing and testing a Python function to find the roots of polynomial equations using Newton Gregory forward and backward interpolation.
4. Developing and testing a Python function to solve systems of linear equations using Gauss Elimination method.
5. Developing and testing a Python function to solve linear system of equations using Gauss Seidel iterative method.
6. Developing and testing a Python function to implement Power method for the computation of the largest eigenvalue and corresponding eigenvector.
7. Developing the equations for reactions, shear force and bending moment for a simply supported beam.
8. Finding out the principal stress in the three dimensional state of stress at a point.
9. Using Power method, obtain the smallest natural frequency and the corresponding mode shape.
10. Estimating the population for a given year by extrapolation using first, second, third and fourth order interpolating polynomials and comparing the prediction with actual results.

Text Book

1. Mark Lutz, Programming python, O’Reilly Media, 2010.
2. Alex Martelli, Python in a nutshell, O’Reilly Media, 2003.
3. M.K.Jain, S.R.K.Iyengar, R.K.Jain, 'Numerical Methods for scientific and engineering computation', New Age International Publishers, 2003.

Course Title: Mini Project		**Course Code: 15ECVW301**
L-T-P: 0-0-3	**Credits: 3**	**Contact Hours: 3 Hrs/ week**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 40	**Examination Duration: 3 Hrs**	

(To be conducted in the beginning of 5th Semester for a period of 7 days, Viva voce conducted along with 5th semester exams)

An extensive survey training involving investigation and design of the following projects is to be conducted for 7 days. The student shall submit a project report consisting of designs and drawings.

1. General instructions

Reconnaissance of the sites and fly leveling to establish bench marks.

2. Water Supply and Sanitary Project

Examination of sources of water supply, Calculation of quantity of water required based on existing and projected population. Preparation of village map by any suitable method of surveying (like plane tabling), location of sites for ground level and overhead tanks underground drainage system surveys for laying the sewers.

3. Highway Project

Preliminary and detailed investigations to align a new road (min. 1 to 1.5 km stretch) between two obligatory points. The investigations shall consist of topographic surveying of strip of land for considering alternate routes and for final alignment. Report should justify the selected alignment with details of all geometric designs for traffic and design speed assumed. Drawing shall include key plan initial alignment, final alignment, longitudinal section along final alignment, typical cross sections of road.

NOTE:

A) For the above works to Total Station should also be used along with conventional instruments.

B) All relevant drawings to be prepared using ZW CAD.

Reference Books:

1. Basak, *Text Book of Surveying*, 2010
2. Bhavikatti S.S., *Surveying and Leveling Vol-I & II,* I.K. International Publishers, 2008.
3. *CPHEEO: Manual on water supply and treatment*, Ministry of Urban Development.
4. Duggal, S.K., *Text Book of Surveying*, 2013
5. Garg, S.K., *Water supply Engineering*, 7ed., Khanna Publishers, New Delhi, 2005.
6. Kadiyali, L.R., Traffic Engineering and Transportation Planning, 7ed., Khanna

Publishers, New Delhi, 2011.

7. Khanna, S.K., and C.E.G. Justo, & A. Veeraragavan, Highway Engineering, 10ed., Nem Chand and Bros. Publishers, Roorkee, 2015.
8. Modi, P.N., *Sewage Treatment and Disposal Engg.,* 15ed., Std. Book House, New Delhi, 2015.
9. Punmia, B.C., Jain, Ashok.K. Jain, Arun.K. *Surveying Vol. 1 and Vol-2*, Lakshmi Publishers, 2015.
10. *IRC: 37-2012, Guidelines for the Design of Flexible Pavements (Third Revision)*, Indian Roads Congress, New Delhi.
11. *IRC:15-2011, Construction of Concrete Roads,* Indian Roads Congress, New Delhi.
12. *IRC: 58-2015,Guidelines for the Design of Plain jointed Rigid pavements for highway*, Indian Roads Congress, New Delhi.

6th Semester

Course Title: Advanced Geotechnical Engineering **Course Code: 15ECVC306**

L-T-P: 3-0-0	**Credits: 3**	**Contact Hours: 3 Hrs/ week**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 40	**Examination Duration: 3 Hrs**	

Unit I

1. Subsurface Exploration

Importance of exploration program, Methods of soil exploration: Boring, sounding tests, geophysical Methods-Electrical resistivity and Seismic refraction methods. Types of soil samples- disturbed, undisturbed, and representative samples. Stabilization of boreholes - Typical bore log. Number and depth of borings for various civil engineering structures. Location of ground water table in fine and coarse grained soils. **03 hrs**

2. Lateral Earth Pressure

Active and Passive earth pressures, Earth pressure at rest, Earth pressure coefficients. Earth pressure theories- Rankine's and Coulomb's – assumptions and limitations, Graphical solutions for active earth pressure Cullman's and Rebhann's methods, Lateral earth pressure in cohesive and cohesionless soils, Earth pressure distribution. **06 hrs**

3. Stability of Slopes

Types of slopes, causes and type of failure of slopes. Definition of factor of safety, Stability of finite and infinite slopes- Method of slices, Friction Circle method, Fellineous method, Taylor's stability number. **06 hrs**

Unit II

4. Shallow Foundations

Definitions of ultimate, net and safe bearing capacities, Allowable bearing pressure. Terzaghi's and Brinch Hansen's bearing capacity equations- assumptions and limitations. Bearing capacity of footing subjected to eccentric loading. Effect of ground water table on bearing capacity. Plate load test, Standard penetration test, cone penetration test. **06 hrs**

5. Deep Foundations

Types of Deep foundation. Piles, Drilled Piers and Cassons. Load carrying capacity of pile. Design of pile and pile groups. Batter piles and under reamed piles. Design of pile cap. Design aspects of Well foundations. **06 hrs**

6. Foundation Settlement

Settlement Analysis, Data for settlement analysis, computation of settlement, Concept of immediate, consolidation and secondary settlements. Tolerance BIS specifications for total and differential settlements of footings and rafts. **03 hrs**

Unit III

7. Soil Stabilization and Reinforced soil

Introduction Methods of soil stabilization Reinforced soil**,** basic mechanism, choice of soil and reinforcement, Strength characteristics of reinforced soil, Design of Reinforced earth retaining walls, Wall with reinforced backfill, Reinforced earth slab. **06 hrs**

8. Containment of solid waste in landfills

Waste containment, Landfills, Shapes and size of landfills, Types of landfills, Impervious barriers for liners and covers, Stability of landfills, Landfill construction and operation **04 hrs**

Text Books

1. Alam Singh and Chowdhary, G.R., *Soil Engineering in Theory and Practice,* 2ed., CBS Publishers and Distributors Ltd., New Delhi, 2009.
2. Punmia, B.C., *Soil Mechanics and Foundation Engg.*, 16ed., Laxmi Publications Co., New Delhi, 2005.
3. B.M. Das, *Principles of Foundation Engineering*, 6ed., Thomson Business Information India (P) Ltd., India, 2007.

Reference Books:

1. Braja M. Das, *Principles of Geotechnical Engineering*, 8ed., Cenage Learning India (P) Ltd., India, 2014.
2. Gopal Ranjan and A.S.R Rao., *Basic and Applied Soil Mechanics*, New Age International (P) Ltd., New Delhi, 2000.
3. Knappett J.A and R.F Craig, *Soil Mechanics*, 8ed., Van Nostrand Reinhold Co. Ltd., 2012.
4. Murthy V.N.S., *Principle and Practices Soil Mechanics and Foundation Engineering*, 4ed., UBS Publishers and Distributors, New Delhi, 2002.
5. N.N.Som and S.C.Das, *Theory and practice of foundation engineering*, PHI learning Pvt Ltd
6. Sashi K Gulhati and Manoj data, *Geotechnical Engineering*, Tata Mcgraw Hill
7. Sivakumar Babu, G. L., *Introduction to Soil Reinforcement and Geosynthetics*, Universities Press, Hyderabad, 2006.
8. Swami saran, *Analysis and Design of Substructures: Limit State Design,* 2ed

oxford and IBH publishing co. pvt. ltd

9. Venkatrahmaiah, C., *Geotechnical Engineering,* 3ed., New Age International (P) Ltd., New Delhi, 2006.

IS Codes

10. IS 8403 : 1981 (Reaffirmed 2002) Code of practice for Determination of Brearing Capacity of Shallow Foundations.
11. IS 2911:1985 Part I to IV (Reaffirmed 1995) Code of Practice for Design and Construction of Pile Foundations.
12. IRC-SP-102-2014-Guidelines for design and construction of reinforced soil walls.

Course Title: Estimation and Costing		**Course Code: 15ECVC307**
L-T-P: 3-0-0	**Credits: 3**	**Contact Hours: 3 Hrs/ week**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 40	**Examination Duration: 3 Hrs**	

Unit I

1. Introduction

Different type of estimates, study of various drawing attached with estimates, important terms, units of measurement, abstract, approximate methods of estimating buildings, cost from materials and labour equations recommended by CBRI –examples. **04 hrs**

2. Methods of Estimation

Methods of taking out quantities and cost -center line method, long and short wall method or crossing method. **04 hrs**

3. Preparation of Estimates for Building Components

Preparation of detailed and abstract estimates for the following Civil Engineering works -Buildings -Masonry structures and framed structures with flat, sloped RCC roofs. Building components (Beams, Columns and Column Footings, RCC Roof Slabs etc) **08 hrs**

Unit II

3. Preparation of Estimates for Truss & Culverts

Wooden and Steel truss, RCC slab culverts, Manhole and Septic tanks. **04 hrs**

4. Specifications

Definition of specifications,- objective of writing specifications, essentials in specifications, general and detail specifications of item of works in buildings, specifications of aluminum and wooden partitions, false ceiling, aluminum and fiber doors and windows, various types of claddings. **04 hrs**

5. Rate Analysis

Definition and purpose. Working out quantities and rates for the following standard items of works -earth work in different types of soils, cement concrete of different mixes, bricks and stone masonry, flooring, plastering, RCC works, centering and form work for different RCC items, wood and steel works for doors, windows and ventilators. **08 hrs**

Unit III

6. Measurement of Earthwork for Roads

Methods for computation of earthwork -cross sections -mid section formula, trapezoidal or average end area or mean sectional area formula, prismoidal formula, for different terrains. **04 hrs**

7. Department (PWD) Procedures / Processes

Types of contract -essentials of contract agreement - legal aspects, penal provisions on breach of contract. Definition of the terms -Tender, earnest money deposit, security deposit, tender forms, documents and types. Comparative statements, acceptance of contract documents and issue of work orders. Duties and liabilities, termination of contract, completion certificate, quality control, right of contractor, refund of deposit. Administrative approval -Technical sanction. Nominal muster roll, measurement books -procedure for recording and checking measurements - preparation of bills, Arbitration. **04 hrs**

Text Books

1. Chakraborti, N., *Estimating, Costing, specification and valuation in Civil Engg.*, Calcutta, 2007.
2. Dutta, B.N., *Estimating and Costing in Civil Engineering: Theory and Practice Including Specifications and Valuation*, Sangam Books, 2002

Reference Books:

1. Birde, G.S., Text book of Estimating & Costing, Dhanpath Rai and Sons. New Delhi, 2014.
2. Kohli, D.D. and Kohli, R.C., Text Book of: Estimating and Costing (Civil), Ed.12, S. Chand Co. New Delhi, 2012.
3. Public Works Department Schedule of Rates 2016-17.
4. Rangwala S.C., *Estimating, Costing and Valuation,* Charotar Publishing House, Anand, 2009.

Open Elective -1

Course Title: Nano Composite Materials **Course Code: 15ECVE301**

L-T-P: 3-0-0	**Credits: 3**	**Contact Hours: 3 Hrs/ week**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 40	**Examination Duration: 3 Hrs**	

Unit I

1. Introduction

Introduction to materials, traditional materials, development, properties, strength of and mechanical properties of materials , introduction, definition, classification and characteristics of composite materials - fibrous composites, laminated composites, particulate composites **06 hrs**

2. Fiber and matrices

Carbon fibers, glass fibers, silicon carbide and organic fibers. Polymer matrices, metal matrices and ceramic matrices. **05 hrs**

3. Fabrication and application

Polymer composites, metal composites and ceramic composites Application of composites: Automobile, Aircrafts, missiles, Space hardware, Electrical and electronics, marine, recreational and Sports equipment, future potential of composites. **05 hrs**

Unit II

4. An overview of Nanoscience & Nanotechnology

Historical background – nature, scope and content of the subject – multidisciplinary aspects – industrial, economic and societal implications. **06 hrs**

5. Experimental Techniques and Methods

For investigating and manipulating materials in the nano scale – electron microscope – scanning probe microscope – optical and other microscopes **05 hrs**

6. Introduction to Nanomaterials

Carbon Nanotubes , synthesis and purification – filling of nanotubes – mechanism of growth – electronic structure – transport properties – mechanical and physical properties – applications **05 hrs**

Unit III

7. Introduction to nano-composite

Nano composite polymer matrix, nano composite ceramic matrix, nano composite metal matrix Applications in engineering , future scope of nano-composite, research , training in development of nano-composite materials. **05 hrs**

8. Safety and environmental aspects

Safety and environmental aspects of nano-materials, future challenge, cost optimization and fabrication process of nano composite materials **03 hrs**

Text Book:

1. Hull and Clyne, *Introduction to composite materials*, Cambridge University Press, 2nd edition, 1990.
2. NANO: The Essentials – Understanding Nanoscience and Nanotechnology; T Pradeep; Tata McGraw-Hill India (2007)

References:

1. Di Ventra, et al (Ed), *Introduction to Nanoscale Science and Technology [Series: Nanostructure Science andTechnology]*; Springer (2004).
2. K.K.Chawla, *Composite Science and Engineering*, Springer Verlag 1998.
3. Nanotechnology Demystified: Linda Williams & Wade Adams; McGraw-Hill (2007)
4. Richard Booker & Earl Boysen; Wiley , Nanotechnology, (2005).
5. Richard Booker & Earl Boysen; Wiley, *Nanotechnology,* (2005).
6. Robert M. Jones, *Mechanics of Composite Materials*, McGraw Hill Kogakusha Ltd. 1998

Program Elective -1

Course Title: Pavement Engineering		**Course Code: 15ECVE303**
L-T-P: 3-0-0	**Credits: 3**	**Contact Hours: 3 Hrs/ week**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 40	**Examination Duration: 3 Hrs**	

Unit I

1. Introduction to pavement system

Desirable characteristics of pavement, types and components, Difference between Highway pavement and Air field pavement, Functions of sub-grade, sub base – Base course – surface course, comparison between Rigid and flexible pavement. **04 hrs**

2. Stresses and Deflections in Flexible Pavements

Factors affecting design and performance of flexible and rigid pavements – Pavement design factors, loads – axle load distribution, ESWL, EWL,VDF due to varying loads and CSA. Application of elastic theory, stresses, deflections / strains in single, two and three layer system, Applications in pavement design. **08 hrs**

3. Pavement Design Approach

Flexible pavement design: Empirical, semi- empirical and theoretical design approaches, principle, advantages and application. Determination of ESWL, EWL for dual and dual tandem wheel loads in Rigid pavements **03 hrs**

Unit II

4. Flexible Pavement Design

Design steps by CBR method as per IRC, outline of other common design methods such as AASHTO and Asphalt Institute methods. **07 hrs**

5. Rigid Pavement Design

General design principle, Stresses in rigid pavements, stresses due to wheel loads and temperature variations, design of cement concrete pavements as per IRC guidelines. Design features of CRCP, SFRC and ICBP. **08 hrs**

Unit III

6. Flexible Pavement Failures, Maintenance and Evaluation

Types of failures, causes, remedial/maintenance measures in flexible pavements – Functional Evaluation by visual inspection and unevenness measurement by using different techniques - Structural Evaluation by Benkelman Beam Deflection Method, Falling weight deflectometer. **05 hrs**

7. Rigid Pavement Failures, Maintenance and Evaluation

Types of failures, causes, remedial/maintenance measures in rigid pavements. Definition and concepts of condition and evaluation surveys, Present serviceability index, methods of measuring condition. **05 hrs**

Text Books

7. Khanna, S.K., and C.E.G. Justo, & A. Veeraragavan, *Highway Engineering,* 10ed., Nem Chand and Bros. Publishers, Roorkee, 2014.
8. Yoder E.J. and Witczak, Principles of pavement design, 2ed., John Wiley and Sons, 1975.

Reference Books:.

1. IRC 101-1988- Guidelines for Design of Continuously Reinforced Concrete Pavement with Elastic Joints, Indian Roads Congress, New Delhi.
2. IRC 59 – 1976- Tentative Guidelines for Design of Gap Graded Cement Concrete Mixes for Road Pavement, Indian Roads Congress, New Delhi.
3. IRC 81-1997- Guidelines for strengthening of flexible road pavements using Benkelman beam deflection technique, Indian Roads Congress, New Delhi.
4. IRC: 37-2012 -Guidelines for the Design of Flexible Pavements (Third Revision), Indian Roads Congress, New Delhi.
5. IRC: 58-2015- Guidelines for the Design of Plain jointed Rigid pavements for highway, Indian Roads Congress, New Delhi.
6. T. Fwa, '*The Handbook of Highway Engineering'*, Taylor & Francis Group, Newyork, 2006.

Course Title: Design of Hydraulic Structures		**Course Code: 15ECVE304**
L-T-P: 3-0-0	**Credits: 3**	**Contact Hours: 3 Hrs/ week**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 40	**Examination Duration: 3 Hrs**	

Unit I

1. Reservoir sedimentation

Introduction, the process of erosion, factors affecting erosion. Trap efficiency and numerical problems. Reservoir sedimentation, life of a reservoir . **06 hrs**

2. Gravity Dams

Introduction, forces acting on a gravity dam, types of joints. Stress analysis in gravity dam, Elementary & practical profiles of a gravity dam, stability analysis and drainage galleries in gravity dams **10 hrs**

Unit II

3. Earth Dams

Introduction, types of Earth dams, Design criteria for Earth dams, causes of failure of earth dams, section of dam, preliminary design criteria and problems on it, control of seepage through earth dams, Safety measures. **08 hrs**

4. Cross Drainage works and Spillways

Types of cross drainage works. Features of design of cross drainage works. Design of siphon aqueduct. Introduction, essentials of a spillway, spillway components, factors affecting type & design of spillways. Ogee spillway. Energy dissipation below spillways. **08 hrs**

Unit III

5. Diversion Head Works

Introduction, Khosla's theory, method of independent variables, elements of design for surface flow. Design of vertical drop weir on Bligh's theory. Function of canal head regulator. **08 hrs**

Text Books

1. Modi, P.N., *Irrigation, Water Resources, and Water Power Engineering*, Standard Book House, New Delhi, 2004.
2. Punmia, B.C. and Pande Lal, *Irrigation and Water Power Engineering*, 16ed., Laxhmi Publications, New Delhi, 2009.
3. Sharma, R.K., *Text Book of Irrigation Engineering and Hydraulic Structures*, S. Chand, New Delhi, 2002.

Reference Books:

1. Garg, S.K., *Irrigation Engineering and Hydraulic Structures*, Khanna Publications, New Delhi, 2005.
2. Madan Mohan Das & Mimi Das Saikia, *Irrigation and Water Power Engineering,* PHI Learning Pvt. Ltd., New Delhi, 2009.
3. N. Balasubramanya, *Hydraulic Structures & Irrigation Design Drawing* Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2015
4. Sathya C, Narayana Murthy, *Design of Minor Irrigation and Canal Structures* Wiley eastern limited, New Delhi, 1990.

Course Title: Geotechnical Engineering Laboratory **Course Code: 15ECVP304**

L-T-P: 0-0-1	**Credits: 1**	**Contact Hours: 2 Hrs/ week**
ISA Marks: 80	**ESA Marks: 20**	**Total Marks: 100**
Teaching Hours: 30	**Examination Duration: 3 Hrs**	

List Of Experiments

1. Tests for determination of specific gravity and moisture content.
2. Grain size analysis of soil sample (sieve analysis).
3. In situ density by core cutter and sand replacement methods.
4. Consistency Limits – Liquid Limit (Casagrande and Cone Penetration Methods), plastic limit and shrinkage limit.
5. Standard Proctor Compaction Test and Modified Proctor Compaction Test.
6. Coefficient of permeability by constant head and variable head methods.
7. Strength Tests

a) Unconfined Compression Test.
b) Direct Shear Test**.**
c) Triaxial Compression Test (undrained)**.**

8. Consolidation Test- Determination of compression index and coefficient of consolidation.
9. a) Demonstration of miscellaneous equipments such as Augers, Samplers, Rapid Moisture meter, Proctor's needle.
   b) Demonstration of Hydrometer Test.
   c) Demonstration of Free Swell Index and Swell Pressure Test
   d) Demonstration of determination of relative density of sands.
   e) Laboratory vane shear
10. Open ended experiments to use soil as foundation material and construction material.

Reference Books:

1. Braja M. Das., *Soil Mechanics Laboratory Manual*, 9ed., Oxford University Press, 2016.
2. Lambe T.W., Soil *Testing for Engineers*, Wiley Eastern Ltd., New Delhi.
3. Shamsher Prakash and P.K.Jain, *Engineering soil testing*, NEM Chand and Bros, Roorkee.
4. SP-36-1987-Compendium of Indian standard on soil engineering.

Course Title: Computer Aided Design Laboratory **Course Code: 15ECVP305**

L-T-P: 0-0-1	**Credits: 1**	**Contact Hours: 3 Hrs/ week**
ISA Marks: 80	**ESA Marks: 20**	**Total Marks: 100**
Teaching Hours: 30	**Examination Duration: 3 Hrs**	

Students should be able to write coding in MS Excel, compile the same and run, for simple numerical in various civil engineering fields. They should be able to document the laboratory work in the forms of Flow charts, Algorithms, coding, output of results in tabular/graphical formats.

Also they should be able to use the available software (SAP) to analyse a simple structures and present the results in tabular/ graphical formats and generate reports.

Using MS Excel to solve Civil Engineering Problems

Structural Engineering

1. Calculating and plotting shear force and bending moment diagrams for cantilever, simply supported and fixed beams subjected to a combination of loads.
2. Calculation of deflection diagrams for cantilever and simply supported beams subjected to single point loads and UDL.
3. Design of singly and doubly reinforced rectangular sections subjected to bending moment and shear force.
4. Stability of dams.

Surveying

5. Balancing of closed traverse using transit rule
6. Computation of volume of earthwork in cutting and filling.
7. Setting out a horizontal curve by different methods – (i) Offset from long chord (ii) Perpendicular offset from tangents (iii) Radial offsets from tangents

Transportation Engineering

8. Design of super elevation
9. Design of horizontal and vertical alignment

Geotechnical Engineering

10. Grain size distribution and grading of soil
11. Calculation of shear parameters

Fluid Mechanics

12. Most economical section for a canal

13. Water hammer analysis
14. Head over Ogee weir

Use of Structural Analysis Software

The student shall analyse the following structures in SAP:

15. Plane truss subjected to dead loads, live loads and wind loads
16. Continuous beam with at least three spans subjected to dead loads and live loads
17. Plane frame subjected to dead loads, live loads and lateral loads.
18. Analysis of two bay two storey structure under static loading conditions (concrete frame).
19. Analysis of long span steel truss bridge.

Text Book

1. Microsoft Excel 2010 Formulas, John Walkenbach, Wiley-India pvt. Ltd.

Course Title: Construction Engineering & Management Laboratory | **Course Code: 15ECVP306**

L-T-P: 0-0-1	**Credits: 1**	**Contact Hours: 2 Hrs/ week**
ISA Marks: 80	**ESA Marks: 20**	**Total Marks: 100**
Teaching Hours: 30	**Examination Duration: 3 Hrs**	

1. Introduction to Primavera P6
2. Develop a Work Break-down Structure (WBS) for a residential building of 3 storey.
3. Create and add activities to the WBS and assign relationships as per the logic of the precedence diagram for the residential building. Determine the duration of the project.
4. Apply constraints and filters to the developed activities to develop two-week, one-month and three-month look-ahead schedule.
5. Develop different roles and resources in the resource library and assign to the various activities along with their unit rates.
6. Develop the cost-loaded schedule and create baseline of the project.
7. Perform earned value analysis to track and monitor the project.
8. Conduct simulations in Microsoft Visio process simulator to determine most efficient excavation cycles on large scale projects.
9. Conduct Monte-Carlo simulation in Microsoft Excel to perform risk analysis for the project.

Reference Books:

1. Kim Heldman & William Heldman, *Microsoft Excel for Project managers 2007.*
2. P. Harris, *Planning and Scheduling Using Primavera P6 2010.*

Course Title: Minor Project		**Course Code: 15ECVW302**
L-T-P: 0-0-6	**Credits: 6**	**Contact Hours: 6 Hrs/ week**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 40	**Examination Duration: 3 Hrs**	

Functional and architectural design of a building from, but not restricted to one of the following category: Educational institutions, Administration buildings, Industrial buildings, Commercial buildings, Public facilities such as bus terminus, rail station, hospitals, cinema halls, auditorium etc.

The students shall identify a building and collect requirements for the building, carry out functional design through bubble diagrams and circulation diagrams and consider aspects such as orientation, aspect, best use of site conditions. The project shall include calculation of loads and analysis and design of components including foundations, columns, beams and slab. Simplified computer aided analysis should be performed.

The student shall submit the following:

- Identification of Project.
- Bubble diagrams and Circulation diagrams
- Logic used to arrive at room dimensions based on ergonomics, furniture sizes and placement, equipment etc.
- Architectural plans, elevations, sections and building services fit for submission to approving authorities
- Preliminary soil investigation.
- Results of structural analysis and design of selected components
- Drawings showing structural details of components designed
- Develop WBS, calculate productivity, create precedence diagram, develop cost-loaded schedule and create a baseline.
- Collection of progress data, update the schedule, perform earned value analysis.

Expected Deliverables:

Identified project details, bubble diagrams and circulation diagrams, complete architectural plans, Soil investigation report, Final structural design drawings and calculations, detailed WBS, productivity calculations, precedence diagram, Initial cost-loaded schedule (Primary Baseline), 1st progress report and earned value report.

Reference Books:

1. IS 1172 – 1971 Code of Basic Requirements for Water Supply, Drainage and Sanitation (Second Rev.), BIS.
2. IS 1642 – 1960 Code of Practice for Fire Safety in Buildings (General): Materials and Constructions in Buildings, BIS.
3. IS 1648 – 1961 Code of Practice for Fire Safety in Buildings (General): Fire fighting Equipment and its maintenance, BIS.
4. IS 1742 – 1972 Code of Practice for Building Drainage, BIS.
5. IS 2065 – 1972 Code of Practice for Water Supply in Buildings (First Rev.) BIS.
6. IS 3861 – 1975 Method of Measurement of Plinth, Carpet and Rentable Area of Buildings(First Rev.) BIS.
7. IS 4326 – 1993 Earthquake Resistant Design and Construction of Buildings – Code of Practice (Second Rev.)
8. IS 7564 – 1974 Recommendations for Co-ordination of Dimensions in Buildings – Arrangement of Building Components.
9. IS:456-2000, Plain and Reinforced Concrete – Code of Practice, BIS, New Delhi, 2000
10. IS:875 (Part 1) - 1987, Code of Practice for Design Loads (Other than Buildings and Structures – Dead Loads, BIS, 1987
11. IS:875 (Part 2) - 1987, Code of Practice for Design Loads (Other than r Buildings and Structures – Live Loads, BIS, 1987.
12. Kraners, Sieverts and Partners. 1977. Open – Plan Offices, UK: McGraw Hill. (English Translation Ritchie, J.L.)
13. Leonard, M. and Cunliffe, R. 1962. Office Buildings, New York: Reinhold
14. National Building Code of India 2005 (NBC 2005), Bureau of Indian Standards, New Delhi
15. SP:1983 National Building Code of India (First Rev.) BIS.
16. Subramaniyam, T.N. (edited by) n.d. Architects, Engineers and Builders Handbook, Madras: Fairhaven Printers.

7th and 8th Semester

Course Title: Design of Steel Structures		**Course Code: 15ECVC401**
L-T-P: 3-0-0	**Credits: 3**	**Contact Hours: 3 Hrs/ week**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 40	**Examination Duration: 3 Hrs**	

Unit I

1. Introduction Advantages and disadvantages of Steel structures, Loads and load combinations. Structural forms, Design concepts. IS code provisions. Fire resistance and ductility of steel. Introduction to working stress method.	**03 hrs**
2. Structural Fasteners Bolted and welded connections, Strength of bolt and bolted joint. Design of bolted connections. Bracket connections. Welded connections, fillet and Butt welds, strength of a weld, Bracket connections.	**07 hrs**
3.Design of Tension Members Axially loaded tension members and their connections, design of lug angles, Design of truss ties and joints.	**05 hrs**

Unit II

4. Design of Compression Members Angle struts, Columns including built up sections, Laced and Battened systems. Column splicing, column bases- simple slab base, gusseted base.	**09 hrs**
5. Design of Flexural Members Simple and built up sections. Laterally supported and unsupported compression flange. Web crippling and web buckling,	**06 hrs**

Unit III

6. Design of Truss Wind load, dead load and other loads wind pressure, calculation of loads on nodes, design of members of the roof Truss (Forces in the members to be given), Design of purlins	**05 hrs**
7. Design of Welded Plate Girders Introduction, Design of Plate Girders (without intermediate stiffeners)	**05 hrs**

Text Book

1. Bhavikatti, S.S, *Design of Steel Structures*, 5ed., New Age International , 2017
2. Duggal S.K , *Design of Steel Structures*, 2ed., Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2014.

References

1. Subramanian, N., *Design of Steel Structures*, 1ed., Oxford University Press, New Delhi, 2014.
2. IS: 800: 2007 *Guidelines for Design of Structural Steel*.
3. IS: 875 (Part 3) 1987 *Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures : Wind Loads.*

Course Title: Design of Sub-structures **Course Code: 15ECVE401**

L-T-P: 3-0-0	**Credits: 3**	**Contact Hours: 3 Hrs/ week**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 40	**Examination Duration: 3 Hrs**	

Unit I

1. Soil Exploration

Subsurface exploration programme for civil engineering projects. Interpretation of soil parameters. Tests on disturbed and undisturbed soil samples, Soil exploration report. **02 hrs**

2. Shallow Foundations

Design Criteria. Types of shallow foundations. Bearing capacity theories. Bearing capacity from field tests. Use of different foundation models. Design of individual and combined footings. Design of raft foundations - Conventional methods. Modulus of subgrade reaction. Beams on elastic foundations. Analysis of footings by Finite Difference. **07 hrs**

3. Pile Foundations **06 hrs**

Load carrying capacity of pile. Design of pile and pile groups. Batter piles and under reamed piles. Design of pile cap. Design of axially and laterally loaded piles.

Unit II

3. Drilled Piers and Caissons

Construction, advantages and disadvantages of drilled piers. Design of open, pneumatic and floating caissons. Advantages and disadvantages of floating caissons. **06 hrs**

4. Well Foundation

Different shapes and characteristics of wells. Components of well foundation. Forces acting on well foundation. Sinking of wells. Causes and remedies of tilts and shifts. **05 hrs**

5. Foundations on Expansive Soils **05 hrs**

Definition, Identification, Structure, Index properties of expansive soils, Swell potential and Swell pressure, Free swell, CNS layer, foundation treatment for structures in expansive soil.

Unit III

6. Machine Foundations **05 hrs**

Basic terminologies. Design criteria for machine foundations. Vibration analysis. Methods of analysis. Determination of soil parameters. Foundations for reciprocating machines. Foundations for impact type of machines. Vibration isolation.

7. Foundations for Special Structures **04 hrs**

Foundations for tall structures - Water tanks, Chimneys, Antenna towers and Radar units.

Text Books

9. Bowles. J. E, *Foundation analysis and design*, 5ed, McGraw-Hill Company, Inc, New York, 2012.
10. Das. B.M, *Principles of Foundation Engineering*, 8ed., Thomson Business Information India (P) Ltd., India, 2014.
11. Murthy V.N.S., *Soil Mechanics and Foundation Engineering*, 4ed., UBS Publishers and Distributors, New Delhi, 2016.
12. Swami Saran, *Analysis and Design of Substructures: Limit State Design*, 2ed, oxford and IBH publishing co. Pvt. Ltd., 2006.

Reference Books:

6. Ghosh K.M., *Foundation Design in Practice*, PHI Learning Pvt. Ltd., New Delhi, 2009.
7. Nainan Kurian., *Modern Foundations: An Introduction to Advanced Techniques*, Tata McGraw Hill Education Pvt. Ltd, New Dehli, 1982.
8. Som N. N., Das S. C., *Theory and Practice of Foundation Design*, PHI Learning Private Limited, New Delhi, 2009.
9. Srinivasulu, P. and Vaidyanathan, C.V., *Hand Book of Machine Foundations*, 1ed, Tata McGraw Hill Education Pvt. Ltd, New Dehli , 2002.
10. Tomlinson, M.J., *Pile Design and Construction Practice*, 6ed, CRC Press, 2014.
11. Winterkorn, H. F. and Fang H. Y., *Foundation Engineering Hand Book*, 2ed, Van Nostrand Reinhold Company, 1991.

IS Codes:

1. IS 2911 (Part 1/Sec 3) : 2010 - *Design And Construction Of Pile Foundations*
2. IS: 2950 (Part I) -1981 (Reaffirmed 2008) - *Code Of Practice For Design And Construction Of Raft Foundations*

Course Title: Advanced RCC Structures		**Course Code: 15ECVE402**
L-T-P: 3-0-0	**Credits: 3**	**Contact Hours: 3 Hrs/ week**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 40	**Examination Duration: 3 Hrs**	

Unit I

1. Design of Footings
Introduction, load for footing, Design of isolated rectangular footing for axial load and uniaxial moment, design of pedestal. **05 hrs**

2. Design of Combined Footing
Design of strap footing, Design of Combined footings: Rectangular and trapezoidal Combined Footings. **05 hrs**

3. Design of Raft Footing **05 hrs**
Design of raft footing as per IS:456:2000 Guidelines

Unit II

4. Retaining Walls

Design of Cantilever and Counter-fort type of retaining walls.

08 hrs

5. Design of Portal Frame **07 hrs**

Design of RCC Portal Frame, Design of beam, column, footing for the given bending moment, shear force and torsion as per IS: 456: 2000 Guidelines

Unit III

6.Design of continuous beams **05 hrs**
Bending moment envelops moment redistribution as per IS Code provisions

7. Design of Water tanks **05 hrs**
Design of circular and rectangular water tanks, resting on ground and over head water tanks and design of Intz tank.

Text Books

1. Jain, A.K., *Limit State Method of Design*, 7ed., Nemichand and Bros., Roorkee, 2012.
2. Punmia B.C., Ashok Kumar Jain, and Arun Kumar Jain, *Limit State Design of Reinforced Concrete*, Laxmi Publications Pvt. Ltd., New-Delhi-2016.

Reference Books:

1. Bhavikatti S.S, *Advanced RCC Design (RCC Vol-II)*, New Age International Publishers, New Delhi, 2008.
2. Krishnaraju, N., *Design of Reinforced Concrete Structures (IS: 456 – 2000)*, 3ed., CBS Publishers, New Delhi, 2016.
3. Robert Park & Thomson, *Reinforced Concrete*, John Wiley & Bros Pvt. Ltd, 1975
4. Unnikrishnan Pillai S. and Devdas Menon, *Reinforced Concrete Design Third*

Edition, Tata McGraw Hill Education Pvt Ltd., New-Delhi-2017.

5. IS:456-2000, *Plain and Reinforced Concrete – Code of Practice (Fourth Revision)*, BIS, New Delhi, 2000
6. SP 16: *Design Aids for Reinforced Concrete to IS 456:1978.*

Course Title: Design Studio – Steel and RC Structures		**Course Code: 15ECVP401**
L-T-P: 1-0-1	**Credits: 2**	**Contact Hours: 6 Hrs/ week**
ISA Marks: 20	**ESA Marks: 80**	**Total Marks: 100**
Teaching Hours: 40	**Examination Duration: 3 Hrs**	

Unit – I

1. RCC Detailing **20 hrs**
   a. Drawing and detailing of beams (Simply supported and Continuous beam), slab (One way and two way), column, footing (Isolated and combined) and stairs (Dog legged)
   b. Retaining walls – cantilever and counter fort retaining walls
   c. Water tanks – Over head (Intz tank)
   d. Portal frame – Single bay

Unit – II

2. Drawings to be prepared for given structural details **12 hrs**
   a. Connections: Bolted and welded, beam-beam, Beam-column, seated, stiffened and un-stiffened.
   b. Columns: Splices, Column-column of same and different sections. Lacing and battens
   c. Column Bases: Slab base and gusseted base.
   d. Roof Trusses: At supports and different nodes.

Text Books

2. Bhavikatti, S.S., *Design of Steel Structures by Limit State of Method – As per IS 800-2007*, I.K. International Publishing House Pvt. Ltd., New Delhi, 2009
3. Ramachandra, *Design of Steel Structures,* Vol- 1 & 2, Standard Book House, New Delhi, 2009.
4. Subramanian, N., *Design of Steel Structures*, Oxford University Press, New Delhi, 2008.
5. Kazimi and Jindal, *Design of Steel Structures*, 2ed., Prentice Hall of India, New Delhi, 2000.

References

1. Arya and Ajmani, *Design of Steel Structures*, Nem Chand Bros, Roorkee, 1977.
2. Negi, L.S., *Design of Steel Structures*, Tata McGraw Hi11 Publishers, 2004.
3. SP 6 (Part 1) Year: 1984 Handbook for structural engineers - Structural

steel sections

4. SP: 34 Year1987 Handbook on Concrete Reinforcement and Detailing
5. IS:800-2007 Code of Practice for general Construction in Steel.

Course Title: Finite Element Methods **Course Code: 15ECVE403**

L-T-P: 3-0-0 **Credits: 3** **Contact Hours: 3 Hrs/ week**

ISA Marks: 50 **ESA Marks: 50** **Total Marks: 100**

Teaching Hours: 40 **Examination Duration: 3 Hrs**

Unit I

1. Introduction to Finite Element method.

Introduction, Basic concepts on finite element analysis, Introduction to elasticity, Steps in Finite Element Analysis. **05 hrs**

2. Element Properties.

Natural Coordinates, Triangular Elements, Rectangular Elements , Lagrange and Serendipity Elements, Solid Elements, Isoparametric Formulation , Stiffness Matrix of Isoparametric Elements, Numerical Integration: One Dimensional, Numerical Integration: Two and Three Dimensional Worked out Examples **05 hrs**

3. Finite Element Formulation Technique. **05 hrs**

Virtual Work and Variational Principle, Galerkin Method, Rayleigh-Ritz Method.

Unit II

4. Analysis of Frame Structures

Stiffness of Truss Members , Analysis of Truss, Stiffness of Beam Members, Finite Element Analysis of Continuous Beams. **08 hrs**

5. FEM for Two and Three Dimensional Solids **10 hrs**

Constant Strain Triangle, Linear Strain Triangle, Rectangular Elements , Numerical Evaluation of Element Stiffness , Computation of Stresses, Geometric Nonlinearity and Static Condensation , Axisymmetric Element, Finite Element Formulation of Axisymmetric Element, Finite Element Formulation for 3 Dimensional Elements Worked out Examples

Unit III

6. FEM Program

Structure of FEM program for FEM Analysis, Description of different modules, Pre and post processing. **07 hrs**

Text Books

1. Reddy J.N., *An Introduction to Finite Element Method*, 3ed., McGraw- Hill Publishing Company Inc, New York, 2017.
2. Krishnamoorthy C. S., *Finite Element Analysis*, Tata McGraw-Hill Education Pvt. Ltd, New Delhi, 2004.

Reference Books:

1. Rajasekaran, S., *Finite Element Analysis in Engineering Design*, S. Chand Group, 2006.
2. Pandit G.S. and Gupta, S.P., *Structural Analysis, A Matrix Approach*, 2ed., Tata McGraw- Hill Education Pvt. Ltd, New Delhi, 2008.
3. Cook R.D., Malkus D.S., Plesha M.E. and Witt R.J. *Concepts And Applications Of Finite Element Analysis*, 4ed., John Wiley and Jous, Inc., 2013.
4. Bathe K.J., *Finite Element Procedures*, Klaus-Jürgen Bathe; 2ed., 2014.
5. Bhavikatti S.S., *Finite Element Analysis*, New Age International Publication Pvt. Ltd., New Delhi, 2010.
6. Daryl L. Logan., *A first course in the Finite Element Method*, 5ed, Cengage Learning, 2010.
7. Tirupathi R. Chandrupatla and Ashok D. Belegundu, *Introduction to Finite Elements in Engineering*, 4ed, Pearson, 2011

Course Title: Horizontal and Vertical Construction Methods		**Course Code: 15ECVE405**
L-T-P: 3-0-0	**Credits: 3**	**Contact Hours: 3 Hrs/ week**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 40	**Examination Duration: 3 Hrs**	

Unit I

1. Planning for earthwork construction

Planning, Graphical presentation of Earthwork, Earthwork quantities, Mass diagram and its applications, Pricing of earthwork operations. **05 hrs**

2. Compaction and Stabilization Equipment

Compaction of soil and rock, Types of compaction equipment, roller production estimating, Dynamic compaction, Soil stabilization, stabilizing soils with lime, Cement-soil stabilization. **05 hrs**

3. Excavators and loaders **05 hrs**

Hydraulic Excavators, selection of front shovels, Calculating shovel production, height of cut effect on shovel production, angle of swing effect on shovel production, Loaders – introduction, Loader buckets/attachments, operating specifications, Loader production rates, Calculating wheel loader production, Calculating track loader production, Loader safety.

Unit II

4. Drilled Shaft Foundations

Introduction, Construction of drilled shafts – dry method of construction, casing method of construction, wet construction method, Installation of casings, Steel cages, Placement of concrete, Dewatering, open dewatering systems, deep well systems, well point systems – Types, techniques, Basement waterproofing systems. **05 hrs**

5. Formwork Systems **06 hrs**

Introduction, formwork materials, shores and scaffolding, Vertical formwork systems – Conventional wall/columns forming systems, Modular panel column form, adjustable wraparound column forms, circular steel forms for round columns, wall panel system, single sided wall formwork, formwork ties, Horizontal formwork systems – conventional wood form and metal systems, cup-lock type scaffolding system, slab flex system, tunnel form, flying formwork system, crane-jumped formwork, automatic climbing formwork, self-rising core system.

6. Concrete and Conveying Systems **05 hrs**

Introduction, Concrete – Mixers, Concrete plants, Pre-tensioning and Post tensioning, Transporting and handling – Concrete chute, concrete mixer with lift, concrete skip, truck mixer concrete pumps, concrete belt conveyors, concrete pump truck, trailer pump and pipeline with tower-mounted boom, trailer mounted pumps, pipeline system, mobile concrete placing booms, finishing.

Unit III

7. Cranes

Major cranes types, Mobile cranes, Crawler cranes, Telescoping-boom truck-mounted cranes, Lattice-boom truck-mounted cranes, Rough-terrain cranes, modified cranes for heavy lifting, crane booms, lifting capacities of cranes, Rated loads for lattice and telescopic boom cranes, Tower cranes – classifications, operation, Tower crane selection, Rated loads for tower cranes, rigging, slings, safety. **09 hrs**

Text Books

1. Peurifoy, *Construction Planning, Equipment & Method,* 7ed., Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2010.
2. Basem M, *Construction Technology for High-rise Buildings-Handbook*, 2014.

Reference Books:

1. Stephens W. Nunnally, *Managing Construction Equipment*, 2ed, Pearson Publications, USA, 2000.
2. Gupta B. L., Amit Gupta, *Construction Management and Machinary*, 5ed, Standard Publications, New Delhi, 2015.

Course Title: Construction Economics & Management **Course Code: 15ECVE404**

L-T-P: 3-0-0	**Credits: 3**	**Contact Hours: 3 Hrs/ week**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 40	**Examination Duration: 3 Hrs**	

Unit I

1. Project Organization

Introduction, Forms of business organizations, Structure of construction organization, organizing for project management, management levels, traits of a project manager and project coordinator, Factors behind the success of a construction organization. **07 hrs**

2. Construction Economics

Introduction, economic decision making, Time Value of Money, Cash Flow Diagrams, Using Interest Tables, Evaluating Alternatives by Equivalence, Effect of Taxation on Comparison of Alternatives, Effect of Inflation on Cash Flow, Evaluation of Public Projects: Discussion on Benefit-cost Ratio **10 hrs**

Unit II

3. Construction Contract

Introduction, Contract Documents, Classification of Engineering Contracts, CPWD Contract Conditions, FIDIC Form of Contract Agreement, Subcontracting. **03 hrs**

4. Construction Material Management **07 hrs**

Introduction, Material procurement process in construction organization, material management functions, inventory management.

5. Construction Project Success: Factors **03 hrs**

Introduction, project performance measurement, criteria for project performance Evaluation, project performance attributes, effect of other elements on project Performance.

Unit III

6. Construction Accounts Management

Introduction, Principles of Accounting, Accounting process, Construction Contract Revenue Recognition, Construction contract status report, Limitations of accounting, Balance Sheet, Profit and Loss Account, Working Capital, Ratio Analysis, Funds Flow Statement. **06 hrs**

7. Construction Equipment Management

Introduction, Plant and Equipment Acquisition, Depreciation, Methods of Calculating Depreciation, Example of Depreciation Calculations for Equipment on Site, The Effect of Depreciation and Tax on Selection of Alternatives, Evaluating Replacement Alternatives. **04 hrs**

Text Books

1. Kumar Neeraj Jha, *Construction Project Management – Theory and Practice*, 2ed., Pearson Publication, 2015.

Reference Books:

1. Shrivastava U. K., *Construction Planning and Management*, Galgotia Publication Pvt. Ltd., New Delhi-2007.
2. Verma Mahesh, *Construction planning and Management*, Metropolitan Book Co., Delhi,1982.
3. Seetharaman S., *Construction Engineering and Management*, Umesh Publications, New Delhi, 2006.

Course Title: Construction Quality Management		**Course Code: 15ECVE406**
L-T-P: 3-0-0	**Credits: 3**	**Contact Hours: 3 Hrs/ week**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 40	**Examination Duration: 3 Hrs**	

Unit – I

1. Concept of Quality

Definition of Quality, Historical background of quality control, difference between Quality control and Quality Assurance (QA/QC). Total quality control (TQC) and Total Quality Management (TQM), Need for TQM in construction industry, TQM philosophy: Concept of Deming, Juran, Crosby, Imai, Ishikawa, Taguchi, Shingo philosophies. Models and frame works.	**05 hrs**

2. Quality Control Tools

Cause and Effect diagrams, Check sheets, Control charts, Data collection, Flow charts, Histograms, Pareto analysis, Pie charts, Run chart, Scatter diagrams and Control charts (Concepts and examples in construction projects), Project Rework Reduction Tool (PRRT) software.	**04 hrs**

3. Development of Human Resource and Quality Circles

Training and development, technical and managerial competencies necessary for achieving quality Cultural change, Innovation and learning, Leadership and commitment, Philosophy of quality circles, Organization of Quality Circles, Stages of Adoption, Areas of Interest to Quality circles, Essential Requirements for the success of circles, Gains from circles. Inspection reports, Monitoring and Control, 360 feedback for quality.	**05 hrs**

Unit – II

4. Study of ISO 9001- Quality System Standards.

Purpose of ISO Standards. Difference between ISO 9001 and ISO 9004.Certification process for ISO 9001. Certification bodies involved. Eight Principles of ISO-Basic meaning, Quality management system requirements.	**04 hrs**

5. Quality Management System Procedures

Introduction, procedure for management review, Format for writing procedures, Procedure for preparing Quality plans/ work Instructions, Contract review, Design control, Document and data control, Document numbering system, Change request, purchasing, control of customer supplied product, product identification and traceability, process control, inspection and testing, measuring and test equipments, the control of non- conforming product, corrective and preventive action, handling, storage, packaging and delivery, control of quality records.	**09 hrs**

6. Work Instructions

Introduction -Document and Data Control, Material Procurement, Material Handling, Tendering and Estimating, Planning, Design, Training, Plant and Equipment, Bar Bending Schedule, Concrete Works, Earthworks and Compaction, Soil Investigation works, Survey works, Concrete Repair Works, Road Works, Painting Works, Water Proofing works, Drainage Works, Quality Assurance and Control, Patching and Transportation of Concrete. **03 hrs**

Unit – III

7. Method Statement

Introduction, Concrete Works, Earthworks and Compaction, General Soil Investigation works, Survey works, Concrete Repair Works, Concrete Demolition Works, Road Works, Fencing works etc. **04 hrs**

8. Job Description

Introduction, Job Description of: Managing Director, Project Manager, Site Manager, Site Engineer, QA/QC Engineer, Foreman, Typist/Clerk, Design Engineer, Planning Engineer. **03 hrs**

9. Introduction to Six Sigma

Introduction, Definition of Six Sigma, evolution – Historical aspects, Six Sigma methodology, Leadership principles, Six Sigma team, Six Sigma in construction projects **03 hrs**

Text Books

1. Bagchi, *ISO 9000 Concepts, Methods, Implementation,* Wheeler Publishing
2. Gary E. MacLean, *Documenting Quality for ISO 9000 and other Industry Standards,* Tata McGraw-Hill Publishing Company Limited, 1993.
3. Girdhar J. Gyani, *Training Manual on ISO 9000-2000 and* TQM, Raj Publishing House, 1994.
4. Mohamed Zairi, *Total Quality Management for Engineers,* Aditya Books Private Limited.
5. P.L.Jain, *Quality Control and Total Quality Management*, Tata Mcgraw Hill Publicaions
6. Rajendra Prasad, D.S., *Quality Management System in Civil Engineering ISO 9001-2000*, Sapna Book House, Bangalore, 2000.

References

1. Elwyn E. Seelye, *Data Book for Civil Engineers Field Practice,* John Wiley & Sons, inc., 1957.
2. Feigenbaum Armand V., "*Total Quality Control*", McGraw Hill Inter- national Edition,1991
3. John L. Hardesky, *Productivity and Quality Improvement,* McGraw Hill Book Company
4. Neville, A.M., *Properties of Concrete,* ELBS Publications.

IS Codes

1. IS: 456-2000, *Indian Standard Specifications for Plain and Reinforced Concrete Code of Practice,* 4th Revision, Bureau of Indian Standards.
2. IS: 383-1990, *Indian Standard Specifications for Coarse and Fine Aggregates from Natural sources for Concrete,* Bureau of Indian Standards.
3. ISO 9001-2015*, Quality Management System in Civil Engineering*
4. ISO 9004:2018, *Quality management — Quality of an organization — Guidance to achieve sustained success*

Course Title: Solid Waste Management **Course Code: 15ECVE407**

L-T-P: 3-0-0 **Credits: 3** **Contact Hours: 3 Hrs/ week**

ISA Marks: 50 **ESA Marks: 50** **Total Marks: 100**

Teaching Hours: 40 **Examination Duration: 3 Hrs**

Unit I

1. Introduction

Solid waste -Definition, Land Pollution -scope and importance of solid waste management, functional elements of solid waste management. SOURCES: Classification and characteristics- municipal, hospital / biomedical waste, Quantity -Generation rate, methods. **05 hrs**

2. Collection and Transportation

Systems of collection, collection equipment, garbage chutes, transfer stations - bailing and compacting, route optimization **05 hrs**

3. Processing Techniques **05 hrs**

Components separation, volume reduction, size reduction, chemical reduction and biological processing

Unit II

4. Disposal Methods

Open dumping -selection of site, ocean disposal, feeding to hogs, composting, sanitary land. filling, merits and demerits. Construction/Demolition waste. **04 hrs**

5. Incineration **04 hrs**

Processes -3 T 's, factors affecting incineration process, incinerators -types, prevention of air pollution, pyrolysis.

6. Composting **05 hrs**

Aerobic and anaerobic composting, factors affecting, composting, Indoor and Bangalore processes, mechanical and semi-mechanical composting processes. Vermi composting

Unit III

7. Sanitary Land Filling

Definition, methods, trench area, Ramp and pit method, site selection, basic steps involved, cell design, prevention of site pollution, leachate collection and control methods, gas collection systems. **07 hrs**

8. Recycle and Reuse

Material and Energy Recovery Operations, Reuse In Other Industries, Plastic Wastes, Environmental Significance and Reuse **05 hrs**

Text Books

1. George Tchobanoglous, Hilary Theisen and Vigil S. A., *Integrated solid waste management: engineering principles and management issues*, McGraw-Hill Inc,US, 1993.
2. Bhide A. D. and , Sundaresan B. B., *Solid Waste Management in Developing Countries,* Indian National Scientific Documentation Centre, 2010.
3. Ministry of Environment and Forests, Govt. of India, The Municipal Solid Wastes (Management and Handling) Rules, 2000.

Reference Books:

1. Joseph L. Pavoni, John E. Heer, D. Joseph Hagerty, *Solid Waste Management, Van Nostrand Reinhold Co.,* 1973.
2. Howard S. Peavy, Donald R. Rowe, George Tchobanoglous*, Environmental Engineering,* McGraw-Hill Publishing Company Inc., New York, 2017.
3. Ramesha Chandrappa, Jeff Brown, *Solid Waste Management – Principles and Practice,* Springer Science & Business Media, 2012.

Course Title: Advanced Waste Water Treatment		**Course Code: 15ECVE408**
L-T-P: 3-0-0	**Credits: 3**	**Contact Hours: 3 Hrs/ week**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 40	**Examination Duration: 3 Hrs**	

Unit I

1.Introduction Wastewater Characteristics, Effluent Quality Standards, Receiving Stream Quality	**03 hrs**
2. Primary Treatment- Screening, Grit removal, Neutralization, equalization, Sedimentation, Flotation (oil & grease removal),	**06hrs**
3. Secondary Treatment- Fundamental concept of reactors: Mass balance relationships, analysis and descriptions of reactors- batch, completely mixed flow and plug flow oxygen requirement in aerobic process.	**06hrs**

Unit II

4. Biological Treatment : Activated Sludge Process: Substrate Utilization and Biomass Growth, Kinetic Parameters, Process Description and its Modification, Process Design , Biofilm Process: Trickling Filter, Rotational Biological Contactor Aerated lagoons, oxidation pond-operation and maintenance	**10 hrs**
5.Advanced Treatment Processes- Chemical Coagulation, Carbon Adsorption, Phosphorus Removal, Nitrogen Removal (Nitrification/Denitrification), Media Filtration, UV Disinfection	**06 hrs**

Unit III

6. Solids Handling Processes- Gravity Thickening, Flotation Thickening, Dewatering, Pressure Filtration, Stabilization, Aerobic and Anaerobic Digestion, Composting, Drying, Incineration, Landfilling, Land Application	**09 hrs**

Text Books

1. Eddy and Metcalf ,*Wastewater Engineering – Treatment and Reuse* ,Tata McGraw Hill Education Pvt Ltd., New Delhi, 2003.
2. Modi, P.N., *Sewage Treatment and Disposal Engg.*, Standard Book House, New Delhi, 2000.
3. Howard S. Peavy, Donald R. Rowe, George Techno Bano Glous, *Environmental Engineering*, McGraw Hill International, 2010.

Reference Books:

1. Qasim S.R., Motley E. M., *Wastewater Treatment Plants – Planning, Design and Operation*, Prentice Hall, New Delhi. 2002.
2. Davis, M.L. and Cornwell, D.A., *Introduction to Environmental Engineering*, Tata McGraw Hill Education Pvt. Ltd., New Delhi,. 2010
3. Hammer M.J., *Water and Waste Water Technology*, John Wiley and Sons, New York , 2000.

Course Title: Air Pollution **Course Code: 15ECVE409**

L-T-P: 3-0-0	**Credits: 3**	**Contact Hours: 3 Hrs/ week**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 40	**Examination Duration: 3 Hrs**	

Unit I

1. Introduction

Definition -Classification and properties of Air pollutants, Primary and secondary Air pollutants, Concentrations of Air pollutants and sources. Behavior and Fate of Air Pollution: Chemical reaction in the Atmosphere, photochemical Smog. **05 hrs**

2. Effects of Air Pollution **05 hrs**

On human health, Animals, Plant and properties, Major Episodes.

3. Meteorology

Introduction -Meteorological Variables, Lapse Rate – Adiabatic - Dispersion, inversion, stability conditions, wind rose, general characteristics of stack plumes **05 hrs**

Unit II

4. Sampling and Analysis of Air Pollutants

Sampling and measurement of Gaseous and particulate pollutants, stack sampling, smoke and its measurements. **05 hrs**

5. Control of Air Pollutants **10 hrs**

Control methods -Particulate emission control, gravitational settling chambers, cyclone separators, fabric filters, Electrostatic precipitators, wet scrubbers, control of gaseous emissions (Design not requires)

Unit III

6. Air Pollution Due to Automobiles

Air pollution due to gasoline driven and Diesel driven engines, effects, control - direct and indirect methods. **02 hrs**

7. Global Environmental Issues **04 hrs**

Acid rain, Green House effect, Global warming, Ozone layer Depletion.

8. Environmental Impact Assessment

Environmental Impact Assessment in industrial plant locations and planning. Standards and legislation -Air quality and emission standards - legislation and regulation, Air pollution index **04 hrs**

Text Books

1. Rao, H.V.N., and Rao, M.N., *Air Pollution*, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2007.

2. Rao, C.S., *Environmental Pollution Control*, New Age International Pvt. Ltd, New Delhi, 2006.

Reference Books:

1. A.O.C., Stem, *Air Pollution -Vol I -IV*, Academic Press., 2010.
2. Henry C Perkins, *Air pollution*, Tata McGraw Hill Education Pvt Ltd., New Delhi, 1974.

Course Content

Course Code: **15EARC201**	Course Title: Analog and Digital Electronic Circuits	
L-T-P-SS: 4-0-0-0	Credits: 4	Contact Hrs: 50
CIE Marks: 50	SEE Marks: 50	Total Marks: 100
Teaching Hrs: 50		Exam Duration: 3 hrs

Content	**Hrs**
Unit - 1	
Chapter No. 01 Modeling and analysis of electrical circuits The Lumped Circuit Abstraction, Modeling Physical Elements using lumped circuit abstraction, Signal Representation, Dependent Sources and the Control Concept, Network theorems: The Node Method, Loop Method, Superposition, Thévenin's Theorem and Norton's Theorem.	8 hrs
Chapter No. 02 Basics of Digital Electronics Number Representation , MOSFET Switch Implementation of Logic Gates, The SR Model of the MOSFET, Active Pullups Voltage Levels and the Static Discipline, Simplifying Logic Expressions using K-map, Combinational circuits: encoder/decoder, multiplexers/de-multiplexers , Binary adder/ subtractor, Binary comparator, Sequential Circuits: Gated D Latch, JK Flip-Flop, Registers, Counters.	7 hrs
Chapter No. 03 Transistor Modeling Operating point, Fixed bias circuits, Emitter stabilized biased circuits, Voltage divider biased, Bias stabilization, BJT transistor modeling, , Emitter follower, CB configuration, Collector feedback configuration, analysis of CE configuration using h- parameter model; Relationship between h-parameter model of CE,CC and CB configuration.	5 hrs
Unit - 2	
Chapter No. 04 Power Amplifiers Definitions and amplifier types, series fed class A amplifier, Transformer coupled Class A amplifiers, Class B amplifier operations, Class B amplifier circuits, Amplifier distortions. Designing Power amplifiers: Heat flow calculations using analogous circuit. Calculation of actual power handling capacity of transistors with and without heat sink. Heat sink design.	6 hrs
Chapter No. 05 Operational Amplifiers Device Properties of the Operational Amplifier, Simple Op Amp Circuits: The Non-Inverting Op Amp, The Inverting Connection, A Special Case: The Voltage Follower, Op Amp RC Circuits: Op Amp Integrator, Op Amp Differentiator, An RC Active Filter, The RC Active Filter Impedance Analysis, Sallen-Key Filter, Op Amp in Saturation: Op Amp Integrator in Saturation, Positive Feedback : RC Oscillator.	8 hrs
Chapter No. 06 Energy and Power in Digital Circuits Energy Storage Elements; capacitors and inductors , Power and Energy Relations for a	6 hrs

Simple RC Circuit, Average Power in an RC Circuit, Power Dissipation in Logic Gates: Static Power Dissipation, Total Power Dissipation, CMOS Logic Gate Design.	
Unit - 3	
Chapter No. 07 First Order Transients in Linear Electrical Circuits Analysis of RC & RL circuits, Propagation Delays, State and State variables	5 hrs
Chapter No. 08 Transients in Second Order Circuits Undriven Series RLC circuit, Stored Energy in Transient Series RLC circuit, Undriven Parallel RLC circuit, Driven Parallel RLC circuit, State Space Analysis	5 hrs

Course Content

Course Code: 15EARC202	Course Title: Mechanics of Materials	
L-T-P-Self Study: 3-1-0-0	Credits: 4	Contact Hrs: 50
CIA Marks: 50	SEE Marks: 50	Total Marks: 100
Teaching Hrs: 50		Exam Duration: 3 hrs

Content	Hrs
Unit - 1	
Chapter No. 1.Stress & Strain Introduction,Normal Stress Under Axial Loading,Direct Shear Stress,BearingStress,Stresses on Inclined Sections,Equality of Shear Stresses on Perpendicular Planes,Strain,Displacement, Deformation, and the Concept of Strain,NormalStrain,Shear Strain	5 hrs
Chapter No. 2.Mechanical Properties of Materials The Tension Test,The Stress–Strain Diagram,Hooke'sLaw,Poisson'sRatio,DesignConcepts,Types of Loads,Safety,Allowable Stress Design,Load and Resistance Factor Design	5 hrs
Chapter No. 3.Axial Deformation Introduction,Saint-Venant'sPrinciple,Deformations in Axially Loaded Bars,Deformations in a System of Axially Loaded Bars,Statically Indeterminate Axially Loaded Members	5 hrs
Unit - 2	
Chapter No. 4.Torsion Introduction, Torsional Shear Strain, Torsional Shear Stress, Stresses on Oblique Planes, Torsional Deformations, Torsion Sign Conventions, Power Transmission, Statically Indeterminate Torsion Members.	5 hrs
Chapter No. 5. Equilibrium of Beams Introduction, Shear and Moment in Beams, Graphical Method for Constructing Shear and Moment Diagrams, Discontinuity Functions to Represent Load, Shear, and Moment	5 hrs
Chapter No. 6.Bending Introduction, Flexural Strains, Normal Stresses in Beams, Analysis of Bending Stresses in Beams, Introductory Beam Design for Strength, Flexural Stresses in Beams of Two Materials, Bending Due to Eccentric Axial Load, Unsymmetric Bending	5 hrs
Unit - 3	
Chapter No. 7. Shear Stress in Beams Introduction, Resultant Forces Produced by Bending Stresses, The Shear Stress Formula, The First Moment of Area Q, Shear Stresses in Beams of Rectangular Cross Section, Shear Stresses in Beams of Circular Cross Section.	5 hrs

Chapter No. 8. Beam Deflections Introduction, Moment-Curvature Relationship,The Differential Equation of the Elastic Curve,Deflections by Integration of a Moment Equation,Deflections by Integration of Shear-Force or Load Equations,Deflections Using Discontinuity Functions	5 hrs

Course Content

Course Code: 15EARC203	Course Title: Manufacturing Technology & Metrology	
L-T-P: 4-0-0	Credits: 4	Contact Hrs: 50
CIA Marks: 50	SEE Marks: 50	Total Marks: 100
Teaching Hrs: 50		Exam Duration: 3 hrs

Content	Hrs
Unit - 1	
Chapter No. 1. Turning , Shaping and Planing Machines Classification, constructional features of Lathe, Shaping Machine, Planing Machine. Driving mechanisms of Lathe, Shaping and Planing machines. Different operations on Lathe, Shaping Machine &Planing Machine. Simple problems on machining time calculations	7 hrs
Chapter No. 2. Milling Machines Classification, constructional features of milling machines. Types of milling cutters & milling cutter nomenclature. Milling processes, up milling and down milling concepts. Various milling operations. Indexing: Simple, compound, differential and angular indexing. Simple problems on simple and compound indexing	7 hrs
Chapter No. 3. Drilling & Grinding Machines Classification, constructional features of drilling machine & related operations. Types of drill & drill bit nomenclature, drill materials. Types of abrasives, Grain size, bonding process, grade and structure of grinding wheels, grinding wheel types. Classification, constructional features of grinding machines (Center less, cylindrical and surface grinding). Selection of grinding wheel, dressing and truing of grinding wheels. Analysis of the grinding process	6 hrs
Unit - 2	
Chapter No. 4. CNC Machine Tools Introduction to CNC machines- Principles of operation. Axes of NC machine-Coordinate systems. Basics of Manual part programming methods	7 hrs
Chapter No. 5. Nontraditional Machining Need for nontraditional machining, principle, equipment & operation of Abrasive Jet Machining, Water Jet Machining, Electro-Chemical Machining, Electrical Discharge Machining, Wire EDM, Electron Beam Machining, Laser Beam Machining & Plasma Arc Machining	7 hrs
Chapter No. 6. Measurement and Inspection Standards of measurement, allowance and tolerance, inspection methods of measurement, measuring instruments, gauges for attribute measurements, geometric dimensioning and tolerance, comparators & angular measurements	6 hrs

Unit - 3	
Chapter No. 7. Advancements in Metrology: Introduction & applications of: Co-ordinate Measuring Machine, Universal Measuring Machine, Laser in Metrology.	5 hrs
Chapter No. 8. Form Measurement Measurement of screw thread-Thread gauges, measurement of gears-tooth thickness, Measurement of surface finish, straightness, flatness and roundness measurements	5 hrs

Course Content

Course Code: 15EARC204	Course Title: **Analysis of algorithms & Design of Programs**	
L-T-P : 3-0-0-0	Credits: 3	Contact Hrs: 40
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 40		Exam Duration: 03 hours

Content	Hrs
Unit - 1	
Chapter 1: GENERAL PROBLEM SOLVING CONCEPTS- Problem Solving in Everyday Life, Types of Problems, Problem Solving with Computers - Problem Definition, Solution Design & Refinement, Testing Strategy Development, Program Coding and Testing, Using the Problem Solving Method, Break-Out Diagrams**,** Difficulties with Problem Solving. How the Computer Stores Data, Functions-function prototypes, Operators, Expressions and Equations,	5 hrs
Chapter 2: SOLUTION PLANNING- Software Development Cycle, Requirement Modeling framework, Computer Communication methods, Unified modeling language: UML Building Blocks, UML Diagrams-Class Diagram, object diagram, component diagram, UML Modeling Types, UML Basic Notations,UML-SysML ,Using the Tools, Testing the Solution, Coding the Solution, Case studies-Modeling the sequence diagram for the Plant operation,Modeling the control strategy action.	5 hrs
Chapter 3: DESIGN AND ANALYSIS OF ALGORITHMS-Algorithms and Their Representations, Modifying Algorithms, Alternative Algorithms. Review of Asymptotic Notations, Mathematical Analysis of Non-Recursive and Recursive Algorithms, Brute Force Approaches: Introduction, Selection Sort and Bubble Sort, Sequential Search and Brute Force String Matching ,Divide and Conquer: General Method, Defective Chess Board, Binary Search, Merge Sort, Quick Sort and its performance.	5 hrs
Unit - 2	
Chapter 4: ARRAYS, STACKS & QUEUES: Arrays, Dynamically Allocated Arrays, , Polynomials, Sparse Matrices, Representation of Multidimensional Arrays, Structures and Unions, Stacks, Stacks Using Dynamic Arrays, Queues, Circular Queues, Evaluation of Expressions, Multiple Stacks and Queues, Single- and Double-Ended Priority Queues.	.
Chapter 5: LINKED LISTS, TREES &GRAPHS: Singly Linked lists and Chains, Representing Chains in C, Linked Stacks and Queues, Polynomials, Additional List operations, Sparse Matrices, Doubly Linked Lists. Introduction, Binary Trees, Binary Tree Traversals, Threaded Binary Trees, Heaps, Graph representation, Adjacency matrix, Adjancey list, Application of graphs.	
Unit - 3	
Chapter 6:DYNAMIC PROGRAMMING& GREEDY METHOD: Depth First Search and Breadth	5 hrs

First Search,The General Method, Warshall's Algorithm, Floyd's Algorithm for the All-Pairs Shortest Paths Problem, Single-Source Shortest Paths, The Traveling Salesperson problem,Kruskal's algorithm, Huffman trees**.**	
Chapter 7:LIMITATIONS OF ALGORITHMIC POWER AND COPING WITH THEM: Lower-Bound Arguments, Decision Trees, P, NP, and NP-CompleteProblems, Challenges of Numerical Algorithms	5 hrs

Laboratory Plan

Semester: III *Year:* **2016 - 2017**

Laboratory Title: **Programming laboratory**	Lab. Code: 15EARP201
Total Hours: **28**	Duration of SEE Hours: 2
SEE Marks: **20**	CIE Marks: **80**

Experiment wise Plan

List of experiments/jobs planned to meet the requirements of the course.

Category: Demonstration		**Total Weightage: 10**		**No. of lab sessions:2**
Expt. / Job No.	**Experiment / Job Details**	**No. of Lab Session(s) per batch (estimate)**	**Marks / Experiment**	**Correlation of Experiment with the theory**
1	program to sort the given N numbers using 1.bubble sort,2.Quick sort	1	5	
	Learning Objectives: The students should be able to: 1.Rearrange the given set of elements in ascending or descending order 2.Use different types of tool to execute programs			Unit I
2	Program to search an element from a given set of elements using 1.Linear search,2.Binary search.	1	5	Unit I
	Learning Objectives: The students should be able 1. Search an element based on the specific method			Unit I
Category :Exercises		Total weightage:5		No of lab sessions1
3	Program to simulate arrangement of goods in a box by robot on first come first serve basis and perform the following operations on it a.pushb.popc.display>The program should print	1	10	

	appropriate messages for stack overflow,stack,underflow and stack empty.			
	Learning Objectives: The students should be able to: 1.Developing of program using stack concepts			Unit II
	Category:Structured Enquiry	Total weightage:45		No of lab sessions 6
4	Design an algorithm to create a record to maintain details of 5 flights, having informationas name, source & destination stations, seatsavailable with category	1	10	
	Learning Objectives: The students should be able to: 1.Demonstrate how to compile and run a C program in Microsoft visual studio, 2. Develop programs using operators and control statements 3. Develop programs using structures and file concepts			Unit II
5	Design an algorithm to assign a job for a robot & make it to perform jobs in circular manner.	1	10	
	Learning Objectives: The students should be able to: 1. Illustrate using of structure definition. 2. Develop a program using circular queue.			Unit II
6	Develop menu driven program in C language for maintaining university information.	1	10	
	Learning Objectives: The students should be able to: 1. Demonstrate how to maintain information of a university 2. 2.Demonstrate how to specify different types of constraints on a given set of operations 3. Develop a program in C language using linked list. .			Unit III

7	Design an algorithm to a Student Prerequisite Subjects Management System to store different courses and their prerequisites and based on this list it will allow any student to take particular	1	10	
	Learning Objectives: The students should be able to: 1. Demonstrate how it will store Prerequisite subject details 2. Classify the method of course allocation for student 3. Develop the programs in C language using doubly linked list.			Unit II
8	Design an algorithm to find the optimal solution for travelling salesperson problem Leaming Outcomes: The students should be able to: 1. Demonstrate the graphical solution for the problem. 2. Analyze the efficiency of an algorithm. 3.Develop the program in C language using dynamic Programming technique.	1	10	Unit III
9	Design an algorithm to implement Floyd's algorithm Learning Outcomes: The students should be able to: 1.Demonstrate the graphical solution for the problem 2. Analyze the efficiency of an algorithm. 3. Develop the program in c using dynamic programming technique	1	10	Unit III

Category: Open Ended		**Total Weightage: 20**		**No. of lab sessions: 2**
Expt./ Job No.	**Experiment / Job Details**	**No. of Lab Session(s) per batch (estimate)**	**Marks / Experiment**	**Correlation of Experiment with the theory**
10	Implement a project using C language, for automation and robotics applications. (FOR SEE)	2	20	
	Learning Objectives: The students should be able to: 1. Use Analysis of algorithms & Design of Programs concepts to implement the project. 2. Select the appropriate tool/software to to implement the project. 3. Write a technical report using IEEE standard. 4. Present the technical report for the implemented project. 5. Demonstrate the learning experiences of working in a team.			Analysis of algorithms & Design of Programs Unit I, Unit II , UnitI III

Laboratory Plan

Laboratory Course Plan: B E in A&R 2015-2019

Laboratory Title: **Machine Drawing Lab**	Lab. Code: **15EARP202**
Total Hours: **28**	Duration of SEE Hours: 2
SEE Marks: **20**	CIE Marks: **80**

Experiment wise Plan

List of experiments/jobs planned to meet the requirements of the course.

<table>
<tr><th colspan="2">Category: Demonstration</th><th colspan="2">Total Weightage: 15.00</th><th>No. of lab sessions: 3.00</th></tr>
<tr><th>Expt./ Job No.</th><th>Experiment / Job Details</th><th>No. of Lab Session(s) per batch (estimate)</th><th>Marks / Experiment</th><th>Correlation of Experiment with the theory</th></tr>
<tr><td>1</td><td>Blueprint Reading</td><td>1.00</td><td>5.00</td><td></td></tr>
<tr><td></td><td colspan="3">Learning Outcomes:
The students should be able to:
The students should be able to:
1. • Explain the importance of information on blueprints. • Explain the differences between assembly drawings and detail drawings. • Describe methods used to create and reproduce blueprints. • Define and describe parts of a blueprint. • Identify elements located within the title block of a detail drawing. • List methods of care and security of blueprints. • Identify the standard lines used on blueprints. • Explain the meaning and applications of standard lines on blueprints. • Identify common views used on a blueprint. • Name the advantages and disadvantages of various projection types. • Explain the concept of visualization</td><td>Workshop & CAD</td></tr>
<tr><td>2</td><td>Geometric Dimensioning and Tolerancing</td><td>1.00</td><td>5.00</td><td></td></tr>
<tr><td></td><td colspan="3">Learning Outcomes:
The students should be able to:
1. The students should be able to:</td><td>Workshop & CAD</td></tr>
</table>

	• Concepts of zero defects & on-target tolerancing • Drawing conventions used in GD&T for ANSI and ISO applications • Limits, fits and datum systems • Form control, orientation control, location control , run-out and profile control • Comparison of ANSI and ISO GD&T practices • How to standardize GD&T concepts			
3	Introduction to SolidWorks® Interface	1.00	5.00	
	Learning Outcomes: The students should be able to: 1. Learning Objectives: The students should be able to: • Familiar with the SolidWorks® user interface • Understand the basic functionality of the SolidWorks® software • Create part modeling • Become familiar with Microsoft Windows • Become familiar with the SolidWorks® user interface • Develop an understanding of 3D modeling and recognition of an object in 3D space • Apply 2D sketch geometry, rectangle, circle, and dimensions • Understand 3D features that add and remove geometry including Extruded Base, Extruded Cut, Fillet and Shell			CAD/CREO PARAMTERIC
Category: Exercise		**Total Weightage: 45.00**		**No. of lab sessions: 4.00**
Expt./ Job No.	**Experiment / Job Details**	**No. of Lab Session(s) per batch (estimate)**	**Marks / Experiment**	**Correlation of Experiment with the theory**
4	Part Modeling	2.00	20.00	
	Learning Outcomes: The students should be able to: 1. The students should be able to: • Using SolidWorks® 2014 students should be able to execute around 20 problems using various commands • Reinforce the understanding of 3D features that add and remove geometry • Apply 2D sketch geometry, rectangle, circle, and dimensions • Understand 3D features that add and remove geometry including Revolve and Sweep • Apply 2D sketch tools such as ellipse, trim and centerline • Create the Candlestick part • Understand the 3D Loft feature created from multiple profiles sketched on			CAD LAB

	different planes • Create the Chisel part			
5	Advanced Modeling & Assembly	1.00	15.00	
	Learning Outcomes: The students should be able to: 1. Learning Objectives: The students should be able to: • Assemble Knuckle joint, tailstock, table clamp etc. • Familiar with the mating commands in assembly module • Develop an understanding of 3D assembly modeling by combining one part with another part • Apply 2D sketch tools to offset geometry and project geometry to the sketch plane			Engineering Graphics
6	SolidWorks® Routing-Electrical	1.00	10.00	
	Learning Outcomes: The students should be able to: 1. The students should be able to: Explains how to create, edit and manage Electrical routes, from the critical routing components and their design requirements to the sub-assemblies that contain the routes. Topics include: 1. Fundamentals of Routing 2. Basic Electrical Routing 3. Routing with Clips			CAD LAB
Category: Structured Enquiry		**Total Weightage: 10.00**		**No. of lab sessions: 1.00**
Expt./ Job No.	**Experiment / Job Details**	**No. of Lab Session(s) per batch (estimate)**	**Marks / Experiment**	**Correlation of Experiment with the theory**
7	Sustainability	1.00	10.00	

	Learning Outcomes: The students should be able to: 1. The students should be able to: As an engineer or product designer, you have the power to dramatically alter how we interact with our environment. The question is how. Many designers don’t know about the life cycle assessment (LCA) process or how it could guide them to more sustainable designs. Others may think the process is too complex and time-consuming, or is someone else’s responsibility. Learning about designing for the environment now will put you ahead of the curve. With SolidWorks® Sustainability, you’ll have the built-in environmental intelligence to make more informed decisions about what materials to use. You’ll also see how region-specific material sourcing, manufacturing, use, and disposal will affect your product’s life cycle before manufacturing begins. 1. Understand the basic concepts of sustainable design 2. Measure the environmental impacts of various design choices, including material, manufacture location, and more on the various parts and assemblies			
Category: Open Ended		**Total Weightage: 20.00**		**No. of lab sessions: 1.00**
Expt./ Job No.	**Experiment / Job Details**	**No. of Lab Session(s) per batch (estimate)**	**Marks / Experiment**	**Correlation of Experiment with the theory**
8	Project Work	1.00	20.00	
	Learning Outcomes: The students should be able to: 1. The students should be able to: Reverse Engineering The process of duplicating an existing component, subassembly, or product, without the aid of drawings, documentation, or computer model is known as reverse engineering Reverse engineering can be viewed as the process of analyzing a system to 1. Identify the system's components and their interrelationships 2. Create representations of the system in another form or a higher level of abstraction 3. Create the physical representation of that system Tasks Involved: 1. Study the system components and their interrelationships 2. Disassemble			Elements of Mechanical Engineering

	the given product 3. Take measurements with tolerance 4. Capture the surface details like texture, colour, pattern etc. 5. Identify the material 6. Reproduce the same components using solidworks 7. Assemble all the components in solidworks 8. Render the product using solidworksphotoview 360	

Laboratory Plan

Laboratory Course Plan: B E in A&R 2015-2019

Semester-III

Laboratory Title: **Analog and Digital Circuits Lab**	Lab. Code: **15EARP203**
Total Hours: **28**	Duration of SEE Hours: 2
SEE Marks: **20**	CIE Marks: **80**

Experiment wise Plan

List of experiments/jobs planned to meet the requirements of the course.

Category: Demonstration		**Total Weightage: 10.00**		**No. of lab sessions: 2.00**
Expt./ Job No.	**Experiment / Job Details**	**No. of Lab Session(s) per batch (estimate)**	**Marks / Experiment**	**Correlation of Experiment with the theory**
01	Demonstration of lab equipments and components: CRO, Multimeter, Function Generator, Power supply-Active/Passive Components & Bread Board. Demonstration of Software – Multisim / Ultiboard.	1.00	0.00	
	Learning Objectives: The students should be able to: 1. Identify and demo knowledge of functioning and purposes of different components like Resistors, Inductors, capacitors, transistors etc. 2. Identify and demo knowledge of functioning and purposes of different Test and Measuring equipments such as Multimeters, Power Supplies, CROs and Function generators etc.			Chapter 1

	3. Simulate circuits using Multisim software.			
2	DOE: Study of different methods used for DOE and Obtain the step response of the Resonant circuit by taking fixed resistance of 10Ω and choosing the values of inductor (L) & capacitor(C).	1.00	10.00	
	Learning Objectives: The students should be able to: 1. Carryout design of experiments (DOE).			Chapter 2
Category: Exercise		**Total Weightage: 10.00**		**No. of lab sessions: 1.00**
Expt./ Job No.	**Experiment / Job Details**	**No. of Lab Session(s) per batch (estimate)**	**Marks / Experiment**	**Correlation of Experiment with the theory**
3	Analyze the operation of a MOSFET as I. A Switch II. An Amplifier And conclude it for different regions	1.00	10.00	
	Learning Objectives: The students should be able to: 1. Study the behavior of the MOSFET as a Switch. 2. Study the behavior of the MOSFET as an Amplifier.			Chapter 1
Category: Structured Enquiry		**Total Weightage: 60.00**		**No. of lab sessions: 10.00**
Expt./ Job No.	**Experiment / Job Details**	**No. of Lab Session(s) per batch (estimate)**	**Marks / Experiment**	**Correlation of Experiment with the theory**
4	Design a Line sensor circuit using an Operational Amplifier.	2.00	10.00	
	Learning Objectives: The students should be able to: 1. Build, test, and troubleshoot a line sensor circuit. 2. Study the operation of an Op-Amp.			Chapter 5

	3. Analyze the behavior of a line sensor.			
5	Build a circuit that converts an input voltage of – 1 V to + 2.2 V to an output voltage of 0 to 5 V. Dual supply of 12 V available and need to drive a 10 k load. Test designs under different input voltages and verify that output voltages are within 5% of the calculated ones.	2.00	10.00	
	Learning Objectives: The students should be able to: 1. Build, test, and troubleshoot an analog signal conditioning circuit using Multisim. 2. Analyze an analog signal conditioning circuit to provide a range of desired output voltages in respond to a certain range of input voltages.			Chapter 5
6	A sensor provides temperature sensitivity of 200 V/°C. Design a circuit that activates an alarm when the temperature reaches 300 °C. Use a single 10 V supply. The alarm could be any type, visual- or sound-based.	2.00	10.00	
	Learning Objectives: The students should be able to: 1. Build, test, and troubleshoot a temperature sensor circuit using Multisim. 2. Hardwire the temperature sensor circuit of objective 1 and compare the measurements of the hardwired circuit with the measurements obtained in Multisim.			Chapter 4
7	Design a simple DAC circuit with 0-10V output voltage.	2.00	10.00	

	Learning Objectives: The students should be able to: 1. Learn how to design a DAC circuit that converts digital input signals to expected corresponding analog voltage levels. 2. Build, test, and troubleshoot a DAC circuit using Multisim.			Chapter 6
8	Design an 8-bit ADC circuit that utilizes LEDs to indicate its binary output value. Use a reference voltage of 2.5V to 5 VDC.	2.00	10.00	
Category:Viva, Journal and Attendance		**Total Weightage: 10**		**No. of lab sessions: 01**
Expt./ Job No.	**Experiment / Job Details**	**No. of Lab Session(s) per batch (estimate)**	**Marks / Experiment**	**Correlation of Experiment with the theory**
09	Viva, Journal and Attendance	01	10	
	Learning Outcomes : The students should be able to: 1. Command of appropriate communication skills such as technical reports, viva and presentations through the lab. Maintaining the punctuality to all the lab sessions.			
Category: Open Ended Enquiry		**Total Weightage: 20**		**No. of lab sessions: 02**
Expt./ Job No.	**Experiment / Job Details**	**No. of Lab Session(s) per batch (estimate)**	**Marks / Experiment**	**Correlation of Experiment with the theory**
10	Project	02	20	
	Learning Outcomes :			

	The students should be able to: 1. Carryout a project in a team. 2. Come up with PCB design using Ultiboard.	

Course Content

Course Code: 15EARC205	Course Title: Kinematics of machinery	
L-T-P-Self Study: 4-0-0-0	Credits: 4	Contact Hrs: 50
CIA Marks: 50	SEE Marks: 50	Total Marks: 100
Teaching Hrs: 50		Exam Duration: 3 hrs

Content	Hrs
Unit - 1	
Chapter No. 1.INTRODUCTION TO KINEMATICS Introduction, Mechanisms, kinematics, mechanism terminology, kinematic diagrams, kinematic inversion, mobility, four bar mechanism, slider crank mechanism, techniques of mechanism analysis.	4 hrs
Chapter No. 2.POSITION ANALYSIS Position, displacement, position analysis, position analysis applications to simple mechanisms – analytical analysis,Displacement Diagrams	5 hrs
Chapter No. 3.VELOCITY ANALYSIS Velocity of a point, velocity of a link, linear and angular velocities, relative velocity, velocity image, analytical velocity analysis: relative velocity method, algebraic solutions for common mechanisms, instantaneous center of rotation, velocity curves	6 hrs
Chapter No. 4. ACCELERATION ANALYSIS Linear acceleration of a point, acceleration of a link, normal and tangential acceleration, relative acceleration, relative acceleration analysis: analytical method, algebraic solutions for common mechanisms, acceleration of a general point on a floating link, coriolis acceleration, equivalent linkages, acceleration curves.	5 hrs
Unit - 2	
Chapter No. 5.CAMS: DESIGN AND KINEMATIC ANALYSIS Introduction, Types of Cam, Types of Followers, Prescribed follower motion, Follower motion schemes, Graphical disk cam profile design, Pressure angle, Design Limitations, Analytical disk cam profile design.	7 hrs
Chapter No. 6.GEARS: KINEMATIC ANALYSIS AND SELECTION Types of gears, spur gear terminology, involute tooth profiles, spur gear kinematics, rack and pinion kinematics, gear trains, idler gears, planetary gear trains.	7 hrs
Chapter No. 7.BELTS AND CHAIN DRIVES Introduction, Belts, Belt drive geometry, Belt drive kinematics, Chains, Chain drive geometry, Chain drive kinematics.	6 hrs
Unit - 3	

Chapter No. 8.SCREW MECHANISMS Introduction, Thread features, Thread forms, Ball screws, Lead, Screw kinematics, Screw forces and torques, Differential screws, Auger screws.	5 hrs
Chapter No. 9.STATIC FORCE ANALYSIS Introduction ,Forces ,Moments and Torques, Laws of Motion, Free-Body Diagrams ,Drawing a Free-Body Diagram ,Characterizing Contact Forces ,Static Equilibrium ,Analysis of a Two-Force Member ,Sliding Friction Force.	5 hrs

Course Content

Course Code: 15EARC206	**Course Title: Control Systems**	
L-T-P: **4-1-0**	Credits: 4	**Teaching Hours: 50 hrs**
CIA Marks: 50	SEE Marks: 50	Total Marks: 100
Teaching Hrs: 50		Exam Duration: 3 hrs
Unit –I		

1.Introduction to control system and system modeling in frequency domain Introduction, A History of Control Systems, System Configurations (open-loop & closed loop systems), Analysis and Design Objectives, The Design Process**.**Mathematical modeling of physical Systems: Electrical networks, Mechanical systems, Electro mechanical systems, Analogous systems.	**7h**
2. Topological Models Transfer function, Block diagram representation and reduction, signal flow graph representation and reduction using Mason's Gain formula, Transfer functions of control components – dc servomotor.	**6h**
3. Time –Domain modeling and Analysis The General State-Space Representation, Applying the State-Space Representation, Converting a Transfer Function to State Space, Converting from State Space to a Transfer Function, Standard test signals, Unit step response of First and second order systems, Time response specifications of first and second order systems, steady – state errors and error constants.	**7h**
Unit – II	
4. Stability analysis Concepts of stability, Necessary conditions for Stability, Routh- stability criterion, Relative stability analysis; More on the Routh stability criterion.	**5h**
5. **Root-Locus Techniques and Design Via Root Locus** Introduction, The root locus concepts, Construction of root loci. Improving Transient Response and Steady-State Error via Cascade Compensation, Feedback Compensation, Physical Realization of Compensation.	**7 h**
6. Frequency domain analysis Introduction, Correlation between time and frequency response, Stability analysis, Bode plot and Nyquist plot to obtain phase margin and gain margin of a given system. Experimental determination of transfer functions, Assessment of relative stability using Bode Plots.	**8h**
Unit – III	
7. Design Via Frequency Response Transient Response via Gain Adjustment, Lag Compensation, Lead Compensation, Lag-Lead Compensation.	**5h**
8. State Space Design Controller Design, Controllability, Observability, Observer Design, Examples.	**5h**

Course Content

Course Code: 15EARC207	Course Title: Machine Design	
L-T-P: 4-0-0	Credits: 4	Contact Hrs: 50
CIE Marks: 50	SEE Marks: 50	Total Marks: 100
Teaching Hrs: 50		Exam Duration: 3 hrs

Content	Hrs
Unit - 1	
Chapter No. 1. THE DESIGN PROCESS 1. Introduction, Materials in Design, 2. The Evolution of Engineering Materials, 3. The Evolution of Materials in Products, the Design Process, Types of Design, 4. Design Tools and Materials Data, Function, Material, Shape, and Process.	7
Chapter No. 2. MATERIAL PROPERTY CHARTS Exploring Material Properties, 2. modulus–density chart 3. strength–density chart 4. modulus–strength chart 5. maximum service temperature chart, Cost bar charts 6. The modulus–relative cost chart 7. The strength–relative cost chart **ENGINEERING MATERIALS, THEIR PROPERTIES AND MATERIAL SELECTION** The Families of Engineering Materials 2. Materials Information for Design 3. Material Properties and 4. Units	7
Chapter No. 3. KINEMATICS OF GEARS AND GEAR DESIGN Spur Gear Geometry: Involute-Tooth Form, Interference Between Mating Spur Gear Teeth, Devising Gear Trains, Forces, Torque And Power In Gearing, Gear Manufacture, Gear Quality, Allowable Stress Numbers, Stresses In Gear Teeth, Selection Of Gear Material Based On Bending Stress, Design Of Spur Gears, Power-Transmitting Capacity, Practical Considerations For Gears And Interfaces With Other Elements. Forces and stresses on helical gear teeth, design of helical gears, bearing forces on shafts carrying bevel gears, bending moments on shafts carrying bevel gears, design of bevel gears for pitting resistance, forces, friction, and efficiency in worm gear sets, stress in worm gear teeth, surface durability of worm gear drives.	7
Unit - 2	
Chapter No. 4. KEYS, COUPLINGS, SEALS AND SHAFT DESIGNS Materials for keys, stress analysis to determine key length, other methods of fastening elements to shafts, couplings, universal joints, retaining rings and other means of axial location, types of seals, seal materials, shaft design procedure, forces exerted on shafts by machine elements, stress concentrations in shafts, design stresses for shafts, shafts in bending and torsion only, shaft design example, recommended basic sizes for shafts, shaft rigidity and dynamic considerations, flexible shafts	7
Chapter No. 5. LINEAR MOTION ELEMENTS, SPRINGS, FASTNERS Power screws, ball screws, application considerations for power screws and ball screws, bolt materials and strength, externally applied force on a bolted joint, thread stripping strength,	7

other means of fastening and joining. Kinds of springs, helical compression springs, stresses and deflection for helical compression springs, analysis of spring characteristics, design of helical compression springs, helical torsion springs, improving spring performance by shot peening, spring manufacturing.	
Chapter No. 6. CLUTCHES AND BRAKES Descriptions of clutches and brakes, types of friction clutches and brakes, performance parameters, time required accelerating a load, inertia of a system referred to the clutch shaft speed, effective inertia for bodies moving linearly, energy absorption: heat-dissipation requirements, response time, friction materials and coefficient of friction, plate-type clutch or brake.	7
Unit - 3	
Chapter No. 7. BEARINGS: ROLLING CONTACT & SURFACE CONTACT Types of rolling contact bearings, thrust bearings, mounted bearings, bearing materials, load/life relationship, design life, bearing selection: radial loads only, bearing selection: radial and thrust loads combined, mourning of bearings, tapered roller bearings, practical considerations in the application of bearings, importance of oil film thickness in bearings, life prediction under varying loads.	5
Chapter No. 8. MACHINE FRAMES, BOLTED CONNECTIONS AND WELDED JOINTS Machine frames and structures, recommended deflection limits, design to resist bending, design of members to resist torsion, eccentrically loaded bolted joints, types of joints, types of welds, size of weld, method of treating weld as a line, welded joints.	5

Course Content

Course Code: 15EARC208	Course Title: Microcontrollers		
L-T-P-**SS**: **3-0-0-0**	Credits:3	Contact Hrs: 4	
CIE Marks: 50	SEE Marks: 50	Total Marks: 100	
Teaching Hrs: 50		Exam Duration: 100	

	Unit I	
No	**Content**	**Hrs**
1	**Chapter 1: Introduction to Microcontroller** Introduction To Microprocessor and Microcontroller: History and Evolution, types of microprocessors, Difference between Microprocessors and Microcontrollers. CPU architectures: RISC/CISC and Harvard/Von-Neumann, Overview of PIC Microcontroller family, Introduction to different microcontroller families (8051, ATMEL/AVR, and ARM).	**5 Hrs**
2	**Chapter 2: PIC and AVR Microcontroller Architecture and ALP** Architecture and pin functions, Registers and Instructions, Data formats and directives, Introduction to assembly language programming, Program counter and program ROM space. Branch, Call and Time delay loop: Branch instructions and looping, Call instruction and stack, Time delay instructions and pipeline. Timing diagrams.	**7 Hrs**
3	**Chapter 3: I/O Port programming** I/O port programming, I/O bit manipulation programming, Arithmetic, logic instructions and programs: Arithmetic instructions, Signed number concepts and arithmetic operations, logic and compare instructions, rotate instructions and data serialization, BCD and ASCII conversion.	**8 Hrs**
	Unit II	
4	**Chapter 4:PIC and AVR programming in C** Data types and time delays in C, I/O programming, logic operations, data serialization, program ROM allocation, Program ROM allocation inC18, State diagrams, Timing diagrams in-depth.	**5 Hrs**
5	**Chapter 5: Timer and Serial port programming** Programming TIMERS 0 and 1, counter programming, Programming TIMER0 and 1 in C, Basics of serial communications, PIC18 connection to RS232, PIC18 serial port programming in assembly and C	**8 Hrs**
6	**Chapter 6:Interrupt programming in Assembly and C** Polling Vs interrupts, PIC18 Interrupts, Programming timer interrupts, programming external hardware interrupts, programming the serial communication interrupt, PortB change interrupts. ADC, DAC and sensor interfacing: ADC characteristics, ADC programming in the PIC18, DAC interfacing, sensor interfacing and signal interfacing.	**7 Hrs**
	Unit – III	
7	**Chapter 7:Using Flash and EEPROM Memories for data storage** Semiconductor memory, Erasing and writing to flash in the PIC18F, Reading and writing to data EEPROM in the PIC18.	**5 Hrs**

8	**Chapter 8: Applications of Microcontroller**: Event counter, Linear variable Differential Transformer (LVDT), Angular speed measurement (RPM meter), Digital Thermometer, Digital PID controller.	**5 Hrs**

Text Book

Mazidi&Mazidi, “ PIC Micrcontroller and Embedded systems”, Pearson Edition

Mazidi&Mazidi, “ Introduction to AVR Micrcontroller and Embedded systems”, Pearson Edition

Reference Books

Ramesh Gaonkar , Fundamentals of microcontrollers and Applications in Embedded Systems. Penram International Publishing(India) Pvt. Ltd.

Ajay V Deshmukh, “Microcontroller: Theory and Applications”

Course Content

Course Code:15EARC209	Course Title: **Engineering Design Practice**	
L-T-P:2-1-0	Credits:3	Contact Hrs: 4
CIE Marks: 80	SEE Marks: 20	**Teaching Hours: 30 hrs** **SEE: 20 marks**

Unit –I

1. Engineering Design and the Design Process Definition of engineering design, Design levels, Importance and challenges of engineering design, Introduction to systematic design, Design process and models.	**4 hrs**
2. Essential transferable skills, Identifying needs and gathering information Working In Teams, Forming a Team, Dynamics of a Team, Scheduling, Gantt Chart, CPM/PERT, Definitions, CPM/PERT Network Development, Problem Definition: Need Statement, Gathering Information: Clarifying the Need, How To Conduct a Market Analysis, Product Information, Industry Information, Company Information, Market Information.	**5 hrs**
3. Customer requirements & Design specifications Identifying Customer Requirements, Prioritizing Customer Requirements, Organizing Customer Requirements—Objective Tree, Kano Model Customer Needs Assessment, Design specifications	**3 hrs**

Unit – II

4. Functional analysis & performance specifications Functions, Function Decomposition and Structure, Bounding Box and Overall Function Diagram, Function Tree, Function Structure, Detailed Procedure to Establish Functional Structures, Function Structure, Reverse Engineering, Performance-Specification Method, Quality-Function-Deployment Method.	**4 hrs**
5. Conceptual design and evaluation Developing Working Structures, Steps to Develop Concepts From Functions, Brainstorming, Mechanism of Brainstorming Session, Ideation, Creativity, How to Increase Your Level of Creativity, Developing Concepts, Sketch Assembly of Alternatives, Evaluating Conceptual Alternatives, Pugh's Evaluation Matrix, Decision Matrix.	**4 hrs**
6. Embodiment design Product Drawings, Prototype, Design for "X", Design for Manufacturing, Design for Assembly, Design for Environment, Safety Considerations, Safety Analysis Techniques, Human Factors, Human Sensory Capabilities, Anthropometric Data.	**4 hrs**

Unit – III

7. Detailed design Analysis, Material Selection, Material Classifications and Properties, Material Selection Process, Primary Manufacturing Methods, Material Selection Theory,Bill of Material	**3 hrs**

8. Ethics in Design Ethics: Understanding obligations, Codes of ethics: What are our professional obligations? Obligations may start with the client. ..... But what about the public and the profession? On engineering practice and the welfare of the public, Ethics: Always a part of engineering practice.	**3 hrs**

Text Books:

1. Yousef Haik, Engineering Design Process, Cengage Learning India Private Limited, New Delhi

References:

2. Clive L Dym and Patrick Little, Engineering Design: A Project Based Introduction, John Wiley & Sons.
3. George Dieter and Linda C Schimdt, Engineering Design, Macgraw Hill

Laboratory Plan

Laboratory Course Plan: B E in A&R

Laboratory Title: **Manufacturing &Metrologylab**	Lab. Code: 15EARP204
Total Hours: **24**	Duration of SEE Hours: 3
SEE Marks: **20**	CIE Marks: **80**

Experiment wise Plan

List of experiments/jobs planned to meet the requirements of the course.

Category: Demonstration		**Total Weightage: 20**		**No. of lab sessions: 2**
Expt./ Job No.	**Experiment / Job Details**	**No. of Lab Session(s) per batch (estimate)**	**Marks / Experiment**	**Correlation of Experiment with the theory**
1.	Material Removal Operations	1	10	
	Learning Objectives: The students should be able to: 1. Demonstrate various operations like Facing, Turning, threading on a work piece using Lathe machine. 2. Perform operations like drilling of holes on a given work material using Drilling Machine. 3. Perform Tapping operation on a given slab of metal. 4. Demonstrate grinding operation on a given metal cube to achieve predefined dimensions. 5. Demonstrate taper turning operation on a circular bar			Unit 1
2.	Material Testing	1	10	
	Learning Objectives: The students should be able to: 1. To calculate various stresses acting on a circular bar subjected to axial loading using UTM and plot a graph by taking the readings.			Unit I

	2. To calculated Impact strength of a given material using CHARPY and IZOD testing machine. 3. To calculate Hardness of a given material			
Category: Exercise		**Total Weightage: 30**		**No. of lab sessions: 6**
Expt./ Job No.	**Experiment / Job Details**	**No. of Lab Session(s) per batch (estimate)**	**Marks / Experiment**	**Correlation of Experiment with the theory**
3.	Fabricate the Parts for Table Clamping Device	6	30	
	Learning Objectives: The students should be able to: 1. To machine a given raw metal sheet to actual dimensions. 2. Perform drilling operations at suitable locations. 3. Mark the work piece before going for manufacture. 4. Taking measurements at every step of operations using vernier calipers. 5. Perform welding operation on hinges to achieve perfect right angle. 6. Fill machining time calculation chart. 7. Performing threading on a circular bar to a given pitch. 8. Fill operation chart and inspections reports.			Unit I, II
Category: Structured Enquiry		**Total Weightage: 10**		**No. of lab sessions: 1**
Expt./ Job No.	**Experiment / Job Details**	**No. of Lab Session(s) per batch (estimate)**	**Marks / Experiment**	**Correlation of Experiment with the theory**
4.	Assembly of parts Learning	1	10	
	Learning Objectives: The students should be able to: 1. Ensure all the parts are ready for assembly.			Unit I, II

	2. Make sure all the parts are within the defined limits 3. Prepare a process chart to ensure easy flow of assembly 4. Write specification of assembly .			
Category: Open Ended		**Total Weightage: 10**		**No. of lab sessions: 1**
Expt./ Job No.	**Experiment / Job Details**	**No. of Lab Session(s) per batch (estimate)**	**Marks / Experiment**	**Correlation of Experiment with the theory**
5.	DFM using Solid works Learning outcomes	1	10	
	Learning Objectives: The students should be able to: 1. Ensure all the parts can be manufactured without any difficulties. 2. Ensure dimensions given and machine selected can perform the operation. 3. Visualize all the parts and remember the location of each link in assembly. 4. Identify alternate dimensions to any failing part and correct without performing machining operations. 5. Select suitable machine to perform specific operations.			Unit I, II, III

Laboratory Plan

Laboratory Course Plan: B E in A&R 2014-2018

Laboratory Title: **Microcontroller Lab**	Lab. Code: **15EARP205**
Total Hours: **24**	Duration of SEE Hours: 3
SEE Marks: **20**	CIE Marks: **80**

Experiment wise Plan

List of experiments/jobs planned to meet the requirements of the course.

Category: Demonstration		**Total Weightage: 15**		**No. of lab sessions: 6**
Expt./ Job No.	**Experiment / Job Details**	**No. of Lab Session(s) per batch (estimate)**	**Marks / Experiment**	**Correlation of Experiment with the theory**
1	Compare Architectures of different microcontrollers w.r.t to time response, frequency response, delay, process time etc. Write a program to demonstrate the blinking of LED in PIC16F877A and Arduino board	2	5	
	Learning Objectives: The students should be able to: 1. *1. study the data sheets and make a comparative study of the Architectures, resources, tools and applications of different microcontroller* 2. *Compare and contrast different microcontrollers.* 3. *Connect microcontroller to LED and blink LED with proper delay.* 4. *Apply suitable method or logic to solve given problem.*			
2	Develop a counter machine which count from 0000 to 9999 and display on 7 segment LED display using PIC16F877A and Arduino	2	5	

	board.			
	Learning Objectives: The students should be able to: 1. 1. *Use 7Segment LED for counting numbers.* 2. *Use appropriate logic or method for counting.*			
3	In a manufacturing industry there is a need of continuous temperature monitoring and inform to the concern authority. Develop an application that reads the values from LM35 temperature sensor and display the temperature in degree Celsius on LCD display using PIC16F877A and Arduino board.	2	5	
	Learning Objectives: The students should be able to: 1. 1. *Connect LM35, LCD and microcontroller.* 2. *Write function to read values from LM35 and display it on LCD.*			
Category: Exercise		**Total Weightage: 20**		**No. of lab sessions: 8**
Expt./ Job No.	**Experiment / Job Details**	**No. of Lab Session(s) per batch (estimate)**	**Marks / Experiment**	**Correlation of Experiment with the theory**
4	In bank lockers there is requirement of password protection to open the locker. Develop an application Using a 4*3 keypad and LCD to secure the lockers by providing password protection.	2	5	
	Learning Objectives: The students should be able to: 1. *Connect Keypad, LCD with microcontroller.* 2. *Write logic to read key press event from keypad*			

5	There is a need to develop a microcontroller based in an automobile to estimate the exact distance of an object from the car. Develop a system using Ultrasonic Sensors to find the distance of an object and inform the driver. The schematic of the system with all the connections are shown in the diagram below. Make the connections as per the schematic and develop the flowchart and the code to perform the required operation.	2	5	
	Learning Objectives: The students should be able to: 1. *Connect Ultrasonic Distance Sensor and microcontroller* 2. *Logic to find distance in CM and Meters.*			
6	There is a need to develop a microcontroller based system to do control the speed and direction of a wheeled autonomous mobile robot. Develop an add-on to autonomous robot using sensors to control the speed control of a DC motor hence control the robot movement.	2	5	
	Learning Objectives: The students should be able to: 1. *Understand the connections from microcontroller to DC motor using drives.* 2. *Discuss how motor driver helps in controlling the speed on a DC motor.*			

7	Write a program to sensor based control of a stepper motor	2	5	
	Learning Objectives: The students should be able to: 1. *Connect stepper motor to microcontroller using driver.* 2. *Understand different types of stepper motors.*			
Category: Structured Enquiry		**Total Weightage: 25**		**No. of lab sessions: 4**
Expt./ Job No.	**Experiment / Job Details**	**No. of Lab Session(s) per batch (estimate)**	**Marks / Experiment**	**Correlation of Experiment with the theory**
8	There is a need to develop a microcontroller based system to continuously monitor and check products for defect which are moving on a conveyer belt using sensors and kick out the defect product from the queue.	2	5	
	Learning Objectives: The students should be able to: 1. *Connect Push button, LED and microcontroller*. 2. *Logic to control ON/OFF of LED using push button.*			
9	People sitting in a car have the tendency of keeping their hand out of window and when driver closes the window their hand may get struck in between. Implement an Anti-Pinch System for Power Window which helps in avoiding such accidents.	2	20	
	Learning Objectives: The students should be able to:			

	1. Understand difference between software and hardware interrupts. 2. *Write interrupt programs*			
Category: Open Ended		**Total Weightage: 20**		**No. of lab sessions: 4**
Expt./ Job No.	**Experiment / Job Details**	**No. of Lab Session(s) per batch (estimate)**	**Marks / Experiment**	**Correlation of Experiment with the theory**
11	Develop a system to create Liquid flow rate measurement using any microcontroller.	4	20	
	Learning Objectives: The students should be able to: 1. *Identify the problem and solve.* 2. *Apply the knowledge of electronics and programming to measurement Liquid flow rate.*			

Laboratory Plan

Laboratory Course Plan: B Ein A&R 2014-2018

Laboratory Title: **Kinematics of Machinery lab**	Lab. Code:15EARP206
Total Hours: **24**	Duration of SEE Hours: 3
SEE Marks: **20**	CIE Marks: **80**

Experiment wise Plan

List of experiments/jobs planned to meet the requirements of the course.

Category: Demonstration		**Total Weightage: 15.00**		**No. of lab sessions: 3.00**
Expt./ Job No.	**Experiment / Job Details**	**No. of Lab Session(s) per batch (estimate)**	**Marks / Experiment**	**Correlation of Experiment with the theory**
1	SolidWorks Motion	1.00	5.00	
	Learning Outcomes: The students should be able to: 1. Demonstration of commands used in SolidWorks Motion interface. Demonstration of advanced mates and mechanical mates The students should be able to: The students are asked to answer the following questions 1. How do you start a SolidWorks Motion session? 2. How do you activate SolidWorks Motion Add-In? 3. What types of motion analyses are available in SolidWorks? 4. What is analysis? 5. Why analysis is important? 6. What does SolidWorks Motion analysis calculate?			UNIT – I
2	Position, Velocity and Acceleration Analysis	1.00	5.00	
	Learning Outcomes: The students should be able to: 1. Simulate and compare the results obtained for the given scenario Graphically determine the combined effect of velocity vectors. Calculate the final position, direction and velocity of a ball			UNIT – I
3	Simulations of sliding, and rigid body rotations (using SolidWorks motion)	1.00	5.00	

	Learning Outcomes: The students should be able to: 1. 1. Demonstration of sliding, and rigid body rotation using solidworks motion 2. Examine problems involving objects sliding and/or rolling down inclined planes The students should be able to: The students are asked to answer the following questions 1. What will be the motion of the block on the plane if there is no friction? 2. Calculate the velocity of the block at the bottom of the ramp if we know its starting position? 3. What will be the motion of the block on the plane if friction is included? 4. Calculate the velocity of the block at the bottom of the ramp? 5. How will the motion of a roller be different than that of the block?			UNIT – I
Category: Exercise		**Total Weightage: 45.00**		**No. of lab sessions: 9.00**
Expt./ Job No.	**Experiment / Job Details**	**No. of Lab Session(s) per batch (estimate)**	**Marks / Experiment**	**Correlation of Experiment with the theory**
1	Motion simulation 4 bar linkage(Tracing the path generated by the points on the mechanisms)	1.00	5.00	
	Learning Outcomes: The students should be able to: 1. Simulate and apply motors to the given mechanism The students are asked to answer the following questions Students simulate the motion of 4 bar linkage with respective to each other. This exercise shows the following key figures of Motion Simulation in SolidWorks. 1. Applying motors to simulate the movement. 2. Setting the time flow and frame rate.			UNIT-I
2	Motion Analysis of a 4 bar mechanism (Using SolidWorks Motion)	1.00	5.00	
	Learning Outcomes: The students should be able to: 1. 1. Simulation of 4 bar link mechanism 2. Apply motors to the joints 3. Plot angular acceleration and angular velocity The students should be able to: Use SolidWorks Motion Simulation to perform motion analysis on the assembly			UNIT-I

	shown below. The green link is given an angular displacement of 45 degrees in 1 sec in the clockwise direction and it is required to determine the angular velocity and acceleration of the other links as a function of time & Create a Trace Path			
3	Modification of the geometry of 4 bar mechanism and its effect on kinematic properties (Using SolidWorks Motion)	1.00	5.00	
	Learning Outcomes: The students should be able to: 1. Students should modify the geometry of Link3 so that the 4Bar mechanism looks like the one shown in the image below. Now ask them to use SolidWorks Motion to calculate the new torque required to drive this mechanism. Use the same uniform angular velocity input of 45 deg/sec. Will the new driving torque be higher or lower? Why?			UNIT-I
4	Motion analysis of a Slider Crank Mechanism	1.00	5.00	
	Learning Outcomes: The students should be able to: 1. Use SolidWorks Motion to simulate a slider crank mechanism. The goal of the students is to calculate the velocity and acceleration of the center of mass of the reciprocating part (using SolidWorks motion)			UNIT-I
5	Analysis of Torque and Power of a rotating drum	1.00	5.00	
	Learning Outcomes: The students should be able to: 1. 1. Compute the torque and power analytically 2. Obtaining the results in solidworks			UNIT-I
6	Simulation of CAM – Following mechanism	1.00	5.00	
	Learning Outcomes: The students should be able to: 1. Design and simulate the motion of CAM & Follower using SolidWorks motion 1. Design CAM & Follower 2. Applying motors to simulate the movement 3. Setting the time flow			UNIT-II

	and frame rate			
7	Gears: Motion study of spur gears & Planetary gear.	1.00	5.00	
	Learning Outcomes: The students should be able to: 1. Importing Standard Gears from solidworks toolbox. Meshing of Gears (Spur gear, Rack and Pinion and Planetary Gear)			UNIT-II
8	Simulation of Belt and Chain Drive Mechanism.	2.00	10.00	
	Learning Outcomes: The students should be able to: 1. Silmulation of conveyor system using belt and chain command using SolidWorks Motion Study.			UNIT-II
Category: Structured Enquiry		**Total Weightage: 10.00**		**No. of lab sessions: 2.00**
Expt./ Job No.	**Experiment / Job Details**	**No. of Lab Session(s) per batch (estimate)**	**Marks / Experiment**	**Correlation of Experiment with the theory**
1	EVENT BASED MOTION ANALYSIS	2.00	10.00	
	Learning Outcomes: The students should be able to: 1. Easily simulate complex machine operations using event-based motion analysis with SOLIDWORKS Simulation and validate the sequencing of the design to ensure correct operation, product quality, and safety. See how your product would move in the real world and measure the forces and loads while you design, helping you correctly size the motors and the structure and confirm the timing. Event-based motion can solve either kinematic or dynamic rigid body motion problems, and can simulate the effect of: • Forces • Springs • Dampers • Gravity • Contact between components • Bushings			UNIT-3

Course Content

Course Code: 15EARC301	Course Title: Robot Analysis & Design	
L-T-P: 4-0-0	Credits: 4	Contact Hrs: 50
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 50		Exam Duration: 3 Hrs

UNIT – I

No	Content	Hrs
1	Chapter 1:**Introduction to Robotics and Applications** Introduction, Classifications of Robots, Robot Components, Robot Degrees of Freedom, Robot Joints, Robot Coordinates, Robot Reference Frames, Programming Modes, Robot Characteristics, Robot Workspace, Robot Languages, and Robot Applications.	6
2	Chapter 2:**Representing Position and Orientation** Coordinate frames,representing Pose in 2-Dimensions, representing Pose in 3-Dimensions, representing Orientation in 3-Dimensions, orthonormal Rotation Matrix, three-Angle Representations, combining Translation and Orientation.	6
3	Chapter 3:**Position Analysis of Serial Manipulators** Describing a Robot Arm,Link Parameters and Link Coordinate systems, Homogeneous transformation Matrices, Denavit-Hartenberg,Forward Kinematics, Inverse Kinematics,A 2-Link Robot, A 6-Axis Robot .	8

UNIT - II

No	Content	Hrs
4	Chapter 4:**Jacobian Analysis of Serial Manipulators** Different Kinematics of rigid body, Different Kinematics of serial manipulators,screw coordinates and screw systems, Manipulator Jacobian Matrix, conventional Jacobian, Screw-Based Jacobian, and Transformations of screw coordinates. Relationship Between Two Methods, condition number, singularity analysis.	6
5	Chapter 5: **Staticsand Dynamics of Serial Manipulators** Statics of Serial Manipulators, Transformations of Forces and Moments, mass properties, momentum, transformation of inertia matrix, kinetic energy. Newton-Euler Laws, Recursive Newton-Euler Formulation, Lagrangian Formulation, Inertia Effects of the Rotors, End-Effectors Space Dynamical Equations.	7

6	Chapter 6: **Trajectoryplanning** Path versus Trajectory, Joint-Space versus Cartesian-Space Descriptions, Basics of Trajectory Planning, Joint-Space Trajectory Planning, Third-Order Polynomial Trajectory Planning, Fifth-Order Polynomial Trajectory Planning, Linear Segments with Parabolic Blends, Linear Segments with Parabolic Blends and Via Points, Higher-Order Trajectories, Other Trajectories, Cartesian-Space Trajectories, Continuous Trajectory Recording.	7
	UNIT - III	
7	Chapter 7:**Wrist Mechanisms** Introduction, Bevel-Gear Wrist Mechanisms, structure representation of mechanisms, structure characteristics of epicyclic Gear Drives, Kinematics of Robotic Wrist Mechanisms, and static force analysis.	5
8	Chapter 8:**Tendon-Driven Manipulators** Introduction, classification of Tendon-Driven Manipulators, Planar Schematic Representation,Kinematics of Tendon-Driven Manipulators, Static Force Analysis, Feasible Structure Matrices, Redundant forces resolution.	5

Course Content

Course Code: **15EARC302**	Course Title: **Hydraulics and Pneumatics**	
L-T-P : : 4-0-0	Credits: 4	Contact Hrs: 50 hours
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 50 hours		Exam Duration: 3 Hrs

Content	Hrs
Unit - 1	
Chapter No. 1. Introduction to Hydraulic Power and Hydraulic Pumps Pascal's law, Structure of Hydraulic Control System. The Source of Hydraulic Power: Pumps Pumping theory, pump classification, gear pumps, vane pumps, piston pumps, Variable displacement pumps, pump performance, pump selection.	7hrs
Chapter No. 2. Hydraulic Actuators: Cylinders and Motors Linear Hydraulic Actuators (cylinders), Mechanics of Hydraulic Cylinder loading, Hydraulic Rotary Actuators, Gear motors, vane motors, piston motors, Hydraulic Motor Performance	6hrs
Chapter No. 3. Hydraulic Valves Hydraulic Valves: Directional Control Valves- classification of directional control valves, direction control valves actuating devices, Symbolic representation as per ISO 1219 and ISO 5599, pressure control valves, flow control valves- classification of flow control valves, proportional control valves, and servo valves.	7hrs
Unit - 2	
Chapter No. 4. Hydraulic Circuit Design and Analysis Control of single acting and double acting Hydraulic Cylinder, regenerative circuit, pump unloading circuit, Double pump Hydraulic system, Counter Balance Valve application, Hydraulic cylinder sequencing circuits. Locked cylinder using pilot check valve, cylinder synchronizing circuits, Speed control of hydraulic cylinder: Meter-in circuit, Meter-out circuit and Bleed-off circuit, speed control of hydraulic motors. Ancillary Hydraulic Devices: Reservoirs, Accumulators, Pressure Intensifiers, Sealing Devices.	6hrs
Chapter No. 5. Pneumatic Systems Structure of Pneumatic control system, Choice of working medium, characteristics of compressed air, Pneumatic Actuators: Types of Linear Actuators or Pneumatic cylinders, Cylinder mountings, Cylinder seals, End cushioning in pneumatic cylinders. Pneumatic Control Valves: Direction control valve- types of direction control valves, ISO designation of direction control valves, Non return valves, methods of actuation of pneumatic directional control valves, Flow control valves, and Pressure control valves.	5hrs
Chapter No. 6. Pneumatic Circuit Design and Hydraulic Control Systems **Pneumatic Circuit Design:** Direct and indirect control of single acting cylinder, control of	9hrs

single acting cylinder using “or” valve, control of single acting cylinder using “and” valve, control of single acting cylinder using “not” valve. Direct control of a double acting cylinder, Indirect control of double acting cylinder using memory valve, Supply air throttling and exhaust air throttling, Various methods of checking end position of a cylinder, Pressure dependent controls and Time dependent controls. **Hydraulic Control Systems:** Servo Control, Valve servo systems: Valve lap, mechanical feedback, systems response, electro hydraulic servo valves, system response and stability, Pump servo systems, Proportional valves: Force control, force position control, spool position control, proportional pressure control, two stage proportional valves, proportional flow control, electrical control of proportional valve, Proportional versus Servo valves, Applications of proportional control valves.	
Unit - 3	
Chapter No. 7. Electro Pneumatics Basic electrical devices- Manually actuated push button switches, Limit switches, Pressure switches, Solenoids, Relays, Timers, Temperature switches, Direct and indirect control of single acting cylinders using electro pneumatics, Direct and indirect control of double acting cylinders using electro- pneumatics, Control of double acting cylinder OR logic (Parallel circuit), Control of double acting cylinder AND logic.	5 hrs
Chapter No. 8. Hydraulic System Maintenance Common faults in a hydraulic systems, contamination, Filter and filter maintenance, pump maintenance, Hydraulic system maintenance, fault diagnosis of Hydraulic system.	5 hrs

Course Content

Course Code: 15EARC303	Course Title: Mechatronic Systems Design	
L-T-P : 4-0-0	Credits: 4	Contact Hrs: 50 hours
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 50 hours		Exam Duration: 3 Hrs

Content	Hrs
Unit - 1	
Chapter No. 1. Mechatronic Systems Design , Engineering & Modeling Introduction to mechatronic systems design, structure of mechatronic systems, Traditional approach to mechatronic systems design, Mechatronics design methodology (V-model) – VDI 2206, Model based design, Bond graph approach to modeling State charts, UML &SysML , Case studies.	**10**
Chapter No. 2. Design of Mechatronic control systems in State space Controller Design,Alternative Approaches toController Design,Observer Design,Alternativeapproaches toObserver Design, Steady-State Error Design ViaIntegral Control, Robust Control System Design, The z-Transform: Transfer Functions, Block Diagram Reduction, Stability, Steady-State Errors, Transient Response on the z-Plane, Gain Design on the z-Plane, Cascade Compensation via the s-Plane, Implementing the Digital Compensator.	**10**
Unit - 2	
Chapter No.3. Mechanisms for motion transmission Characteristics of motion transmission mechanism, Rotary to rotary motion transmission mechanisms, Rotary to translational motion mechanisms, Cyclic motion transmission mechanisms, Shaft misalignments and flexible couplings, Actuator sizing.	**6**
Chapter No. 4: Motion control systems Design Methodology for Programmable motion control Systems, Motion Controller Hardware and Software, Basic Single-Axis Motions, Coordinated Motion Control Methods, Point-to-point Synchronized Motion, Electronic Gearing Coordinated Motion, CAM Profile and Contouring Coordinated Motion, Sensor Based Real-time Coordinated Motion, Coordinated Motion Applications.	**7**
Chapter No. 5 : Sensors Principles & characteristics of measurement devices, Signal conditioning, Sensor characterization, Relations between physical quantities, Sensor Classification, Specifications, Error reduction techniques, Loading errors, Wheatstone bridge circuit, Sensors for position, Velocity , Acceleration , Strain, Force, Torque, Pressure, Temperature, Flow rate, Humidity, Vision systems, Sensor fusion.	**7**

Unit - 3	
Chapter No.6. Actuators Principle and characteristics of electric motors, Solenoids, DC motors & drives, AC induction motors & drives, Step motors, Linear motors.	**7**
Chapter No.7. Data Acquisition Systems Data conversion devices, Filters, Signal sampling and aliasing, Sampling theorem, Quantization, Encoding, Digital to analog conversion methods, Analog to digital conversion methods, Sample & Hold circuit, Flash ADC, Successive approximation ADC, Dual slope ADC, Sigma Delta ADC, Multiplexers.	**7**

Course Content

Course Code: 15EARC304	Course Title: Programming Industrial Automation Systems	
L-T-P-SS: 3-0-0-0	Credits: 3	Contact Hrs: 40
CIE Marks: 50	SEE Marks: 50	Total Marks: 100
Teaching Hrs: 40		Exam Duration: 3 hrs

Content	Hrs
Unit - 1	
Chapter No. 01.Programmable logic controllers(PLC) & its building blocks Internal architecture of Programmable Logic Controllers systems, Input/ Output devices, Memory Organization, I/O processing, Signal conditioning, Remote connections, Networks, Processor Scan cycle, Error Checking and Diagnostics.	4 hrs
Chapter No. 02. The IEC 61131 , IEC61499 standards & Ladder , FB, IL, SFC and ST programming IEC 61131-3: Building Blocks , Goals , benefits, , Programming Languages of IEC 61131-3, Ladder diagrams, Analogy with Boolean Algebra and Binary Logic , Function blocks, Instruction lists, Sequential function charts, State chart modelling, Structured text programming with example programs for each, IEC 61499 models: models ,concepts and industrial examples like Temperature control system, Conveyor test station	6 hrs
Chapter No. 03.Advanced PLC functions PLC Sequencer, Shift registers, Program / Flow Control Instructions, Arithmetic Instructions, Data handling Instructions like FIFO, FAL, ONS, Data Transfer Instructions PLC MOVE, PLC Matrix functions, Network Communication Instructions, Analog PLC operation, PID control of continuous processes.	5 hrs
Unit - 2	
Chapter No. 04.Designing systems, PLC Start-up & Maintenance PLC Core application development, Development Cycle, Safe systems, Commissioning, Fault finding, PLC System Layout , Power Requirements and Safety Circuitry , Noise, Heat, and Voltage Considerations,, I/O Installation, System wiring strategies, and Precautions ,Safety Standards like NEMA & NEC, Electrical wiring diagrams PLC Start-Up and Checking Procedures , PLC System Maintenance & Troubleshooting	7 hrs
Chapter No. 05.PC based Automation, SCADA Technologies and advantages of PC based Automation, Programmable Automation Controller systems (PACs) for Industrial control , Comparison of PLC with PAC Supervisory Digital Control and Data Acquisition (SCADA) system & Distributed Control Systems(DCS): SCADA Hardware and software ,Open SCADA protocols like DNP3 and IEC60870,	8 hrs

Unit - 3	
Chapter No. 06. DCS & Field Bus Overview of DCS, Network Standards: Device net, CAN bus, Control Net, Profibus, Sercos, EtherCAT, Ethernet Powerlink, Comparison of each of them with other network standard.	5 hrs
Chapter No. 07. System Selection Guidelines & Commissioning PLC Selection process ,estimation of program memory and time requirements, PLC Sizes and Scope of applications, Special I/O modules, Electrical relay diagram symbols, Fail Safe Design, IEC 61508/61511 safety standards, Process modeling, Programming for large systems ,Control system documentation & Commissioning	5 hrs

Laboratory Course Plan: B E in A&R 2014-2018

Laboratory Title: **Automation Lab**	Lab. Code: 15EARP303
Total Hours: **28**	Duration of SEE Hours: 2
SEE Marks: **20**	CIE Marks: **80**

<u>Experiment wise Plan</u>

List of experiments/jobs planned to meet the requirements of the course.

Category: Demonstration		**Total Weightage: 20.00**		**No. of lab sessions: 4.00**
Expt./ Job No.	**Experiment / Job Details**	**No. of Lab Session(s) per batch (estimate)**	**Marks / Experiment**	**Correlation of Experiment with the theory**
1	Introduction to Safety guidelines & PLC and system wiring. Introduction to SELEC Hardware and instruction set, demo programs.	1.00	5.00	
	Learning Outcomes: The students should be able to: 1. *appreciate the guidelines to be followed while working with PLC and I/O devices and follow the procedures involved in wiring the PLC system elements* 2. Solve the problems on interfacing by using Selec PLC, sensor and actuators.			UNIT I
2	Introduction to Panasonic PLC Hardware and FPWinPro software , Instruction set, Demo Programs	1.00	5.00	
	Learning Outcomes: The students should be able to: 1. *Identify the different input and output devices and their configuration for interfacing with Panasonic PLC* system elements 2. *Solve the problems on interfacing by using Panasonic PLC, sensors and different types of actuators through ladder*			UNIT I

	logic, Function block and Structured Text programming			
3	Introduction to Bosch Rexroth PLC Hardware, Indra Works, Instruction set and Demo Programs	1.00	5.00	
	Learning Outcomes: The students should be able to: 1. *Simulate PLC logic using Indra logic Software by solving problems on ON - OFF control strategy , Counting Items coming on a conveyor with planned intervals*			UNIT I
4	Demo on Electro Pneumatics : A. Time-dependent control of a double-acting cylinder with switch-on delay B. Sequential control of 2 double-acting cylinders with impulse valves	1.00	5.00	
	Learning Outcomes: The students should be able to: 1. *Implement PLC logic solution to drive electro-pneumatic elements based on stated case study problems* ems on ON - OFF control strategy , Counting Items coming on a conveyor with planned intervals			UNIT I
Category: Exercise		**Total Weightage: 25.00**		**No. of lab sessions: 5.00**
Expt./ Job No.	**Experiment / Job Details**	**No. of Lab Session(s) per batch (estimate)**	**Marks / Experiment**	**Correlation of Experiment with the theory**
5	Simulation Exercises on FPWINPro Software & Panasonic PLC a. Car safety system b. Solving Boolean Expressions c. Sequential Logic Control	1.00	5.00	
	Learning Outcomes: The students should be able to: 1. *Solve problems based on given case studies using ladder logic and function blocks*			UNIT II and III

6	Exercises using Panasonic PLC hardware interfaced with sensors and actuators &FPWinPro software	1.00	5.00	
	Learning Outcomes: The students should be able to: 1. *Implement PLC control logic by interfacing sensors for control of DC motor/stepper motor using timers , counters and process indicators*			
7	simulate exercises using Rexroth PLC software using ladder diagram, function block and structured text programming for the given case studies	1.00	5.00	
	Learning Outcomes: The students should be able to: 1. *simulate exercises using Rexroth PLC software using ladder diagram, function block and structured text programming for the given case studies*			
8	Solve case study problems using Rexroth PLC hardware interfaced with sensors, actuators and process indicators	1.00	5.00	
	Learning Outcomes: The students should be able to: 1. *simulate exercises using Rexroth PLC software using ladder diagram, function block and structured text programming for the given case studies*			
9	Exercises using Rexroth PLC software and hardware Building ALU , Timer and Counter b. Motor Control c.Burglar Alarm . d. Conveyor Control e. To explore PID control	1.00	5.00	
	Learning Outcomes: The students should be able to:			

	1. *Solve case study problems using Rexroth PLC hardware interfaced with sensors, actuators and process indicators.*indent:-.25in;mso-list:l0 level1 lfo1'>*1. simulate exercises using Rexroth PLC software using ladder diagram, function block and structured text programming for the given case studies*			
Category: Structured Enquiry		**Total Weightage: 15.00**		**No. of lab sessions: 2.00**
Expt./ Job No.	**Experiment / Job Details**	**No. of Lab Session(s) per batch (estimate)**	**Marks / Experiment**	**Correlation of Experiment with the theory**
10	Case studies on A. Automatic stamp B. Vehicle control system C. Process control system	2.00	15.00	
				UNIT III
Category: Open Ended		**Total Weightage: 20.00**		**No. of lab sessions: 2.00**
Expt./ Job No.	**Experiment / Job Details**	**No. of Lab Session(s) per batch (estimate)**	**Marks / Experiment**	**Correlation of Experiment with the theory**
11	Exploring PLC Serial communication using Ethernet	2.00	20.00	UNIT III

Laboratory Plan

Laboratory Course Plan: B E in A&R 2015-2019

Laboratory Title: **Mechatronics Laboratory**	Lab. Code: **15EARP304**
Total Hours: **30**	Duration of ESA Hours: 2hrs

Experiment wise Plan

List of experiments/jobs planned to meet the requirements of the course.

<table>
<tr><th colspan="2">Category: Demonstration</th><th colspan="2">Total Weightage: 10</th><th>No. of lab sessions: 2</th></tr>
<tr><th>Expt./ Job No.</th><th>Experiment / Job Details</th><th>No. of Lab Session(s) per batch (estimate)</th><th>Marks / Experiment</th><th>Correlation of Experiment with the theory</th></tr>
<tr><td rowspan="2">1</td><td>Demo on Quanser Mechatronics Sensor kit, DC Motor Control Trainer module, Inverted Pendulum Trainer module with NI ELVIS Platform.</td><td>1</td><td>05</td><td rowspan="2">Unit - 2</td></tr>
<tr><td colspan="3">Learning Objectives:
The students should be able to:
1. Demonstrate the working of Quanser, Mechatronics Sensor kit, DC Motor Control Trainer module, Inverted Pendulum Trainer module with NI ELVIS Platform.</td></tr>
<tr><td rowspan="2">2</td><td>1. Model physical systems using bond graph techniqueusing Model-20Sim software/Open modelica/ /Hopsansoftware.
2. Discretization(S→Z) (Simulation) using Labview.</td><td>1</td><td>05</td><td rowspan="2">Unit - 1</td></tr>
<tr><td colspan="3">Learning Objectives:
The students should be able to:
1. Model physical systems using bond graph technique using Model-20Sim software/Open modelica software.
2. Realize discretizition methods and compare the results.</td></tr>
</table>

	3. Make basic calculation using Laview Virtual Instrument.			
Category: Exercise		**Total Weightage: 20**		**No. of lab sessions: 3**
Expt./ Job No.	**Experiment / Job Details**	**No. of Lab Session(s) per batch (estimate)**	**Marks / Experiment**	**Correlation of Experiment with the theory**
3	A/D and D/A (Simulation) using Labview.	1	05	Unit - 3
	Learning Objectives: The students should be able to: 1. Measure and characterize Analog to Digital Converter (ADC). 2. Measure and characterize Digital to Analog Converter (DAC). 3. Make basic calculation using LabVIEW Virtual Instrument.			
4	Implementing a Level Control System in LabVIEW.	1	05	Unit - 1
	Learning Objectives: The students should be able to: 1. Implement a level control system using PID controller.			
5	Ultrasonic Transducer Characterization and Motor Control on starter kit 2.0	1	10	Unit - 2
	Learning Objectives: The students should be able to: 1. Realize the characteristics of an ultrasonic transducer using Starter kit 2 and LABVIEW. 2. Discover how to control motors using motor drivers, PWM, and PID techniques. 3. Realize the characteristics of an encoder using Starter kit 2 and LABVIEW. 4. Apply conversions between motor command units and user preferred units.			
Category: Structured Enquiry		**Total Weightage: 40**		**No. of lab sessions: 6**
Expt./ Job No.	**Experiment / Job Details**	**No. of Lab Session(s) per batch (estimate)**	**Marks / Experiment**	**Correlation of Experiment with the theory**

6	System identification (DC motor, Inverted pendulum)	2	20	Unit - 2
	Learning Objectives: The students should be able to: 1. Derive analytically the mathematical model of a DC motor and identify experimentally its physical parameters. 2. Measure the resistance and the back-electromotive force (back-EMF) constant of the DC motor and derive the voltage-to-motor speed transfer function. 3. Investigate various physical principles of the rotary pendulum and experimentally determine its moment of inertia.			
7	Design a Lag controller for a DC motor using the frequency response method.	2	10	Unit – 1, 2
	Learning Objectives: The students should be able to: 1. Design a Lag controller for a DC motor 2. Derive and simulate a digital equivalent controller using emulation.			
8	Design a PI controller for a DC motor using the Ziegler Nichols method, and then use this controller to build the discrete equivalent controller using emulation, investigating the effect of the discretization method and sampling frequency.	2	10	Unit – 1, 2
	Learning Objectives: The students should be able to: 1. Design a PI controller using the Ziegler Nichols method 2. Derive and simulate a digital equivalent controller using emulation.			

Category: Open Ended		**Total Weightage: 10**		**No. of lab sessions: 2**
Expt./ Job No.	**Experiment / Job Details**	**No. of Lab Session(s) per batch (estimate)**	**Marks / Experiment**	**Correlation of Experiment with the theory**
9	Select any one of these following experiments and	2	10	Unit – 1, 2 and 3

	perform the experiment: 1. Kinematics, Perception with PING))) and Localization using starter kit 2.0. 2. Pole placement using state feedback (PPSF emulation) for the inverted pendulum 3. Use DSC module in LabVIEW software and SbRIO/ CRIO to build control system. 4. Build SCADA and Cam profile applications using Rexroth Win-studio and MLD-CAM builder software tools.			
	Learning Objectives: The students should be able to: 1. Discover the steering frame. Add motor control of turning and rotating to provide the capability to drive from point A to point B. 2. Learn about hierarchical programming and state machine architectures to build more sophisticated programs to sequence control tasks like rotate and drive to navigate from point A to point B. 3. Calibrate PING)))'s orientation and file IO 4. Displayperception data with an XY Graph 5. Communicate perception data to the host with network Streams 6. Write a program to identify edges using feature extraction method to identify an obstacle, avoid obstacle and follow a wall. 7. Determine DaNI's location in the environment with odometric localization (dead reckoning). 8. Build an occupancy grid map using LABVIEW. 9. Design a state feedback controller for the inverted pendulum using pole placement. 10. Derive and simulate a digital equivalent controller using emulation. 11. Study the effect of sampling rate on the system. 12. Implement the selected control system prototype and develop the user interface using SCADA features of LabVIEW software and SbRIO/ CRIO.			

Semester: V *Year: 2017*

Laboratory Title: **Mini project**	*Lab. Code*: 15EARW301
Total Hours: **30**	*Total Credits*: **3**
Total ESA Marks: 5**0**	*Total ISA. Marks*: **50**

Experiment wise plan

List of activities planned to meet the requirements of the syllabus

Week No	***Activities***	***Deliverables***	***CIE Marks out of 50***
1&2	*Need analysis, Identification of problem statement, Engineering Design process*	*Problem statement, Project plan*	*10*
3&4	*Control System Design*	*Component designs & Integration, Modeling and simulation*	*10*
5,6,7&8	*Fabrication, Testing and validation*	*Prototype (hardware and software)*	*20*
9&10	*Report generation*	*Test reports and Conclusion*	*10*

Course Content

Course Code: 15EARC305	Course Title: Real Time Embedded Systems	
L-T-P-SS: 4-0-0-0	Credits: 4	Contact Hrs: 50
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 50		Exam Duration: 3 hrs

Content	**Hrs**
Unit - 1	
1.0 Introduction to System Structures, Embedded System and Operating System System Structures types, Real time systems & basics, Operating system definition, operations, types,Embedded system purpose, Quality attributes, Core and Supporting components of embedded system, Embedded firmware	5
2.0 Target Architectures : ARM Cortex M3 processors & its Programming: Architecture of ARM Cortex M3, Nested Vector Interrupt Controller. Interrupt behavior of ARM Cortex M3. Exceptions Programming. Advanced Programming Features. Memory Protection. Debug Architecture. Digital Signal Processor (DSP), Field Programmable Generic Array (FPGA).	8
3.0 Real-Time Kernels and Operating Systems: Introduction to Real-Time Kernels, Tasks, process and threads, Introduction to RTOS, key characteristics of RTOS, its kernel, components in RTOS kernel, objects, scheduler, services, context switch, Task scheduling, Task communication and synchronization, Multiprocessing and multitasking, Scheduling types: Preemptive priority-based scheduling, Round-robin and preemptive scheduling.first come first served scheduling, shortest job first scheduling, Device drivers and selection of an RTOS.	7
Unit - 2	
4.0 Inter-task Communication in RTOS Tasks, Semaphores and Message Queues: A task, its structure, A typical finite state machine, Steps showing the how FSM works. A semaphore, its structure, binary semaphore, mutual exclusion (mutex) semaphore, Synchronization between two tasks and multiple tasks, Single shared-resource-access synchronization, Recursive shared- resource-access synchronization. A message queue, its structure, Message copying and memory use for sending and receiving messages, Sending messages in FIFO or LIFO order, broadcasting messages.	7
5.0 Tasks and Task Management VxWorks- task creation and Management, task scheduling, kernel services, inter-task-communication, Micro C/OS-II- task creation and Management, task scheduling, kernel services, inter-task-communication.	7
6.0 Handling Deadlocks Sharing Resources, Deadlock Model- Necessary Conditions, A Graph Theoretic Tool—The Resource Allocation Graph, Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection.	6
Unit - 3	
7.0 Performance Analysis and Optimization Performance or Efficiency Measures, Complexity Analysis—A High-Level Measure, The Methodology, Analyzing Code, algorithms, Response Time, Time Loading, Memory Loading, Evaluating Performance, Performance Optimization, optimizing for Power Consumption.	5

8**.0 Wired and Wireless Protocols used in Real Time Embedded System:** Bus communication protocol (USB, I2C, SPI), Wireless and mobile system protocol (Bluetooth, 802.11 and its variants, ZigBee), Embedded design cycle-case study-ACVM	5

Laboratory Plan **FMTH0303-3.0**
Semester: VI *Year:* **2018 - 2019**

Laboratory Title: **OOP & Python Practice**	Lab Code: **15EARC306**
Total Hours: **48**	Duration of SEE Hours: 3
ISA Marks: **80**	ESA Marks: **20**

Experiment wise Plan

List of experiments/jobs planned to meet the requirements of the course.

Category: Demonstration		**Total Weightage: 20**		**No. of lab sessions: 2**
Expt./ Job No.	**Experiment / Job Details**	**No. of Lab Session(s) per batch (estimate)**	**Marks / Experiment**	**Correlation of Experiment with the theory**
1	Write programs using the concept of OOP (C++/Java) Language Fundamentals and concept of command line arguments.	1	10	
	Learning Objectives: The students should be able to: 1. Demonstrate how to compile and run a program in command prompt. 2. Write programs using operators and control statements. 3. Write programs for accepting command line arguments and process them in program. 4. Demonstrate how to compile and run a Java program using different IDE's like eclipse, Net beans etc.			Object Oriented Programming -I
2	Write programs using the concept of arrays, Strings and String Buffer class and exception Handling.	1	10	
	Learning Objectives: The students should be able to: 1. Write programs using different types of arrays and			Object Oriented Programming -I

	strings. 2. Write a program to catch different types of exceptions. 3. Demonstrate how the String Buffer is used in a program.			
Category: Exercise		**Total Weightage: 20**		**No. of lab sessions: 2**
3	Develop a swing based GUI using swing components and containers and connect it to database .	1	10	Object Oriented Programming -I
	Learning Objectives: The students should be able to: 1. Develop a GUI using swing components and containers. 2. Demonstrate how to insert, update and retrieve data from a database by using a simple swing based program. 3. Demonstrate the procedure of database connection.			
4	Write programs using the concept of Generic class, Inheritance, Interface and Package.	1	10	
	Learning Objectives: The students should be able to: 1. Write a program to create base class and derived class and demonstrate the inheritance concept using the same program. 2. Write a program to create interface and demonstrate how to use the interface for other programs also. 3. Use the built in packages to write programs for defined task. 4. Create the user packages and demonstrate how to use the user package in other programs or other classes. 5. Demonstrate how to create parameterized constructors and how to use different types of access specifies in a program.			Object Oriented Programming -I
Category: Exercise		**Total Weightage: 30**		**No. of lab sessions: 3**
Expt./ Job No.	**Experiment / Job Details**	**No. of Lab Session(s) per batch (estimate)**	**Marks / Experiment**	**Correlation of Experiment with the theory**

5	Write a program using the concepts of python scripting elements python constructs, data structures.	1	10	Python programming-II
	Learning Objectives: The students should be able to: 1. Demonstrate how to compile and run a program in command prompt. 2. Write programs using operators and control statements. 3. Write programs for accepting command line arguments and process them in program. 4. Demonstrate how to compile and run a python program using different IDE's like anaconda ,ipython etc.			
6	Write programs using the concept of functions, modules, packages and regular expressions	1	10	Python programming-II
	Learning Objectives: The students should be able to: 1. Write programs using functions and modules. 2. Write a program to use packages and regular expressions			
7	Write a python program to use the language scripting elements and constructs, data structures, and repository of standard library, to develop real world applications.	1	10	Python programming-II
	Learning Objectives: The students should be able to: 1. Write a program using scripting elements and data structures. 2. Create the user packages and demonstrate how to use the user package in other programs or other classes. 3. Write a program to create interface and demonstrate how to use the interface for other programs also			

Category: Structured Enquiry		**Total Weightage: 10**		**No. of lab sessions: 3**
Expt./ Job No.	**Experiment / Job Details**	**No. of Lab Session(s) per batch (estimate)**	**Marks / Experiment**	**Correlation of Experiment with the theory**
8	Solving a Maze: Program a robot to solve a maze by finding the goal position in the maze starting from a starting position. You will need a data structure to keep track of positions found in the maze that are yet to be explored, starting with positions around the starting position. You will compare the maze solutions found using a Stack versus a Queue for storing unexplored positions.	2	10	
	Learning Objectives: The students should be able to: 1. Select fundamentals concepts of object oriented programming concepts/python, based on the problem scenario to implement programs.			Object Oriented Programming –I/ Python programming-II
Category: Open Ended		**Total Weightage: 20**		**No. of lab sessions: 2**
Expt./ Job No.	**Experiment / Job Details**	**No. of Lab Session(s) per batch (estimate)**	**Marks / Experiment**	**Correlation of Experiment with the theory**
9	Implement a project using C++/Java/python concepts, for automation and robotics applications. (FOR SEE)	2	20	

	Learning Objectives: The students should be able to: 1. Use the C++/Java/python concepts to implement the project. 2. Select the appropriate tool/software to implement the project. 3. Write a technical report using IEEE standard. 4. Present the technical report for the implemented project. 5. Demonstrate the learning experiences of working in a team.	Object Oriented Programming –I/ Python programming-II

Laboratory Plan **FMTH0303-3.0**

Semester: VI *Year:* **2018-2019**

Laboratory Title: **DBMS Lab**	Lab. Code: : 15EARC307
Total Hours: **24**	Duration of ESA Hours: 3
ESA Marks: **20**	ISA Marks: **80**

<u>Experiment wise Plan</u>

List of experiments/jobs planned to meet the requirements of the course.

Category: Demonstration		**Total Weightage: 20**		**No. of lab sessions: 4**
Expt./ Job No.	**Experiment / Job Details**	**No. of Lab Session(s) per batch (estimate)**	**Marks / Experiment**	**Correlation of Experiment with the theory**
1	Preparing an ER diagram for given database	2	10	
	Learning Objectives: The students should be able to 1. Demonstrate how structure of a database can beexpressed graphically by an ER diagram. 2. Demonstrate how torepresent attributes,relationships among entity sets, link attribute to entity sets and entity sets to relationships			
2	Execute basic SQL queries on a given database. (DDL, DML, DCL commands)	2	10	
	Learning Objectives: The students should be able to: 1. Demonstrate how to use DDL, DML and DCL commands on a database. 2. Demonstrate how to specify different types of constraints on a table while creating a table.			
Category: Exercise		**Total Weightage: 40**		**No. of lab sessions: 4**
Expt./ Job No.	**Experiment / Job Details**	**No. of Lab Session(s) per batch (estimate)**	**Marks / Experiment**	**Correlation of Experiment with the theory**
3	Execute nested, correlated queries using exist, like,	1	10	

	union, intersection and joins on a given database.			
	Learning Objectives: The students should be able to: 1. Write SQL queries to retrieve the required data, using correlated queries, nested queries, joins, and using keywords exist, like, union and intersection. 2. Demonstrate how to join two tables using different types of joins and use keywords exist, like, union, and intersection to retrieve data.			
4	Execute SQL queries on - group by, having clauses and aggregate functions on a given database to retrieve the required data.	1	10	
	Learning Objectives: The students should be able to: 1. Write SQL queries using group by, having clauses and aggregate functions to retrieve the required data.			
5	Specifying views in SQL	1	10	
	Learning Objectives: The students should be able to 1. Write SQL queries to create & update Views			
6	Design a database for the given schema using normalization concept and execution of given queries on the database and execution of queries.	1	10	
	Learning Objectives: The students should be able to: 1. Design the database for the given schema using normalization concepts and use the given RDBMS software and implement the database.			
Category: Structured Enquiry		**Total Weightage: 20**		**No. of lab sessions: 2**
Expt./	**Experiment / Job Details**	**No. of Lab**	**Marks /**	**Correlation of Experiment**

Job No.		Session(s) per batch (estimate)	Experiment	with the theory
7	Design a database for the given specifications & implement the database and write and execute the queries for the given statements.	2	20	
	Learning Objectives: The students should be able to: 1. Draw the ER diagram for a given specifications. 2. Design a database based on the specifications given and create tables by specifying different types of constraints on database and write SQL queries for given statements and execute them. 3. Select the proper RDBMS software to implement the database.			
Category: Open Ended		**Total Weightage: 20**		**No. of lab sessions: 2**
Expt./ Job No.	**Experiment / Job Details**	**No. of Lab Session(s) per batch (estimate)**	**Marks / Experiment**	**Correlation of Experiment with the theory**
8	Implement a project using Java/database management systems concepts, for automation and robotics applications. (FOR SEE)	2	20	
	Learning Objectives: The students should be able to: 1. Use the java /database management concepts to implement the project. 2. Select the appropriate tool/software to implement the project. 3. Write a technical report using IEEE standard. 4. Present the technical report for the implemented project. 5. Demonstrate the learning experiences of working in a team.			

Course Content

Course Code: 15EARE301	Course Title: Power Electronics, Motors & Drives	
L-T-P: 3-0-0	Credits: 3	Contact Hrs: 40
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 40		Exam Duration: 3 hrs

Content	Hrs
Unit - 1	
Chapter No. 1.Elements and Dynamics of Electric Drive Systems Basic components of an Electric drive system: Mechanical loads, electric motors, power sources, converters and controllers. Moment of inertia , basic concept of Traveling time, gears and belts, traveling time of dc motors and traveling time of induction motors.(Book-1,3)	3 hrs
Chapter No. 2.Power electronic devices Ratings of power electronic devices, Characteristics of : power diodes, power transistors, power mosfets, triac and IGBT. Thyristors (SCR): static VI characteristics, turn on methods, switching characteristics, gate characteristics, two transistor model, di/dt and dv/dt protection. Firing circuits for SCRs. .(Book-2,5)	6 hrs
Chapter No. 3.Solid state switching circuits Single- phase , half-wave, ac/dc conversion for resistive loads, Single- phase , full-wave, ac/dc conversion for resistive loads, Single- phase , half-wave, ac/dc conversion for inductive loads without/with freewheeling diode, single phase dc/ac converter, voltage, frequency and sequence control and PWM,. Current source Inverter. .(Book-2,5)	6 hrs
Unit - 2	
Chapter No. 4. Power Amplifiers Definitions and amplifier types, series fed class A amplifier, Transformer coupled Class A amplifiers, Class B amplifier operations, Class B amplifier circuits, Amplifier distortions. Designing Power amplifiers: Heat flow calculations using analogous circuit. Calculation of actual power handling capacity of transistors with and without heat sink. Heat sink design.(Book-4)	6 hrs
Chapter No. 5.Speed –torque characteristics &Speed Control of Electric motors Joint Speed-Torque Characteristics of Electric Motors and Mechanical Loads, DC motors: separately excited motors, shunt motors, series motors and compound motors, Speed control of shunt or separately excited DC motors: by adding resistance, adjusting armature voltage, adjusting field voltage and solid-state control, Speed control of DC series motor: by adding resistance to armature circuit, adjusting armature voltage, and by adjusting field current, **Induction motors:** equivalent circuit, power flow, torque characteristics, starting procedure ,Damage to electric machines. speed control of induction motors: by rotor resistance, by slip energy recovery method, by adjusting the stator voltage, adjusting the supply frequency, voltage/frequency (V/F) control. .(Book-1,3)	9hrs
Unit - 3	

Chapter No. 6.Braking of electric motors DC shunt and series motors: Regenerative, dynamic, and concurrent braking. Induction motors: Regenerative , dynamic and concurrent braking. (Book-1,3)	5 hrs
Chapter No. 7.Drives for industrial Applications Rolling mill drives, cement mill drives, electric traction drives, textile mill drives drives and machine tool drives. .(Book-1,3)	5 hrs

Course Content

Course Code: 15EARE302	Course Title: **Computer vision & digital image processing**	
L-T-P-SS: 3-0-0-0	Credits: 3	Contact Hrs: 40
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 40		Exam Duration: 3 hrs

Content	**Hrs**
Unit - 1	
CHAPTER 1: FUNDAMENTALS OF COMPUTER VISION &DIGITAL IMAGE PROCESSING Introduction to –computer vision system, Geometric Camera Models**-** Pinhole Perspective, Cameras with Lenses, the Human Eye, Intrinsic and Extrinsic Parameters, Geometric Camera Calibration. Digital image processing system, application of computer vision & digital image processing. Design of machine vision system.	6 hrs
CHAPTER 2:LIGHT & SHADING, COLOR Modeling Pixel Brightness, Reflection at Surfaces, Sources and Their Effects, the Lambertian+SpecularModel, Inference from Shading, Radiometric Calibration and High Dynamic Range Images, the Shape of specularities, Inferring Lightness and Illumination, Color- Human Color Perception, The Physics of color,representing Color, Inference from Color Finding specularities Using Color Shadow removal, usingColor Constancy: Surface Color from Image Color. .	6hrs
CHAPTER 3: IMAGE FORMATION &PROCESSING Image Acquisition – Sampling and Quantization- Pixel Relationships, image enhancement Spatial Domain Gray level Transformations Histogram Processing Spatial Filtering – Smoothing and Sharpening, Introduction to the Fourier Transform and the Frequency Domain, DFT, FFT.	5 hrs
Unit - 2	
CHAPTER 4:IMAGE SEGMENTATION AND FEATURE ANALYSIS Detection of Discontinuities – Edge Operators – Edge Linking and Boundary Detection – Thresholding – Region Based Segmentation, A Model of the Image Degradation/Restoration Process, Noise Models, Restoration in the Presence of Noise Only–Spatial Filtering, Periodic Noise Reduction by Frequency Domain Filtering.	6hrs
CHAPTER 5: COLOR IMAGE PROCESSING & IMAGE COMPRESSION	6hrs

Color Fundamentals, Color Models, Pseudo color Image Processing, Basics of Full-Color Image Processing Color Transformations, Smoothing and Sharpening, Color Segmentation, Noise in Color Images Color Image Compression, Image Compression-Fundamentals, Image Compression Models, Elements of Information Theory, Error-Free Compression, Lossy Compression	
Unit - 3	
CHAPTER 6: MORPHOLOGICAL PROCESSING Dilation and Erosion, Opening and Closing, The Hit-or-Miss Transformation, Some Basic Morphological Algorithms.	6hrs
CHAPTER 7: RECOGNITION &BAYESIAN MODELING Object detection, Face recognition. Instance recognition, Category recognition, Context and scene understanding, Recognition databases and test sets, Prior models and Bayesian inference. Gradient descent and simulated annealing, Graph cuts, Markov random fields	5 hrs

Course Content

Course Code: **15EARE303**	Course Title: **Computer-Integrated Manufacturing**	
L-T-P : **3-0-0**	Credits: 3	Contact Hrs: 40 hours
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 40 hours		Exam Duration: 3 Hrs

Unit –I

1. Geometric Modelling and Computer-Aided Design, CAD Data Exchange and CAD Standards • Introduction to Geometric Modelling • Geometric Modelling Approaches: Wire-Frame Modelling, Surface Modelling, Solid Modelling • Computer-Aided Design, CAD System Architecture • Computer Hardware for CAD • CAD Kernels • Data Interoperability: Different Types of Data Translation/Conversion, Dual Kernel CAD Systems, Direct Data Translators, Common/Neutral Translators	05 hours
2. Group Technology and Flexible manufacturing system • Group Technology: Part Families, Part Classification and Coding, Production flow analysis, Machine Cell Design, Benefits of Group Technology • Flexible Manufacturing Technology: Introduction, FMS workstations, Material Handling and storage Systems, Computer Controls Systems, Planning the FMS, Analysis Methods for FMS	05 hours
3. Computer-Aided Process Planning and Manufacturing • Computer-Aided Process Planning: Basic Steps in Developing a Process Plan, Principal Process Planning Approaches • Computer-Aided Manufacturing: Computer Applications in a Manufacturing Plant , Key Aspects of CAM in a Manufacturing System , Manufacturing Control	05 hours
Unit –II	

4. Integration of CAD/CAPP/CAM/CNC , Integration Based on STEP Standards, Function Block-Enabled Integration
• Models of Integrating CAD/CAPP/CAM/CNC
• A Case Study of Integrating CAD/CAPP/CAM: Concurrent Product Modelling in a CAD/CAM System, A Bird's-Eye View of the Case Study, CAD/CAM Enabling a Concurrent Environment, Reflections
• Limited Efforts to Integrate CAM and CNC, Post-Processor: A Source of Vexation, Challenges, The APT Effort, The BCL Effort , The BNCL Effort, Intermediate Languages for CNC Programming
• Data Exchange Using STEP and STEP-NC
  o Data Exchange between CAD Systems
  o Data Flow between CAD, CAPP, CAM and CNC Systems
	05 Hours

○ Features as a Common Thread ○ Integration through STEP AP Harmonization ○ Integrate CAD with CAPP ○ Integrate CAPP with CAM ○ Integrate CAM with CNC ○ STEP-NC Data Model ○ Data Access Implementation Methods	
5. Integrating CAD/CAPP/CAM/CNC with Inspections • Closed-Loop Machining and On-Machine Inspection • Past Research • A Data Model for OMI • An Integrated Machining and Inspection System • Implementation	05 Hours
6. Internet-Based Integration • A Collaborative Framework • System Model ○ Client Tier: User Interface ○ Business Logic Tier: CAPP Server ○ Data Tier: Data Model • Framework Development ○ Client Tier Implementation ○ Business Logic Tier Implementation ○ Data Tier Implementation	05 Hours
Unit –III	
7. From CAD/CAPP/CAM/CNC to PDM, PLM and Beyond • PDM’s Capabilities • Benefits of PDM Systems • Web-Based PDM • PDM Standardization • Integrated and Extended PDM • Product Lifecycle Management • Looking Forward to “Grand” Integration	05 Hours
8. Key Enabling Technologies • Knowledge-Based Systems • Artificial Neural Network Methods • Genetic Algorithm • Agent-Based Technology • Other Technologies	05 Hours

Laboratory Plan **FMTH0303-3.3**

Semester: VI *Year: 2018*

Laboratory Title: Robotics Lab	Lab. Code: 15EARP301
Total Hours: 28	Duration of Exam: 3
Total ESA Marks: 20	Total ISA Marks: 80

Experiment wise plan

1. ***List of experiments/jobs planned to meet the requirements of the course.***

Category: Demonstration Total Weightage: 10 No. of lab sessions: 4

Learning Outcomes :

The students should be able to:

1. *Demonstrate the knowledge about the basic principles and laws of robot.*
2. *Demonstrate the knowledge about the basic principle of operation, coordinates and parts of robot.*
3. *Demonstrate the knowledge about Mat lab and Robot studio software based tools.*

Expt./Job No.	***Experiment/job Details***	***No. of Lab. Session/s per batch (estimate)***	***Marks/ Experiment***	***Correlation of Experiment with the theory***	***CLO***	***PI Code***
1	Demonstration on working with Mat Lab software.	*1*	*10*	Chapter 1-3	1	4.1.1
2	Demonstration of operations of ABB Robot and Robot Studio Software.	*1*	*10*	Chapter 1-3	1	4.1.1
3	Demonstration of controlling the robot using Flex pendant.	*1*	*10*	Chapter 1-3	2	5.1.1
4	Demonstration on working with ROS. **Description:** This tutorial introduces ROS filesystem concepts, and covers using the roscd, rosls, and	*1*	*10*	Chapter 1-3	2	5.1.1

	rospackcommandline tools.					
Category: Exercises	***Total Weightage: 20 No. of lab sessions: 4***					
Learning Outcomes: *The students should be able to:* 1. *Demonstrate the robot programming methods.* 2. *Demonstrate the operation of robot using robot controller.* 3. *Simulate the robot using Mat lab and Robot studio software.*						
Expt./Job No.	***Experiment/job Details***	***No. of Lab. Session/s per batch (estimate)***	***Marks/ Experiment***	***Correlation of Experiment with the theory***	***CLO***	***PI Code***
5	Create dynamic simulation of a simple robot with flexible transmission using the toolbox with Mat lab Simulink.	*1*	*20*	Chapter 3-5	2	5.1.1
6	Obtain the kinematic equation of the 3 DOF articulated arm with three revolute joints and simulate the same using ABB robot.	*1*	*20*	Chapter 7, 8	2	5.1.1
7	Obtain the position & orientation of the tool point P with respect to the base for the 2 DOF, RP planar manipulator using ABB robot studio software. Example: Path Tracing, Collision Detection.	*1*	*20*	Chapter 2-8	3	5.1.1
8	Creating a ROS Package. **Description:** This exercise covers using roscreate-pkg or catkin to create a new package, and rospack to list package dependencies.	*1*	*20*	Chapter 2-8	3	5.1.1

Category: Structured Enquiry		*Total Weightage: 20No. of lab sessions: 4*				
Learning Outcomes : *The students should be able to:* 1. *Demonstrate the knowledge of solid modeling software tools.* 2. *Demonstrate the knowledge of industrial applications of robot.* 3. *Demonstrate the knowledge about the mapping of sensors and end effectors with the robot.*						
Expt./Job No.	***Experiment/job Details***	***No. of Lab. Session /s per batch (estimate)***	***Marks/ Experiment***	***Correlation of Experiment with the theory***	***CLO***	***PI Code***
9	Design an end effector for a particular application using Robot Studio and Solid work software.	*2*	*20*	Chapter 1-8	4 and 6	4.2.1
10	Writing a Simple Publisher and Subscriber (Python). i. Writing the Publisher Node ii. Writing the Subscriber Node iii. Building your nodes	*2*	*20*	Chapter 1-8	3	4.2.1

Category: Open Ended		*Total Weightage: 20*		*No. of lab session: 2*		
Learning Outcomes : *The students should be able to:* 1. *Demonstrate the knowledge about the commands used in simulating the robot.* 2. *Demonstrate the knowledge about work stations and conveyors.*						
Expt./Job No.	***Experiment/job Details***	***No. of Lab. Slots per batch (estimate)***	***Marks/ Experiment***	***Correlation of Experiment with the theory***	***CLO***	***PI Code***

12	Design a complete process for welding, assembly, drilling, gluing or sorting using Robot Studio and DELMIA software.	*2*	*20*	Chapter 1-8	5	4.2.1 10.1.1 12.1.1

Laboratory Plan

Laboratory Course Plan: B E in A&R 2015-2019

Laboratory Title: **Hydraulics And Pneumatics Lab**	Lab. Code: **15EARP302**
Total Hours: **24**	Duration of SEE Hours: 2
ESA Marks: **20**	ISA Marks: **80**

Experiment wise Plan

List of experiments/jobs planned to meet the requirements of the course.

Category: Demonstration		**Total Weightage: 25.00**		**No. of lab sessions: 5.00**
Expt./ Job No.	**Experiment / Job Details**	**No. of Lab Session(s) per batch (estimate)**	**Marks / Experiment**	**Correlation of Experiment with the theory**
1	To study hydraulic pump, its characteristics and calculate the hydraulic power	1.00	4.00	
	Learning Objectives: The students should be able to: 1. Differentiate between types of pumps. 2. Plot and infer characteristic curve of the Pump.			Unit - I
2	**A.** To study concepts of Meter-in and Meter-out circuits using Single-rod cylinder and 4/2 DCV **B.** Automation Studio Exercises	1.00	6.00	
	Learning Objectives: The students should be able to: 1. Identify hydraulic cylinders and various direction control valves. 2. Explain meter-in and meter-out circuits used to control the speed of a single acting cylinder using meter in/out throttle.			Unit II

3	To study pressure intensification of a single rod cylinder.	1.00	4.00	
	Learning Objectives: The students should be able to: 1. Demonstrate how the speed of a cylinder is controlled using 4/2 directional valve. 2. Demonstrate the pressure intensification of the single-rod cylinder.			Unit - II
4	Study of Hydraulic Motor with 4/3 DCV	1.00	5.00	
	Learning Objectives: The students should be able to: 1. Discuss the operating features of a hydraulic motor. 2. Explain how a 4/3 directional valves can be used to implement clockwise and counter-clockwise running of the hydraulic motor.			Unit – I
5	**A.** Study of indirect control of a double-acting cylinder with a pneumatically operated 5/2 directional control valve. **B.** Automation Studio Exercises	1.00	6.00	
	Learning Objectives: The students should be able to: 1. Demonstrate how a 5/2 DCV can be used control a double acting cylinder.			Unit - II
Category: Exercise		**Total Weightage: 20.00**		**No. of lab sessions: 4.00**
Expt./ Job No.	**Experiment / Job Details**	**No. of Lab Session(s) per batch (estimate)**	**Marks / Experiment**	**Correlation of Experiment with the theory**
6	To study position dependent control of a double acting cylinder using mechanical limit switches.	1.00	5.00	
	Learning Objectives: The students should be able to:			Unit - II

	1. Identify switches and push buttons and use them to build the circuits.			
7	To study the application of different center configuration of 4/3 DCV. (Tandem and closed centre)	1.00	5.00	
	Learning Objectives: The students should be able to: 1. Demonstrate how a hydraulic cylinder is controlled by a 4/3 directional valve with different spool shapes (blocked and circulation position).			Unit - I
8	Study of Speed Control of Single Acting Cylinder - Slow Speed Extension and Rapid Retraction.	1.00	5.00	
	Learning Objectives: The students should be able to: 1. Explain how the speed of a single acting cylinder is controlled using a quick-exhaust valve.			Unit I and II
9	Stop control, double-acting cylinder with 5/3 directional control valve, tensile load	1.00	5.00	
	Learning Objectives: The students should be able to: 1. Explain the use of a 5/3 directional control valve with closed mid-position for stopping a double-acting cylinder.			Unit - II
Category: Structured Enquiry		**Total Weightage: 20.00**		**No. of lab sessions: 3.00**
Expt./ Job No.	**Experiment / Job Details**	**No. of Lab Session(s) per batch (estimate)**	**Marks / Experiment**	**Correlation of Experiment with the theory**
10	To study the application of Regenerative Circuit	1.00	8.00	
	Learning Objectives: The students should be able to: 1. Understand and record the table of the travel times 2. Calculate the velocity of the piston.			Unit - II

11	By using a 3/2 directional control valve with adjustable minimum pressure of response, a pressure-dependent (and in addition displacement) control of a double acting cylinder is put into effect.	1.00	6.00	
	Learning Objectives: The students should be able to: 1. Use double acting cylinder, appropriate DCVs, flow control valves and push buttons and construct the circuit diagram for the given application.			Unit - II
12	The sequential control with two pneumatic drives. The signal overlapping occurring during this exercise is constructively solved by use of rollers with idle return. Practice is obtained in developing sequential diagrams and pneumatic circuit diagrams.	1.00	6.00	
	Learning Objectives: The students should be able to: 1. Use double acting cylinders, appropriate DCVs, flow control valves and push buttons and construct the circuit diagram for sequential control of two pneumatic drives.			Unit - II
Category: Open Ended		**Total Weightage: 10.00**		**No. of lab sessions: 2.00**
Expt./ Job No.	**Experiment / Job Details**	**No. of Lab Session(s) per batch (estimate)**	**Marks / Experiment**	**Correlation of Experiment with the theory**
13	A double-acting cylinder is used to press together glued components. Upon pressing a push-button, the clamping cylinder is to extend and trip the roller valve. Once the fully extended position of the cylinder has been reached and sufficient	2.00	10.00	

	clamping force has been developed, the cylinder is to retract to the initial position. Develop a control circuit using a pressure sequence valve.			
	Learning Objectives: The students should be able to: 1. Construct a control circuit using a pressure sequence valve for a given application.			Unit - I, II and III

Laboratory Plan **FMTH0303-3.0**

Semester: **VII** *Year:* ***2017***

Laboratory Title: **Real Time Embedded Systems Lab**	*Lab. Code*: 15EARP305
Total Hours: **28**	*Duration of ESA Exam*: **3hrs**
Total ESA Marks: 2**0**	*Total ISA. Marks*: **80**

LIST OF EXERCISES & ISA COMPUTATION

Sl. No	**EXPERIMENTS**	**MAX MARKS**
1	Demo on Energia IDE and TM4c1294NCPDT, TIVA C series microcontroller board & Solving problems on Data Acquisition for Bio Medical / Process control/Industrial control application	**10**
2	Demo on Code Composer Studio(CCS) and TIVA C series TM4C1294NCPDT microcontroller board and problem solving on ADC,TIMERS,INTERRUPTS	**10**
3	Demo on LABVIEW on multitasking to implement Semaphores, Queue Demo on Introduction to Keiluvision 4 problem solving	**10**
4	Demo on Raspberry Pi Programming and peripheral programming	**05**
5	Exercises on basic RTOS program , RTX Kernel using peripherals like RTC, TIMERS , UART, SEMAPHORES	**10**
6	Exercises on implementing scheduling algorithms like Preemptive /Round Robin / Interrupts/ and Multitasking operations in RTX Kernel of Keiluvision 4.	**10**
7	Structured Query : Implementing Communication Protocols like I2C / SPI / UART /CAN / ETHERNET with Energia /CCS & TM4C1294 TIVA board	**10**
8	Synopsis for ESA Project	**10**
9	Attendance & Timely Submission of document	**05**
	TOTAL ISA MARKS	**80**

ESA	Design using state machine architecture or Unified Modeling Language and implement solution for a real world problem using IOT technology for applications related Smart Home, Energy Management, Smart Grid, Smart Agriculture ,Wearable Device, Smart Health Care, Connected Car, Smart Machine involving Inter-process communication, Resource sharing and an effective scheduling technique satisfying real time constraints.	**20**
	TOTAL MARKS	**100**

Semester: VI Year: 2015-16(Even)

Course Title: Professional Aptitude and Logical Reasoning	Course Code:HSC301
Total Contact Hours: 40	Duration of SEE: 90 mins
SEE Marks: 50	CIE Marks: 50

Unit –I - Arithmetical Reasoning and Analytical Thinking

Chapter 1. – ArithmeticalReasoning	**10hrs**
Chapter 2. – AnalyticalThinking	**4hrs**
Chapter 3. – SyllogisticLogic	**3hrs**

Unit – II – Verbal and Non – Verbal Logic

Chapter 1. – Verbal Logic	**9hrs**
Chapter 2. – Non-Verbal Logic	**6hrs**

Unit – III - Lateral Thinking

Chapter 1. - Lateral Thinking	**8hrs**

Text Book

1. A Modern Approach to Verbal and Non – Verbal Reasoning – R. S. Aggarwal, Sultan Chand and Sons, New Delhi

2. Quantitative Aptitude – R. S. Aggarwal, Sultan Chand and Sons, New Delhi

References:

1. Verbal and Non – Verbal Reasoning – Dr. Ravi Chopra, MacMillan India

2. Lateral Thinking – Dr. Edward De Bono, Penguin Books, New Delhi

Semester: VI *Year: 2017-18*

Laboratory Title: **Minor project**	*Lab. Code*: **15EARW302**
Total Hours: **30**	*Duration of Exam*: **3 Hrs**
Total ESA Marks: 5**0**	*Total ISA. Marks*: **50**

Design Process

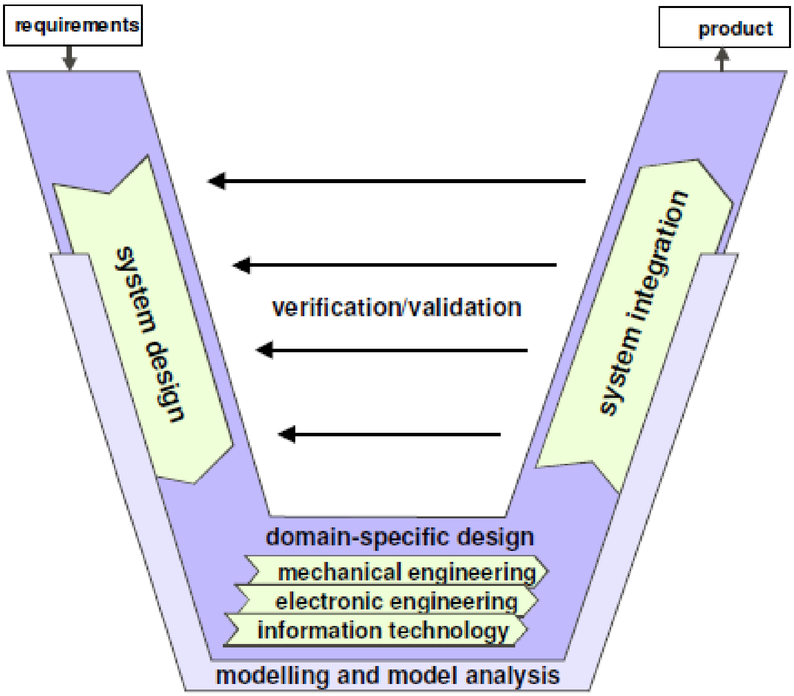
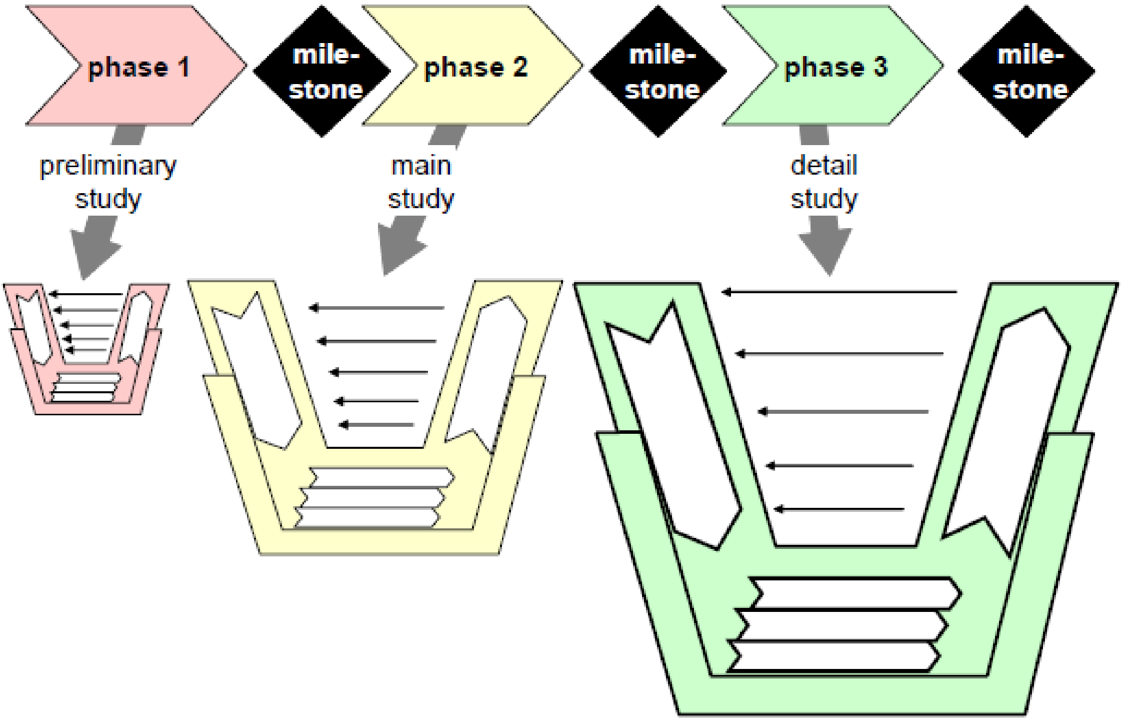


Figure 2. V-shaped model on the macro-level



Combination of V-model and project plan

Experiment wise plan

1. *List of activities planned to meet the requirements of the syllabus (Demonstration only)*

Week No	***Activities***	***Deliverables***	***ISA Marks out of 50***
1&2	*Engineering Design*	*Problem statement, Project plan*	*10*
3&4	*Mechatronics System Design*	*Component designs & Integration*	*10*
5,6,7&8	*Fabrication*	*Prototype*	*20*
9&10	*Testing, Validation an Improvements*	*Test reports and Recommendations*	*10*

Course Content

Course Code: 15EARC401	Course Title: Industrial Data Networks	
L-T-P: 4-0-0	Credits: 4	Contact Hrs: 50
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 50		Duration of ESA: 3 hrs

Content	Hrs
Unit I	
Chapter No. 1. DATA NETWORK FUNDAMENTALS AND INDUSTRIAL ETHERNET Modern Instrumentation and Control Systems, Open Systems Interconnection (OSI) Model, EIA-232, EIA-485, Fiber Optics Overview, Local Area Networks (LANs), Metropolitan Area Networks (MANs), Wide Area Networks (WANs), Circuit Switching and Packet Switching, Network Topologies, Ethernet, Ethernet Topology, 10 Mbps Ethernet, 1 Gigabit Ethernet, Internetwork Connections Devices (Repeaters, Bridges, Hubs, Switches, Routers and Gateways)	8
Chapter No. 2. TCP/IP IP Version 4 (IPv4), IP Version 6 (IPv6), Address Resolution Protocol (ARP), Internet Control Message Protocol (ICMP), IP Routing, Transmission Control Protocol (TCP), User Datagram Protocol (UDP)	7
Chapter No. 3. MODBUS MODBUS: Protocol Structure, Function Codes	5
Unit II	
Chapter No. 4. FIELDBUS, PROFIBUS AND AS-INTERFACE FIELDBUS: Physical Layer, Data Link Layer and Application Layer of FOUNDATION Fieldbus PROFIBUS: PROFIBUS DP (Decentralized Periphery), PROFIBUS DP Communication Protocol, Application Profiles, PROFIBUS PA (Process Automation) AS-Interface: AS-Interface, Physical Layer, Data Link and Application Layer of the AS-Interface	7
Chapter No. 5. ETHERCAT, ETHERNET POWERLINK AND SERCOS III ETHERCAT: Architecture Model, Protocol, Topology, Distributed Clocks, Device Profiles, EtherCAT Master, EtherCAT Slave Ethernet POWERLINK: Slot Communication Network Management, Physical Layer, Data Link Layer, Transport and Application Layer ofEthernet POWERLINK, Ethernet POWERLINK Addressing, Frame Structures SERCOS III: OSI Layers of SERCOS III, Communication Cycle, Protocol Structure, Topology, Communication Network Infrastructure	8

Chapter No. 6. HART, BLUETOOTH AND OPC HART: HART Protocol, Physical Layer, Data Link Layer and Application Layer of HART. BLUETOOTH: Protocol Stack, Topologies, Generic Data Transport Architecture, Basic Rate/Enhanced Data Rate (BR/EDR) Radio Operation, Low Energy (LE) Operation, Operational Procedures and Modes, Profiles OPC: Enterprise Integration, Manufacturing Execution Systems (MES), Process Analysis, Process Modeling, Data Modeling, Data Flow Diagrams (DFDs), Communication Patterns, Data Collection Technologies, OPC (OLE for Process Control)	5
Unit III	
Chapter No. 7. CAN, CAN FD AND DEVICENET CAN: Physical Layer, Data Link Layer and Application Layer of CAN, Protocol, Bus Arbitration, Frames, Bit Stuffing, Bit Synchronization, Bit Timing CAN FD: Physical Layer, Data Link Layer and Application Layer of CAN FD, Protocol, Frames DEVICENET: Physical Layer, Data Link Layer, Network and Transport Layers, and Application Layer of DeviceNet	5
Chapter No. 8. FLEXRAY AND MOST FLEXRAY: Topologies, Protocol, Media Access Control (Communication Cycle), Frame Format, Clock Synchronization MOST: OSI Layers for MOST, Data Frame, Timing Master, Timing Slave, MOST Devices	5

Course Content

Course Code: 15EARE401	Course Title: MeasurementSystems	
L-T-P: 3-0-0	Credits: 3	Contact Hrs: 40 hours
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 40		Duration of ESA: 3 Hrs

Content	Hrs
Unit – 1	
Chapter No. 1. Introduction to Measurement Systems Need for study of Measurement Systems, Classification of Types of Measurement Applications, Computer-Aided Machines and Processes, Functional Elements of an Instrument , Active and Passive Transducers , Analog And Digital Modes of Operation , Null and Deflection Methods , Input-Output Configuration of Instruments and Measurement Systems, Static Characteristics and Static Calibration, Dynamic Characteristics and Problems.	7hrs
Chapter No. 2. Motion Measurement Fundamental Standards , Relative Displacement: Translation and Rotational, Relative Velocity: Translation and Rotational, Relative-Acceleration Measurements, Seismic-Displacement Pickups, Seismic-Velocity Pickups, Seismic-Acceleration Pickups,Calibration and Vibration Pickups, Jerk Pickups, Problems.	4hrs
Chapter No. 3. Force, Torque, and Shaft Power Measurement Standards and Calibration, Basic Methods of Force Measurement, Characteristics of Elastic Force Transducers, Torque measurement on Rotating shaft, Shaft Power Measurement (Dynamometers), Vibrating Wire Force Transducers, Problems.	4hrs
Unit – 2	
Chapter No. 4. Pressure & Sound Measurement Standards and Calibration, Basic Methods of Pressure Measurement, Deadweight Gages and Manometers, Elastic Transducers, Vibrating-Cylinder and Other Resonant Transducers, Dynamic Testing of Pressure-Measuring Systems, High-Pressure Measurement, Low-Pressure Measurement, Sound Measurement, Problems.	7hrs
Chapter No. 5. Flow and Temperature Measurement Local Flow Velocity, Magnitude and Direction, Gross Volume Flow Rate, Standards and Calibration of Temperature Measurement, Thermal-Expansion methods, Thermoelectric Sensors, Electrical-Resistance Sensors, Junction Semiconductor Sensors, Digital Thermometers, Radiation Methods, Problems.	5hrs
Chapter No. 6.Manipulation, Transmission, and Recording of Data Bridge Circuits, Amplifiers , Filters, Integration and Differentiation, Problems	3hrs

Unit – 3	
Chapter No. 7. Data Transmission and Instrument Connectivity Cable Transmission of Analog Voltage and Current Signals, Cable Transmission ofDigital Data, Fiber-Optic Data Transmission, Radio Telemetry, Pneumatic Transmission, Synchro Position Repeater Systems, Slip Rings and Rotary Transformers, Instrument Connectivity, Data Storage with Delayed Playback, Problems.	5 hrs
Chapter No. 8. Voltage-Indicating and Recording Devices Standards and Calibration, Analog Voltmeters and Potentiometers, Electrical Instruments, Digital Voltmeters and Multimeters, Signal Generation, Electromechanical XT and XY Recorders, Thermal-Array Recorders and Data Acquisition Systems, Analog and Digital Cathod-Ray Oscilloscopes/Displays and Liquid-Crystal Flat-Panel Displays, Displays, Virtual Instruments, Magnetic Tape and Disk Recorders/Reproducers, Fiber Optic Sensors.	5 hrs

Course Content

Course Code: 15EARE402	Course Title: **Advanced Microcontrollers**	
L-T-P : 3-0-0	Credits: **3**	Contact Hrs:**40**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **40**		Duration of ESA: **3hours**

Content	**Hrs**
Unit - 1	
1.0. **Introduction to ARM and ARM Architecture:** Background, ARM cortex series portfolio, ARM program model, Instruction Set Development, The Thumb-2 Technology and Instruction SetArchitectural features, R profile, M profile and A Profile, ARM Cortex-M3 Processor :Peripheral Interfacing, Exceptions and Interrupts, Cortex-M3 Programming, Low power modes, Hardware Features, Debug Support, Application development with Cortex M3/M4 controllers using standard peripheral libraries .	7
2.0 Controllers in embedded system design: Low power architectures, High performance capabilities, Microcontroller power saving strategies, Tradeoff between High Performance and low power capabilities for embedded systems. Power/Energy Profiling of Microcontroller/ Embedded systems, Applications	8
Unit - 2	
3.0 MSP430 series Microcontroller devices: Unique architectural features, block diagram, Low power DNA, Addressing modes, Instruction set, Power down modes ,MSP430 Interrupts and Low Power, Digital Input-Output, On chip peripherals, Timers**:** Block diagram, Timer Modes, Timer Interrupts, Low Power Down Modes, Watchdog Timer	8
4.0 MSP430 Peripherals: Analog to Digital Convertors (ADC), Performance measures, Signal to Noise Ratio, ADC Architectural Block diagram, Timing and Triggering options, Low power and Interrupt operation. Digital to Analog Convertors: Architectural Block Diagram and Operation, Comparator Architecture and Operation, Special Function Registers, Hardware Multiplier: Operation, Registers, Direct Memory Access Controller (DMA and DMA Transfer Modes, Applications.	7
Unit - 3	
5.0 Power/ Energy profiling: Profiling of ARM Cortex & MSP430 family devices, Low-power operation Dynamic Voltage and Frequency Scaling ,CPU power modes , Optimizing for low power in embedded MCU designs: MCU power consumption, standby power, peripheral power, battery life.	5
6.0 Case studies: ARM cortexM3/M4 & MSP430 microcontroller based real-time solutions for application like biomedical system design, machine health monitoring, Energy metering applications etc.	5

Course Content

Course Code: 15EARE403	Course Title: Machine Learning	
L-T-P:**3- 0- 0**	Credits:3	Contact Hrs: 40
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Total Teaching Hrs.: 40		Duration of ESA: 3 hrs

UNIT-I

No	Content	Hrs
1	**Chapter 1**: **Introduction** Machine Learning Applications, Learning Associations, Designing of learning system, perspectives & issues in machine learning, Concept learning task, concept learning search, Find-S: Finding a maximally specific hypotheses, version spaces & candidate elimination algorithm, Remarks - version spaces & candidate elimination algorithm, inductive bias.	5 hrs
2	**Chapter 2**: **Decision Tree learning** Representation, decision tree algorithm, hypotheses space search in decision tree algorithm inductive bias in decision tree algorithm, issues in DTL,Bayesian decision theory classification.	5hrs
3.	**Chapter 3: Computational Learning theory** Motivation, Estimating hypotheses accuracy, Basics of sampling theory, general approach for deriving confidence intervals, difference in error of two hypotheses, comparing learning algorithm. Probably learning an approximately correct hypothesis, sample complexity for finite hypnosis spaces, sample complexity for infinite hypothesis spaces, instance based learning-K nearest neighbor learning, locally weighted regression	5 hrs
	UNIT-II	
4.	**Chapter 4: Artificial neural network** Feed forward neural networks, Learning neural network ,the expressive power of neural network, the sample complexity of neural networks, the runtime of learning neural networks,SGD and back-propogation.	5hrs
5	**Chapter 5: Clustering** Linkage–Based clustering algorithms-means and other cost minimization clusterings,spectral clustering, high level view of clustering	5 hrs

6	**Chapter 6:Kernel methods & Graphical models** Embeddings into feature spaces,the kernel trick, Multiple kernel learning, Kernel dimensionality reduction,Implementating soft SVM with kernels, Canonical Cases for Conditional Independence, Example Graphical Models, Naive Bayes' Classifier, Hidden Markov Model, Linear Regression, d-Separation Belief Propagation	5hrs
	UNIT-III	
7	**Chapter 7:Reinforcement Learning** The learning task,Q-learning,Nondeterministic rewards & actions, temporal difference learning, generalizing from examples, relationship to dynamic programming**.**	5 hrs
8	**Chapter 8:Design and Analysis of Machine Learning Experiments** Factors, Response, and Strategy of Experimentation, Response Surface Design, Randomization, Guidelines for Machine Learning Experiments, Cross-Validation and Re sampling Methods, Measuring Classifier Performance, Interval Estimation, Hypothesis Testing, Assessing a Classification Algorithm's Performance, Comparing Two Classification Algorithms, Comparison over Multiple Datasets.	5hrs

Course Content

Course Code: **15EARE404**	Course Title: **Design of Automatic Machinery**	
L-T-P-SS:3-0-0-0	Credits: 3	Contact Hrs: 40
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 40		Exam Duration: 3 Hrs

UNIT – I

No	Content	Hrs
1	**Chapter 1:** **Introduction and Steps to Automation** What is Automation, AnAutomation design process, examples of automation, problems and project assignments? **Justifying Automation** Traditional Project Cost Justification for a Purchase, Traditional Costing Estimating for Building and Selling Automation, Win–Win Purchasing Philosophy, Maximum Profit Cost Estimating for Building and Selling Automation, Justifying Flexible Automation over Hard Automation Intellectual Property, Patents, and Trade Secrets.	6
2	**Chapter 2:** **The Automation Design Process** System Specifications, Brainstorming, Machine Classification by Function, Machine Classification by Transfer Method, Machine Configuration Trade-offs Mechanisms Toolbox, TBBL Automation Project and Conclusions, Case Study Number 1: Case Opening, Case Study Number 2: Label Insertion and Printing, Case Study Number 3: Crossed Four-Bar BMC Unloader.	4
3	***Chapter 3:*** **Workstations** Workstation Basics, Drive Mechanisms, Case Study Number 1: TBBL Workstation Design, Case Study Number 2: Automated Screwdriver Workstation Design, Machine Design and Safety.	5

	Feeders Feeders, Automatic Feeding and Orienting — Vibratory Feeders, Escapement Feeders, Vibratory Bowl Feeder, Centripetal Feeder, Flexible Feeders, Gravity Feed Tracks, Powered Feed Tracks, Escapements, Parts-Placing Mechanisms, Assembly Robots, Case Study Number 1: Dropping Cookies, Case Study Number 2: Feeding of TBBL Cases.	
	UNIT – II	
4	**Chapter 4: Conveyors** Flat Belt Conveyors, Tabletop Chain Conveyor, Belt Conveyors, Static (Gravity) Conveyors, Powered Conveyors, Heavy Unit Load Handling Conveyors, Case Study Number 3: Donut Loader Machine.	3
5	**Chapter 5:** **Single Station Manufacturing Cells** **Single station manned cells, single station automated cells, applications of single station cells, analysis of single station systems.** **Manual Assembly Lines** **Fundamentals of manual assembly lines, Analysis of single model assembly lines, Line balancing algorithms, Mixed model assembly lines, Workstation considerations, Other considerations in assembly line design, Alternative assembly systems.** **Automated Product Lines** **Fundamentals of automated product lines, applications of automated product lines, Analysis of transfer lines.**	6
6	**Chapter 6:** **Automated Assembly Systems** **Fundamentals of automated assembly systems, Quantitative analysis of assembly systems.** **Cellular Manufacturing** **Part families, part classification and coding, product flow analysis, cellular manufacturing, applications of group technology, quantitative analysis in cellular manufacturing.** **Flexible Manufacturing Systems**	6

	Introduction to flexible manufacturing system, flexible manufacturing systems components, flexible manufacturing systems applications and benefits, flexible manufacturing system planning and implementation issues, quantitative analysis of flexible manufacturing systems.	
	UNIT - III	
7	**Chapter 7: System Specifications** Expectations, Other Problems Beyond Specifications, Example 1: Bulk Mail Carrier (BMC) Unloader, Specifications, Design Specifications, Comments, Request for Quote, Example 2: BMC Unloader Bid Award Package.	5
8	**Chapter 8: Packaging Machines** Liquid Filling Machines, Cartoning and Boxes, Labeling, Cases, Palletizing, FormingPouche, Blister Packs and Bags.	5

TEXT BOOKS:

1. Stephen J. Derby., "Design of Automatic Machinery", 2005
2. Patrick M. McGuire, P.E., "Conveyors", CRC Press, 2010.

REFERENCE:

3. Geoffrey Boothroyd., "Assembly Automation and Product Design", Taylor & Francis Group, CRC Press, 2005.

CourseContent

Course Code:15EARO401	CourseTitle:HomeandBuildingAutomation	
L-T-P:3-0-0	Credits:3	ContactHrs:40
ISAMarks:50	ESAMarks:50	TotalMarks:100
TeachingHrs:50		ExamDuration:3hrs

Content	**Hrs**
Unit- 1	
CHAPTERNO.1.INTRODUCTIONConceptandapplicationofBuildingManagementSystem(BMS)andAutomation,requirementsanddesignconsiderationsanditseffectonfunctional efficiencyofbuildingautomation system,architectureandcomponentsofBMS.	5hrs
CHAPTERNO.2.FIREALARMSYSTEMFUNDAMENTALS: What is Fire? Fire modes, History, Components, and Principles of Operation. FAS Components:Different fire sensors, smoke detectors and their types, Fire control panels, design considerations forthe FA system. Field Components, Panel Components, Applications. FAS Architectures: Types ofArchitectures,Examples.FASloops:Classificationofloops,Examples.FireStandards:FASDesignprocedureinbrief,NFPA72A,BS5839,ISConceptofIPenabledfire&alarmsystem,designaspects andcomponents ofPAsystem	5hrs
CHAPTER NO. 3. ACCESS CONTROL SYSTEM: Access Components, Access control systemDesign. CCTV: Camera: Operation & types, Camera Selection Criteria, Camera Applications, DVRBasedsystem,DVM,Networkdesign,Storagedesign.ComponentsofCCTVsystemlikecameras, typesoflenses,typicaltypesofcables,controllingsystem.CCTVApplications:CCTVApplications.	5hrs
Unit-2	
CHAPTER NO. 4. SECURITY SYSTEMS FUNDAMENTALS: Introduction to Security Systems,Concepts.PerimeterIntrusion:Concept,Components,Technology,AdvancedApplications.SecurityDesign: Security system design for verticals. Concept of automation in access control system forsafety,Physicalsecuritysystemwithcomponents,RFIDenabledaccesscontrolwithcomponents, Computersystemaccesscontrol–DAC,MAC,RBAC.	5hrs
CHAPTERNO.5.LIGHTING-CONTROLSYSTEMS Purposeoflighting-controlsystems,Basiccomponentsoflightingandlighting-controlsystems,Systemsbasedonstandardlighting-controlprotocols,Systemsbasedoncommonautomation protocols,Strategiesforenergymanagementandlightingcontrol	5hrs
CHAPTERNO.6.Processcontrol,PIDandadaptivecontrolw.r.t automationsystem Closedcontrolloops,Proportionalcontrol,Integralcontrol,Derivativecontrol,Proportional,integraland derivative functions, Tuning of PID control loops, Digital PID and direct digital control (DDC),Introductionto adaptive control	5hrs

Unit-3	
CHAPTERNO.7.BUILDINGMANAGEMENTSYSTEM:IBMS(HVAC,Fire&Security)project cycle,ProjectstepsBMS.Verticals:Advantages&ApplicationsofBMS,ExamplesIntegration:IBMSArchitecture, Normal&Emergencyoperation.Advantages ofBMS	5hrs
CHAPTERNO.8.PRACTICALAUTOMATIONSYSTEM:DesignconsiderationofAutomationsystem,RapsberryPi, PLC, IoTbased systems.	5hrs

Laboratory Plan **FMTH0303-3.3**

Semester: VIII Year: 2018-19

Laboratory Title: **Project**	Lab Code: 17EARW401
Total Hours: **30**	Duration of Exam:**3 Hrs**
Total ESA Marks: 5**0**	Total ISA. Marks: **50**
Lab. Plan Author: Rakesh Tapaskar	Date: 29**/12/2018**
Checked By: Arun C Giriyapur	Date: 29**/12/2018**

Prerequisites:

Subjects learnt up to VI semester.

Course Outcomes-CO

At the end of the course student will be able to:

1. Carry out market survey, do need analysis and identify suitable problems.
2. Write a project proposal which will involve developing a complete solution for the identified problem from the real world.
3. Apply the principles of engineering design to plan and manage the project.
4. Apply suitable design processes and develop the best possible solution.
5. Develop proof of concepts and models for verification.
6. Prepare production drawings, bill of materials and process plans.

Course Articulation Matrix: Mapping of Course Outcomes (CO) with Program outcomes (PO)

Laboratory (Course) Title:**Project** Laboratory (Course) code: 15EARW401Semester:VIII Year:2018-19

Course Outcomes (CO) / Program Outcomes (PO)	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
1. Carry out market survey, do need analysis and identify suitable problems.														
2. Write a project proposal which will involve developing a complete solution for the identified problem from the real world.														
3. Apply the principles of engineering design to plan and manage the project.														
4. Apply suitable design processes and develop the best possible solution.														
5. Develop proof of concepts and models for verification.														
6. Prepare production drawings, bill of materials and process plans.														

Degree of compliance **L**: Low **M**: Medium **H**: High

Design Process

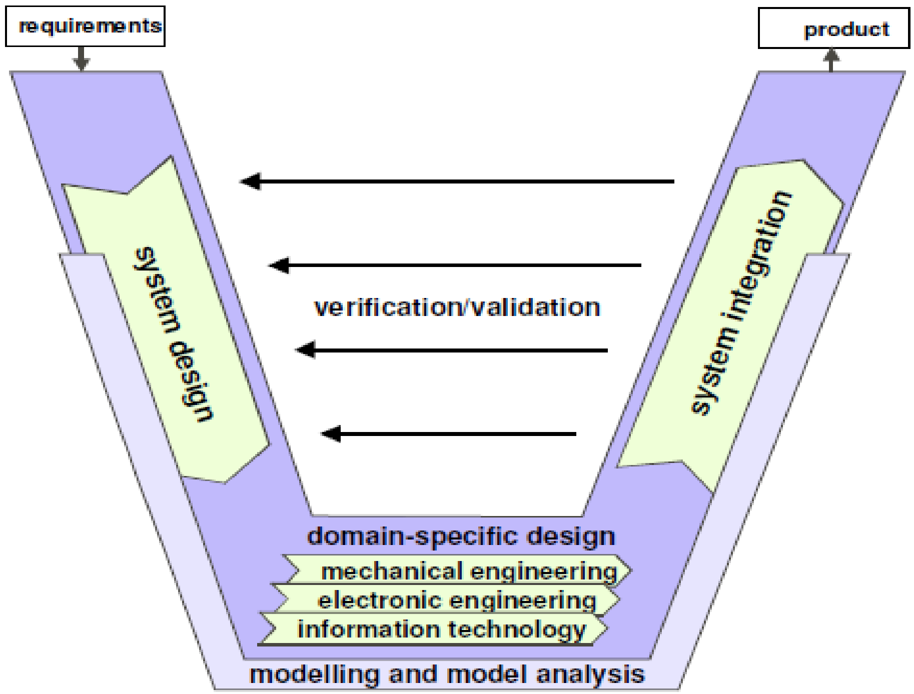
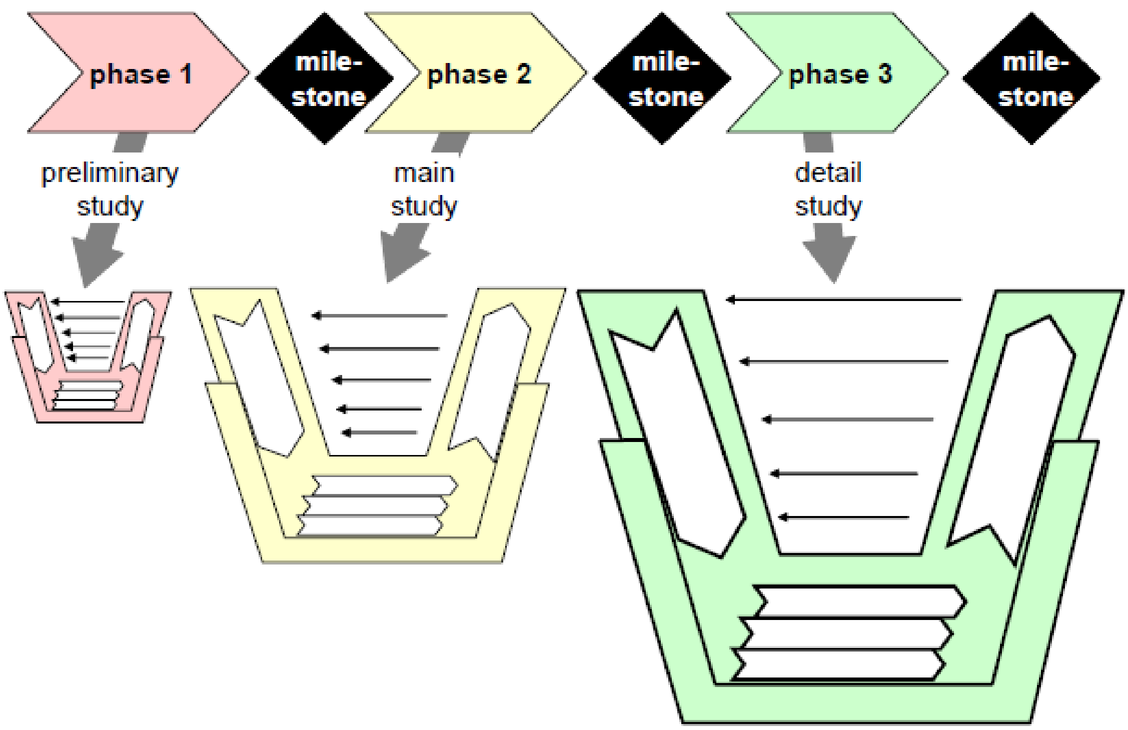


Figure 2. V-shaped model on the macro-level



Combination of V-model and project plan

Experiment wise plan

2. *List of activities planned to meet the requirements of the syllabus*

Week No	***Activities***	***Deliverables***	***CIE Marks out of 50***
1&2	*Need analysis, Problem identification and market survey*	*Project proposal*	*10*
3&4	*Project management*	*Project plan, gantt chart, WBS, Budget*	*10*
5,6,7&8	*Engineering design*	*Component designs & Integration, Proof of concept, modeling and simulation (hardware and software)*	*20*
9&10	*Detailed design*	*Bill of materials, production drawings*	*10*

Laboratory Plan

Semester: VIII Year: 2019-20

Course Title: Internship - Training	Course Code: 18EARI493
Total Contact hrs: 50	Duration of ESA: 3 hrs
ISA Marks: 50	ESA Marks: 50

Prerequisites:

-

Course Outcomes (COs):

Upon completion of an internship, students will be able to demonstrate the following outcomes:

1. Gain knowledge to real-world challenges in an industry environment.
2. Engage in responsible conduct while working as an intern and allow decisions to be informed by a value-centered life.
3. Understanding an organization by proper insight into their structure, processes and functions.
4. Able to assimilate new technical knowledge, and integrate the same with the existing technical knowledge for industrial application.
5. Understanding of lifelong learning processes through critical reflection of internship experiences.
6. Enhance his/her verbal and written communication, and different modes of communication.

Laboratory Plan **FMTH0303-3.1**

Semester: VIII Year: 2019-20

Laboratory Title: Internship - Project	Lab. Code: 18EARW494
Total Hours: 80	Duration of Exam: 3 hrs
Total ESA Marks: 80	Total ISA. Marks: 20

Preamble:

The aim of this project work is to enable students to develop their engineering skills and practice by co-working with industry mentors on an industry relevant problem.

Course Outcomes (COs)

At the end of the course, students will be able to:

1. Generate and evaluate different alternative solutions
2. Formulate a detailed solution plan to solve the given problem.
3. Identify and employ tools that help to arrive at solutions
4. Understand and adhere to various standards, legislation and regulations
5. Distribute the work load based on competences among team members and integrate the various components of the solution
6. Adhere to promised deliverable, including bill of material, production drawings, manufacturing of components, assembly, and so forth.

Course Content

Course Code: **16EARE403**	Course Title: **Machine learning and ROS**	
L-T-P: 3-0-0	Credits: 3	Contact Hrs: 40
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 40		Exam Duration : 3 hours

Content	Hours
UNIT – 1	
Chapter 1:Introduction to Robot operating system ROS concepts, creating ROS packages writing a minimal ROS publisher, compiling ROS nodes, running ROS nodes, examining running minimal publisher node, scheduling node timing, writing a minimal ROS subscribercompiling and running minimal subscriber, minimal subscriber and publisher node summary writing ROS nodes more ROS tools: catkin simple, ROSlaunch, simplifying cmakelists.txt with catkin simple automating starting multiple nodes viewing output in a ROS console recording and playing back data with ROSbag.	5 hrs
Chapter 2:Messages, Classes and Servers in ROS Defining custom messages, ROS services- service messages, ROS service nodes, manual interaction with ROS services, example ROS service client, running, example service and client, using C++ classes in ROS creating library modules in ROS, introduction to action servers and action clients- creating an action server package, defining custom action-server messages, designing an action client running the example code, introduction to parameter server.	5 hrs
Chapter 3: **Introduction to machine learning** Introduction Machine Learning ,Well posed learning problem, Types of learning, supervised learning ,unsupervised learning and reinforcement learning, Learning Associations, Designing of learning system, perspectives & issues in machine learning, Concept learning task, concept learning search, Find-S: Finding a maximally specific hypotheses, version spaces & candidate elimination algorithm, Remarks - version spaces & candidate elimination algorithm, inductive bias.	5 hrs
UNIT – 2	
Chapter 4: Computational learning theory and decision tree learning Motivation, Estimating hypotheses accuracy, Basics of sampling theory, general approach for deriving confidence intervals, comparing learning algorithm. Probably learning an approximately correct hypothesis, sample complexity for finite hypnosis spaces, sample complexity for infinite hypothesis spaces, instance based learning-K nearest neighbor	8hrs

learning, locally weighted regression, Representation, decision tree algorithm, hypotheses space search in decision tree algorithm inductive bias in decision tree algorithm, issues in DTL,Bayesian decision theory classification.	
Chapter 5:Kernel methods and Graphical models Embedding's into feature spaces, the kernel trick, Multiple kernel learning, Kernel dimensionality reduction Canonical Cases for Conditional Independence, Example Graphical Models, Naive Bayes' Classifier, Hidden Markov Model, Linear Regression, d-Separation Belief Propagation, Linkage–Based clustering algorithms-means and other cost minimization clustering.	7hrs
UNIT – 3	
Chapter 6:Reinforcement Learning The learning task,Q-learning,Nondeterministic rewards & actions, temporal difference learning, generalizing from examples, relationship to dynamic programming.	5 hrs
Chapter 7: Artificial neural network Biological motivation, neural network representations, and appropriate problems for neural network learning, perceptron's, multilayer networks and the back propagation, algorithm, an illustrative example: face recognition	5hrs

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Leveraging Knowledge

DEPARTMENT OF AUTOMATION & ROBOTICS

Course Content

CourseCode:17EARE301	Course Title: **Artificial Intelligence For Autonomous Systems**	
L-T-P:3-0-0	Credits:3	ContactHrs:40
ISAMarks:50	ESAMarks:50	TotalMarks: 100
TeachingHrs:40		ExamDuration:3hours

Content	Hours
UNIT–1	
Chapter1:**IntroductiontoArtificialintelligenceand autonomoussystems**Foundationofartificialintelligence,roboticsandtheAIapproach,Semi-autonomouscontrol,SevenareasofAI**,**TheConceptofRationalityTheNatureofEnvironments, TheStructure of Agents,Problem-SolvingAgents,Searching forSolutions, UninformedSearchStrategies,InformedSearchStrategies,KnowledgerepresentationinAI,knowledge	5hrs
Chapter2:Roboticsoftwarearchitectures Subsumptionarchitecture,Three-layerarchitecture, Pipelinearchitecture,HierarchicalParadigm-AttributesoftheHierarchicalParadigm,ReactiveParadigm-AttributesofReactiveParadigm,HybridDeliberative/ReactiveParadigm-AttributesofHybridParadigm,ArchitecturalAspects,ManagerialArchitectures-AutonomousRobotArchitecture(AuRA),SensorFusionEffects(SFX),State-HierarchyArchitectures,Model-	5hrs.
Chapter3:BiologicalFoundationsoftheReactiveParadigm Agencyandcomputationaltheory,AnimalBehaviors,Reflexivebehaviors ,CoordinationandControlofBehaviors,Innatereleasingmechanisms,Concurrentbehaviors,PerceptioninBehaviors,Action-perceptioncycle,TwofunctionsofperceptionGibson:Ecologicalapproach,Neisser:Twoperceptualsystems,SchemaTheory,Behaviorsandschematheory,PrinciplesandIssuesinTransferringInsightstoRobo	5hrs
UNIT–2	
Chapter4:Capturingintelligence-Designingareactiveimplementationwithcommonsensingtechniquesforroboticsperception Behaviors asObjects inOOP,Steps inDesigningaReactiveBehavioralSystem,CaseStudy:UnmannedGroundRoboticsCompetition,AssemblagesofBehaviors,Logicalsensors,BehavioralSensorFusion,DesigningaSensorSuite,ProprioceptiveSensors,ProximitySensors,ComputerVision,RangefromVision,CaseStudy:Horsd'Oeuvres,Anyone?	8hrs
Chapter5: Multi-agentsandnavigation inrobotics Heterogeneity,Control,Cooperation,EmergentSocialBehavior,TopologicalPathPlanning,RelationalMethods,AssociativeMethods,CaseStudyofTopologicalNavigationwithaHybridArchitecture	7hrs

UNIT–3	
Chapter6:LocalizationandMapMaking SonarSensorModel,Bayesian,Conditionalprobabilities,Conditionalprobabilities,UpdatingwithBayes'rule,Dempster-ShaferTheory,ShaferbelieffunctionsBelieffunctionforsonarDempster'sruleofcombinationWeightofconflictmetric,HIMMsonarmodelandComparisonofMethods,Examplecomputations,PerformanceErrorsduetoobservationsfromstationaryrobot,Tuning,Localization,Continuouslocalizationandmapping,Feature-basedlocalizationExploration,Frontier-basedexploration,GeneralizedVoronoigraphmethods **.**	6hrs
Chapter7: Deeplearningandnaturallanguageprocessing DeepLearningImprovementoftheDeepNeuralNetworkVanishingGradientOverfittingComputationalLoad.Languagemodels, textclassification,informationretrieval	4hrs

1.1.3. Average percentage of courses having focus on employability/ entrepreneurship/ skill development during the last five years.

Year of offering: 2016-17
Batch- 2015-19 (3rd semester)

Program: Biotechnology		
Course Title: Microbiology		**Course Code: 15EBTC201**
L-T-P: 4-0-0	**Credits: 4.0**	**Contact Hours: 04 Hours/Week**
CIE Marks: 50	**SEE Marks: 50**	**Total Marks: 100**
Teaching Hours: 50	**Examination Duration: 03 Hours**	

Unit I

1. Introduction

The scope of Microbiology, Historical Foundations, Taxonomy and classification of microorganisms, prokaryotic and eukaryotic cells, Eubacteria and Archaebacteria, study of different types of microorganisms: bacteria, yeasts, viruses, fungi, protozoa (structure, classification, modes of reproduction & growth). Role of microbes in agriculture, public health and industry, common diseases caused by microorganisms.

05 Hours

2. Functional anatomy of Prokaryotic and Eukaryotic cells:

Size, shape and arrangement of bacterial cells, structures external to cell wall, cell wall and structures internal to cell wall including endospores. Structure and functions of eukaryotic cell. Genome structure in prokaryotic and Eukaryotic cells, Genotype & Phenotype, Genetic transfer and recombination (Transformation, Conjugation & Transduction), Genes and evolution.

07 Hours

3. Microscopic Examination

Bright-field Microscopy, Dark-field Microscopy, Phase-contrast Microscopy, Fluorescence Microscopy and Electron Microscopy. Preparation of specimen for light and electron microscopy, Advances in scanned probe microscopy. **04 Hours**

4. Microbial Growth

The requirements for growth, Culture media, Effect of different factors on growth, Growth of bacterial culture: bacterial division, generation time, phases of growth. Measurement of growth: Direct and Indirect methods. **04 Hours**

Unit II

5. Microbial Techniques

Pure culture techniques (streak plate, spread plate, pour plate), Staining techniques (simple and differential staining techniques), Enumeration techniques (Direct Microscopic Count, plating techniques, membrane filtration, Electronic enumeration, etc). Characterization: Biochemical tests and 16S rRNA homology studies. **10 Hours**

6. Microbial Metabolism

Catabolic and Anabolic reactions, Enzymes, Energy production, Carbohydrate catabolism: Glycolysis, Alternatives to Glycolysis, Cellular respiration, Lipid and Protein catabolism, Photosynthesis: Light dependent and light independent reactions. Metabolic diversity among microorganisms: autotrophs and heterotrophs. Metabolic pathways of energy use: Polysaccharide biosynthesis, lipid biosynthesis, amino acid and protein biosynthesis. The integration of metabolism.

Energy production: Principles of bioenergetics, Respiratory chain, Energy production by aerobic process, Energy production by anaerobic process, Energy production by photosynthesis, Mechanism of ATP synthesis. Utilization of Energy and Biosynthesis: Utilization of energy for biosynthetic and non-biosynthetic processes.

Bacterial genetics: Bacterial recombination (Transformation, Conjugation & Transduction)**.** Genome structure in prokaryotic and Eukaryotic cells. Population Genetics and Pedigree Analysis.

10 Hours

Unit III

7. Control & Preservation of Microorganisms

Control of microorganisms by physical methods (heat, filtration, radiation). Control of microorganisms by chemical methods (phenols, alcohols, halogens, dyes, detergents, heavy metals, etc), Common preservation techniques for microbes. **05 Hours**

8. Applied and Industrial Microbiology

Food Microbiology, role of microorganisms in food production, Industrial Microbiology: Introduction to Fermenter & fermentation processes, Media for industrial application, Industrial Products: amino acids, vitamins, enzymes, pharmaceuticals, organic acids (discussion of case study), r-DNA technology & therapeutic products from microbes. Biosynthetic pathways and Introduction to Metabolic Engineering.

Industrial Microbiology:Introduction to Fermenter & fermentation processes, Media for industrial application. Production of amino acids, antibiotics, organic acids & vitamins from microorganisms, Microbes as sources of proteins, enzymes from microbes. r-DNA technology & therapeutic products from microbes. **05 Hours**

Text Books:

1 Chan & Pelzar, Microbiology, Publisher: Tata McGraw Hill 5th Edition 2008.

2 Tortora, Microbiology: An Introduction, Publisher: Pearson Education, 8th Edition, 2004

Reference Books:

1. Stanier Ingraham & Wheeler, General Microbiology, Pub: Mac Millan 5th edition. 2007.

2. Heritage, Introductory Microbiology Pub: Cambridge, 1st edition, 2007

Program: Biotechnology		
Course Title: Biochemistry		Course Code: 15EBTC202
L-T-P: 4-0-0	Credits: 4.0	Contact Hours: 04 Hours/Week
CIE Marks: 50	SEE Marks: 50	Total Marks: 100
Teaching Hours: 50	Examination Duration: 03 Hours	

Unit I

1. Biochemical Foundation & Biomolecules

Chemical Bonding- Ionic bond, covalent bond, Hydrogen bond, Van der waals forces, hydrophobic interactions, coordinate bond with examples. Nomenclature of organic compounds with examples. Stereochemistry of carbon compounds. Types of chemical reactions, Solution chemistry. Biochemical calculations, The pH scale, measurement of pH, pH meter, pKa values Buffers and their properties, biological buffer systems. **04 Hours**

2. Lipids

Definition and classification of lipid – simple, compound and derived lipids. Structure, classification and properties of fatty acids , Essential and non-essential fatty acid with physiological importance. Structure and physiogical functions of phospholipids, Sphingolipids, cerebrosides and gangliosides. Steroids- Structure and functions of cholesterol and its derivatives. Eicosanoids, lipoproteins and terpenes. Vitamins-classifications and functions.

05 Hours

3. Amino acids and Proteins

Definition, Classification and properties of amino acids, reactions, rare amino acids, essential and nonessential amino acids with physiogical importance. Peptides - Definition of peptide bond, Structure and function of Peptides and biological significance. Proteins - Classification, physico-chemical properties, structure- primary, secondary, tertiary and quaternary proteins, Secondary structures: Alpha hélix, Beta sheets, coils and turns, Helix to coil transition & zipper model., Fibrous proteins, structure of collagen. Ramachandran plot. Methodology related to isolation, purification and characterization of proteins, polypeptide sequencing- Edman degradation, Chemical synthesis of Peptides.

07 Hours

4. Nucleic acids

Structure and properties of purines, pyrimidines, nucleosides and nucleotides. Nucleic acids- Structure of DNA, RNA -Types, structure and properties, prokaryotic versus eukaryotic organisms. Genetic code. **04 Hours**

Unit II

4. Carbohydrates

Classification, basic chemical structure and properties of monosaccharides, Disaccharides, Sugar derivatives, deoxy sugars, amino sugars, and sugar acids, phosphorylated sugars, structure and properties of polysaccharides, Homopolysaccharides, Heteropolysaccharides - Peptidoglycan, Glycosaminoglycans, Glycoconjugates, Glycobiology . Biological importance of carbohydrates.

06 Hours

5. Carbohydrate metabolsim:

Glycolysis, Glycolysis in aerobic and in anaerobic conditions. Energy yield of glycolysis, phosphorylation at the substrate level. Regulation of glycolysis- metabolic and hormonal. Fates of pyruvate.Glycogen - structure, synthesis and degradation. Regulation of glycogen metabolism. Gluconeogenesis, Pentose phosphate pathway. Significane of pentose phosphate pathway and regulation.Production of Acetyl-CoA, Reactions of Citric acid cycle, Anaplerotic reactions, regulation of citric acid cycle. Glyoxylate cycle.Structure of Mitochondria, Electon carriers, Electon transport chain, ATP synthesis, energetics of electon transfer, shuttle systems and regulation of Oxidative phosphorylation. Disorders of carbohydrate metabolism. Production of microbial polysaccharides; industrial application of exopolysaccharides; Medical applications of exopolysaccharides. **14 Hours**

Unit III

6. Photosynthesis and Phytochemistry

Photo pigments, Photo systems I & II, Cyclic and Non-cyclic Photophosphorylation. Calvin Cycle (C_3), and balance sheet, C_4 pathway. Bacterial photosynthesis. Exploitation of nature for product development and applications, Medicinal plants, plants secondary metabolites and endophytes.

05 Hours

8. Biological Membranes And Transport Mechanism

Composition and functions of biological membranes – Proteins, Carbohydrates, Glycoproteins and glycolipids. Models of Plasma membrane, Membrane transport - Passive transport, Osmosis and Active transport. Cytoskeleton – Microtubules, Microtubular organelles. Endomembrane systems – Endoplasmic reticulum, Golgi complex and Protein secretion Ion permeability and membrane potential, Cell signaling – devices, autocrine, paracrine and endocrine models, receptors –hormones, enzymes, ion channel, G-protein coupled receptors.

05 Hours

Text Books:

1. David L. Nelson, Michael M. Cox.Lehninger principles of biochemistry.McMillan –worth, third edition, 2003.
2. Lubert Stryer, Jeremy.M.Berg and John L Tymoczko, Biochemistry fifth edition,Freeman and Company.2002.

Reference Books:

1. Voet D. & Voet J, Biochemistry. John wielly and sons. 2nd edition2002.
2. G.Zubay, Biochemistry, Welsey Publ.1983.
3. Laurence A. Moran, Raymond S. Ochs, J. David Rawn, and K. Gray Scrimgeour. Principles of biochemistry. Third edition,Prentice Hall.2002.

Course Title: Bioprocess Calculations		Course Code: 15EBTF201
L-T-P: 4-0-0	Credits: 4	Contact Hours: 04 Hours/Week
CIE Marks: 50	SEE Marks: 50	Total Marks: 100
Teaching Hours: 50	Examination Duration: 03 Hours	

Unit I

1.Units and dimensions

Introduction to Fundamental and derived Units. FPS, MKS, CGS and SI system. Conversion from one system to another system with examples. **04 Hours**.

2.Basics of chemical calculation

Introduction, concept of mole, Atomic mass and molar mass, composition of mixtures of solids, liquids and gaseous. Ideal gas law, Amagats law and Dalton's law. Varification of Vol %=Mol %. Physical properties of solution, normality, morality and molality. Solving problems for normality, morality and molality. **08 Hours**

3.Material balances without chemical reaction

General material balance equation, simplification for steady state without chemical reaction. Material balances of unsteady-state operation. Problems on mixing of streams, Distillation, Drying, Absorption, evaporation, Filtration, Extraction & Crystallization. **08 Hours**

Unit II

4.Material balances with chemical reaction

Introduction, Concept of limiting, excess reactant and inerts. Conversion, yield and selectivity. Fuels and combustion-Definition of ultimate and proximate analysis of coal, air fuel ratio calculation. Problems. **10 Hours**

5.Energy Balance

General steady state energy balance Equation.Thermopysics-Enthalpy, Heat capacities of solids, liquids and gases. Heat capacities of mixture, Thermo chemistry-Heat of combustion, formation and reaction. Effect of temperature on heat of reaction. Definition and significances of NCV and GCV and problems. **10 Hours**

Unit III

6a .Stoichiometry of microbial growth and product formation kinetics

Introduction and definition of various yield coefficients. Elemental balances and Degree of reduction. Problems. **05Hours**

6b .Stoichiometry of microbial growth and product formation kinetics

Introduction and Basic cell kinetic models, Strutured,unstructured and mixed growth kinetic models **05 Hours**

Text Books:

1. B.I Bhatt and S.M.Vora, Stoichiometry,Tata McGraw Hill publications,4th edn,2007.
2. David Himmelblau, Basic principles and calculation in chemical engineering, Pearson Education Limited,6th edn,2005

Reference Books:

1) Hougen, Watson and Rigatz, Chemical Process principles Pati-I , CBS Publishers & Distributors,2nd edn,2004.
2) J E Bailey and D F Ollis, Biochemical engineering Fundamentals, Mc Grew Hill Publication, 2nd edn,1986.

Program: Biotechnology		
Course Title: Heat and Mass Transfer		Course Code: 15EBTF202
L-T-P: 3-0-0	Credits: 3.0	Contact Hours: 03 Hours/Week
CIE Marks: 50	SEE Marks: 50	Total Marks: 100
Teaching Hours: 40	Examination Duration: 03 Hours	

Unit I

1. Basics of mass transfer

Introduction to Mass Transfer, Classification of mass transfer operations, Diffusion, Fick's law of diffusion, Vapour Liquid Equilibrium (Txy & xy plots),Raoult's law, Relative volatility and its importance. Prediction of VLE data for binary mixture (Ideal system).

05 Hours

2. Distillation

Types of distillation: simple distillation, flash vaporization, Multi stage tray tower distillation, Packed tower distillation & steam distillation.

Determination of theoretical stages in multistage tray tower distillation column: Construction of equilibrium curve, Equations for operating lines of rectifying section & stripping section, Equation for feed line(q-line).Concept of Reflux ratio, Types of Refluxes: Total reflux, Minimum reflux & Optimum reflux. Conceptual numerical Problems on determination of number of theoretical stages.

10 Hours

Unit II

3. Drying

Importance of Drying, Terminologies and definitions, Drying rate curves under constant drying conditions, Drying Equipments: Tray dryer, Freeze dryer, spray dryer etc. **04 Hours**

4. Extraction

Introduction, Liquid-Liquid & Solid-Liquid Extraction Principles, selection of solvents. Phase Diagrams, Extraction equipments: Fixed bed, moving bed leaching, mixer and settler Extractor.

04 Hours

5. Adsorption: Concept of Adsorption, Types of Adsorption, Adsorption Isotherms, Applications of Adsorption. **02 Hours**

6. Heat transfer: Introduction, Modes of heat transfer: conduction, convection and radiation. Conduction: Fourior's law of heat conduction, Thermal conductivity. Steady state heat conduction through unilayer and multilayer plain wall, Unilayer & multilayer Cylindrical pipe. Conceptual problems. **05 Hours**

Unit III

7. Convective heat transfer & Heat transfer equipments:

Forced and natural convection, individual and overall heat transfer coefficient, Correlation for h and U for the flow in circular tubes and annulus. Concept of Log Mean Temperature Difference

(LMTD). Typical heat transfer equipments: Double pipe heat exchanger, Shell and tube heat exchanger. (Line diagram and operation). **05 Hours**

8. Condensation & Boiling:

Condensation: Drop wise & Film wise condensation. Boiling: Phenomenon, different regimes of Boiling (descriptive only). Insulation, Critical thickness of Insulation. **05 Hours**

Text Books:

1. McCabe W. L. and Smith J. C, Unit operations of chemical engineering, Pub: McGraw-Hill, 7th edition, 2005.
2. C. J. Geankoplis, Transport Processes and unit operations, Prentice Hall of India, 4th edition, 2004

Reference Books:

1. George Granger Brown, Unit Operations, Pub: CBS Publishers &Distributors,1st Edition, 2004.
2. Alan S Foust, Principles of Unit operations, Pub: John Wiley & Sons, 2nd edition, 1980

Program: Biotechnology		
Course Title: Microbiology Lab		**Course Code: 15EBTP201**
L-T-P: 0-0-1	**Credits:1.0**	**Contact Hours: 2Hrs/week**
CIE Marks: 80	**SEE Marks: 20**	**Total Marks: 100**
Teaching Hours: 24	**Examination Duration: 03 Hours**	

List of Experiments:

1. Laboratory safety precautions, cleaning & storage practices, culture disposal practices.
2. Study of Laboratory equipments: Microscope, Autoclave, Laminar Air Flow Bench, Hot Air Oven, Bacteriological Incubator and Freeze Drier. SOP and Calibration.
3. Media preparation: Nutrient broth/Agar, Mac-Conkey's medium and Potato-Dextrose broth/Agar.
4. Pure culture techniques: Streak plate Method, Spread plate Method, Pour plate Method.
5. Enumeration techniques: Plate Count Method, Direct Microscopic Count.
6. Simple and Differential Staining Techniques (Gram staining technique).
7. Hanging drop technique for motility and Endospore staining.
8. Study of bacterial growth curve.
9. Sterilization by Filtration.
10. Antibiotic susceptibility testing for bacteria.
11. Identification of Unknown fungi.
12. Open ended-experiment.

Note: There shall be ONE Open-Ended Experiment
Text Books/Reference Books: 1. Microbiology: A Lab Manual Seventh Edition by Cappuccino J G and Sherman N 2012 Pearson education Inc, 2012 (ISBN 978-81-317-1437-9). 2. Lab Ref by Jaine Roskams IK International, 2004.

Program: **Biotechnology**		
Course Title: Biochemistry Lab		**Course Code: 15EBTP202**
L-T-P: 0-0-1	**Credits:1.0**	**Contact Hours: 02 Hours/week**
CIE Marks: 80	**SEE Marks: 20**	**Total Marks:100**
Teaching Hours: 24	**Examination Duration: 03 Hours**	

List of Experiments

1. Biochemical Measurements: Molarity, Normality, Molality, Moles, weight/volume measurements, percent solution, concentration Units. pH measurements and Buffer preparation, SOP's, Instrument calibrations.
2. Qualitative analysis of carbohydrates and Lipids
3. Qualitative analysis of amino acids and proteins.
4. Estimation of Reducing sugar by Folin – Wu method.
5. Estimation of Reducing sugar by Nelson –Somogyi/DNS method.
6. Estimation of Amino acids by ninhydrin method.
7. Estimation of Proteins by Lowry's method.
8. Estimation of Inorganic Phosphate by Fiske-Subbarao method.
9. Estimation of Urea by DAMO method
10. Estimation of DNA by Diphenylamine method.
11. Estimation of RNA by Orcinol method.

Text Books/ Reference Books:

1. David Plummer An introduction to Practical biochemistry.Third edition,McGraw-Hill,1987.
2. Sadasivam S and Manickam A.,Biochemical methods.Second edition,New Age International,2005.

Year of offering: 2016-17
Batch- 2015-19 (4th semester)

Program: Biotechnology		
Course Title: Immunology		Course Code: 15EBTC203
L-T-P: 3-0-0	Credits: 03	Contact Hours: 03 Hours/Week
CIE Marks: 50	SEE Marks: 50	Total Marks: 100
Teaching Hours: 40	Examination Duration: 03 Hours	

Unit I

1. Immune system

History and Scope of Immunology and Immune system, Classification of Immune system, Types of Immune responses, Molecules ,Cells and Organs of Immune system and Anatomy of immune response

06 Hours

2. Humoral Immunity

Overview of Humoral immunity, B- Lymphocytes – Development and their activation, Antibody response, Structure and functions of Immunoglobulins, Classes and sub-classes of immunoglobulins, genetic control of antibody production, Monoclonal and Polyclonal antibodies, Production of Monoclonal antibodies and quality screening processes in large scale monoclonal antibody production

05 Hours

3. Cell Mediated Immunity

Overview of cell mediated immunity and its significance, T-Lymphocytes – Development, Types and their activation, Major Histocompatibility (MHC) Complex, Antigen Presenting Cells (APC) and antigen processing and presentation, Mechanism of Phagocytosis- Oxygen dependent and Oxygen independent

04 Hours

Unit II

4. Regulation of Immune response and Immune tolerance

Immune response – Nature and necessity of its regulation, Complement System- Types, activation and types and their biological applications, Cytokines – types and their role in immune response, Immune Tolerance and their types, Hypersensitivity reactions – Types and Treatments

05 Hours

5. Immunological disorders

Auto immune disorders – Features, important types and Experimental models of auto immune diseases Immunodeficiency Disorders – Types and features **04 Hours**

6. Transplantation immunology

Transplantation antigens – Types and functions, Types of Transplantations, Immunological basis of Graft rejection, Role of HLA in graft rejection, Tumor specific antigens, Tissue typing, Immune suppression and immune suppressive drugs

06 Hours

Unit III

7. Molecular Immunology

Vaccines – Types and their development, Production of Recombinant DNA vaccines, Application of PCR technology to produce antibodies, Immune Therapy with genetically engineered antibodies, Catalytic antibodies, immunotherapeutic applications of hematopoietic stem cells, Purification and preparation of antigens in vaccine development and Immunoinformatics.

06 Hours

8. Immunodiagnosis

Immunization and Antiserum, Antigen-Antibody interactions – Precipitation reactions and Agglutination reactions Immunoelectrophoresis and Immunoflurescence assay, Principle and applications of ELISA and RIA and Western blotting analysis.

04 Hours

Text Books:

1. Immunology – J. Kuby, WH Freeman and Company, New York (2003)
2. Immunology and Immunotechnology by Pandian (2003)

Reference Books:

1. Instant notes in Immunology by P.M. Ladyard, Bios Scientific Publishers Ltd (2000)
2. Essential Immunology by Roitt I, Blackwell scientific publications, (1991)

Program: Biotechnology		
Course Title: Enzyme Technology & Metabolism		**Course Code: 15EBTC204**
L-T-P: 4-0-0	**Credits: 04**	**Contact Hours: 04 Hours/Week**
CIE Marks: 50	**SEE Marks: 50**	**Total Marks: 100**
Teaching Hours: 50	**Examination Duration: 03 Hours**	

Unit I

1. Enzyme Purification and characterization

History, nomenclature, classification of enzymes, sources of enzymes, properties of enzyme, strategies for isolation and purification and characterization of enzyme, theories and mechanism of enzyme action with examples.

08 Hours

2. Enzyme catalysis and enzymatic techniques

Types of specificities, Enzyme catalysis -Acid base catalysis, covalent catalysis, metal ion catalysis, Enzyme assay, Enzyme and isoenzyme measurement methods with examples, Methods for investigating the kinetics of Enzyme catalyzed reactions, Standardization and optimization methods, stability and activity of enzymes

06 Hours

3. Allosteric enzymes and Enzyme Inhibitions.

Kinetics of single substrate reactions, Michaelis–Menten plots, Lineweaver–Burk plot, Enzyme inhibition-reversible, competitive, uncompetitive and non-competative inhibitions and kinetics allosteric and irreversible inhibition. Multi-substrate reactions-ordered mechanisms, random mechanisms, Ping-pong mechanism. Allosteric enzymes - The Monad - Changeux - Wyman model (MCW) and The Koshland - Nemethy - Filmer (KNF) model, regulation of enzymes: Allosteric, Feed back regulation and covalent regulation

06 Hours

Unit II

4. Lipid Metabolism

Fatty acid oxidation, biosynthesis of fatty acids, Ketone bodies, cholesterol biosynthesis, steroid, harmones. Regulation. Enivronmental and Industrial Significance of lipid metabolsim. Oleaginous microorganisms and their principal lipids; Production of microbial lipids; Modification of lipids for commercial application; Extracellular microbial lipids and biosurfactants.

. **08 Hours**

5. Protein Metabolism

General reactions of amino acid metabolism, urea cycle, amino acid biosynthesis and degradation, regulation, Protein folding and assembly – protein folding pathways in prokaryotes and eucaryotes. Application of gene cloning in redirecting cellular metabolism for over-production of a few industrial products. Strategies for hyper production of primary and secondary metabolites such as enzymes, amino acids, anti-oxidants and antibiotics. Enivronmental and Industrial Significance of Amino acid metabolsim.

08 Hours

6. Nucleic acid Metabolism

Biosynthesis and degradation of purines and pyrimidines, uric acid production, regulation, metabolic disorders of nucleic acid metabolism. **04 Hours**

Unit III

7.Enzyme Immobilization

Techniques of enzyme immobilization; kinetics of immobilized enzymes, effect of solute, partition & diffusion on the kinetics of immobilized enzymes, applications of immobilized enzyme. Bioreactors for soluble and immobilized enzymes.

05 Hours

8.Industrial Applications and synzymes:
Enzymes used in detergents, use of proteases in food, leather and wool industries,uses of lactase in dairy industry, glucose oxidase and catalase in food industry. Enzymes in diagnostics, Biotransformations, Peptide Synthesis, synzymes, The design and construction of novel enzymes.

05 Hours

Text Books:

1. Lehninger principles of biochemistry, David L. Nelson, Michael M. Cox, Fourth edition.
2. Enzymes: Biochemistry, Biotechnology and Clinical Chemistry-Trevor Palmer, 1st edition, East-West Press Pvt. Ltd. (2004).
3. Fundamentals of Enzymology –Nicholas .C. Price and Lewis Stevens, 3rd ed., Oxford University Press (1991).

Reference Books:

1. Biochemistry by Donald voet, & Judith G. Voet, 2nd Edition, Wiley.
2. Biotransformation in Organic Chemistry - Faber,4th edition,Springer,2000.
3. Enzymes in industry- production and applications- Aehle W, Wiley-VCH,2004

Program: Biotechnology		
Course Title: Cell and Molecular Biology		**Course Code: 15EBTC205**
L-T-P: 4-0-0	**Credits: 04**	**Contact Hours: 04 Hours/Week**
CIE Marks: 50	**SEE Marks: 50**	**Total Marks: 100**
Teaching Hours: 50	**Examination Duration: 03 Hours**	

Unit I

1. Cell, Cell Division and Cell-Cycle

Prokaryotic and Eukaryotic cells. Structure and functions of membranes, cytoskeletal elements, cytoplasm, nucleus, endoplasmic reticulum, Golgi complex, mitochondria, chloroplast and vacuoles. Cell functions: Cell division, Cell Cycle and its regulation.

05 Hours

2. Molecular Biology and Nucleic Acids

Meaning and scope of molecular biology, Central Dogma and its updated view, Nucleic acids as genetic material, Structure and forms of nucleic acids, factors determine the structure of DNA – Denaturation and melting curves, Evidences for hydrogen bonds, hydrophobic interactions and effect of the ionic strength of a solution on the structure of DNA. Isolation and Purification of Nucleic acids – genomic DNA, Plasmid DNA and Total RNA, Quantification and storage of nucleic acids.

06 Hours

3. Organization of Genome or Genetic material

Genome: Viral genome, bacterial genome, Mitochondrial genome, Eukaryotic genome. Organization of Chromatin, Chromosomes: types and Gene organization in Prokaryotes and Eukaryotes.

04 Hours

4. Replication of DNA

An overview and Basic rules for DNA Replication, Enzymes and proteins of DNA Replication, DNA

Replication is Semi conservative, Origin of DNA Replication, Replicon and Replication fork, Unidirectional and Bidirectional replication of DNA, Mechanism of DNA replication in prokaryotes and in Eukaryotes. **05 Hours**

UNIT - II

5. Transcription

General features of Transcription process, Types of RNA molecules, Prokaryotic and eukaryotic RNA polymerases, Promoter structure and Mechanism of transcription in prokaryotes and eukaryotes, Post transcriptional modifications of mRNA, tRNA and rRNA, Transcription inhibitors

05 Hours

6. Translation

Features of Genetic code and Wobble hypothesis, Overview of protein synthesis, Components required for protein synthesis, Mechanism of protein synthesis in prokaryotes and eukaryotes, Post-translational modifications and Protein targeting, Inhibitors in translation

04 Hours

7. Regulation of Gene Expression in Prokaryotes and Eukaryotes.

Regulation of gene activity, Gene regulation in Prokaryotes: Constitutive, Inducible and repressible gene expression systems, Operon model for gene expression regulation in prokaryotes, Positive and Negative regulation of – Lac Operon – Regulation, Catabolic repression and Gratuitous inducers etc, Trp Operon and Gal Operon.

Gene regulation in Eukaryotes, Regulation of Gene expression at Genome level, Transcriptional level –Acetylation of Histones, Chromatin remodeling, DNA Methylation, DNA elements, Transcription factors, Insulators, Regulatory proteins and Hormones. Gene regulation at Post transcriptional level – Splicing, RNA interference, Transport of mRNA and by regulating mRNA stability. **11 Hours**

Unit III

8. Mutations and DNA Repair

Mutation – Source of genetic variability, basic features of Mutation process, Molecular basis of Mutation, Conditional lethal mutations as a powerful tool for genetic studies and Ames test of Mutagenecity testing. DNA damage and different types of DNA repair systems and Human diseases. **05 Hours**

9. Polymerase Chain Reaction

Principle of polymerase chain reaction (PCR) - Components of PCR reaction and optimization of PCR -Gene specific primer and degenerate primer – Inverse PCR, Hot-start PCR, Loop mediated PCR -, Reverse transcription PCR and Real time PCR. Chemistry of primer synthesis.

05 Hours

Text Books:

1. Fundamentals of Molecular Biology Ane's Student Edition. - Veer Bala Rastogi, Ane Books India, New Delhi (2008)
2. Instant Notes in Molecular Biology – P.C. Turner, Viva Series Publishing, New Delhi

Reference Books:

1. Principles of Genetics (IVth) Edition – Snustad and Simmons, Wiley Asia Student Edition (2006)

2. Molecular Biology (IInd) Edition –David Freifelder, Narosa Publishing House,(1990)

Program: Biotechnology		
Course Title: Momentum Transfer		**Course Code: 15EBTF203**
L-T-P: 3-0-0	**Credits: 03**	**Contact Hours: 03 Hours/Week**
CIE Marks: 50	**SEE Marks: 50**	**Total Marks: 100**
Teaching Hours: 40	**Examination Duration: 03 Hours**	

Unit I

1. Basic concepts

Fluid definitions, shear stress, shear strain, Properties of fluids: specific weight, viscosity, Density, specific gravity, specific volume. Types of fluids; real fluid and ideal fluid, compressible fluid and incompressible fluid, Newtonian and non-Newtonian fluids. Types of fluid flow: steady flow, uniform flow, rotational flow, one dimensional flow, laminar flow and turbulent flow, Reynolds number, pressure measurements, Types of manometers, Hydrostatic equilibrium, Newton's law of viscosity, Screen Analysis.

03 Hours

2. Fluid flow

Basic equations of fluid flow: Mass balance, Continuity equation, Euler's equation, Bernoulli's equation, Application of Bernoulli's equation. Numericals on Bernoulli's equation and continuity equation, Laminar Flow through Circular Conduits, Hagen Poiseulle's equation, Boundary layer, development of boundary layer on a plate and in pipe. Boundary layer separation and wake formation, friction factor, friction factor chart, effect of roughness, minor loss and major loss, Losses due to sudden expansion, contraction and other fittings.

. **06 Hours**

3. Flow past immersed bodies

Drag, lift, Drag coefficient, drag coefficients of typical shapes, Pressure drop correlations, Kozney- Carman equation, Blake- plummer equation Ergun's Equation. Filtration, Filter media, Filter aids, Types of filters, cake filter, clarifying filter, cross flow filter,rate of filtration, Constant rate filtration, Constant pressure filtration, Specific cake resistance α and Filter media resistance R_m. Filtration equipment: principle and working of rotary drum filter, plate and frame filter, leaf Filter.

06 Hours

Unit II

4. Flow through stagnant fluids

Settling, Types of settling, Free settling, hindered settling, Terminal settling velocity, Stoke's law, Newton's law, Criterion for settling regime, Sedimentation, Batch sedimentation, Rate of sedimentation, Kynch theory, Thickener, Determination of thickener area. Numericals on Settling and Sedimentation. Fluidization, conditions for fluidization, minimum fluidization velocity.

07 Hours

5. Fluid pumping and metering

Measurement of fluid flow rates, Constructional features and working principles of venturimeter, orificemeter, rotameter, pitot tube. Application of Bernoulli's equation to venturi meter and orificemeter, Flow rate calculations from the readings of venturi meter, orifice meter and pitot tube. Pumps, Classification and selection of Pumps, developed head, power requirement, suction lift and cavitation, NPSH, priming, constructional features and working principle of centrifugal pump, reciprocating pump, rotary pump, peristaltic pump, characteristic curves of a centrifugal pump. Numericals on flowmeters.

08 Hours

Unit III

6. Mixing

Mixing and Agitation: Necessity of mixing & agitation in industries, Principles of agitation Types of Impellers & propellers, Different flow patterns in mixing, prevention of swirling, draft tubes. Standard turbine design, Calculation of power requirement of mixing equipment, Mixing equipment of pastes & viscous material, Solid – Solid Mixing, Agitator selection. Mixing equipments: Change can mixers, Muller mixers, Ribbon blender, Double cone mixer, Twin shell blender, Internal Screw mixer, Jet mixer, Static mixer.

05 Hours

7. Dimensional Analysis:

Units and dimensions, Dimensionless number, Rayleigh and Buckingham π theorem. Problems on Rayleigh and Buckingham π theorem. Model and prototype. Similitude: Geometric, Kinematic and Dynamic. Numericals.

05 Hours

Text Books:

1. McCabe W. L. and Smith J. C, Unit operations of chemical engineering, Pub: McGraw-Hill, 7th edition, 2005.
2. C. J. Geankoplis, Transport Processes and unit operations, Pub: Prentice Hall of
   a. India, 4th edition, 2004

Reference Books:

1. John F. Douglas, Janusz M. Gasiorek, John A. Swaffield, Fluid Mechanics, Pub: Pearson education limited, 4th edition, 2007.
2. Alan S Foust, Principles of Unit operations, Pub: John Wiley & Sons, 2nd edition, 1980.

Program: **Biotechnology**		
Course Title: Enzyme Technology Lab		**Course Code: 15EBTP204**
L-T-P: 0-0-1	**Credits:1.0**	**Contact Hours: 02 Hours/week**
CIE Marks:80	**SEE Marks: 20**	**Total Marks:100**
Teaching Hours: 24	**Examination Duration: 03 Hours**	

List of Experiments

1. Biochemical Measurements: Molarity, Normality, Molality, Moles, weight/volume measurements, percent solution, concentration Units. pH measurements and Buffer preparation, SOP's, Instrument calibrations.
2. Determination of activity of amylase enzyme
3. Estimation of protein content of amylase and specific activity
4. Effect of temperature on enzyme activity
5. Effect of pH on enzyme activity
6. Effect of substrate concentration on enzyme activity
7. Effect of enzyme concentration on enzyme activity
8. Effect of inhibitor on enzyme activity
9. Enzyme immobilization and kinetics of immobilized enzyme
10. Molecular weight determination by SDS PAGE
11. Staining the gel using CBB and silver staining

Text Books/ Reference Books:

1. Introduction to Practical biochemistry – David Plummer, McGraw-Hill Publishing Co,3rd edition,pp:332.
2. Biochemical methods- Sadasivam and Manickam(1996), New Age International Publishers, 2nd edition, pp256.
3. Experimental Biochemistry – A Student Companion by Beedu Shashidhar Rao and Vijay Deshpande.(2005) I.K International Pvt. Ltd,New Delhi. pp301

Program: **Biotechnology**		
Course Title: Cell and Molecular Biology Lab		**Course Code: 15EBTP205**
L-T-P: 0-0-1	**Credits: 1.0**	**Contact Hours: 02 Hours/Week**
CIE Marks: 80	**SEE Marks: 20**	**Total Marks: 100**
Teaching Hours: 24	**Examination Duration: 03 Hours**	

List of Experiments

1. Study of Cell and Molecular Biology laboratory equipments – Table top cooling Centrifuge,

UV – Visible Spectrophotometer, PCR machine and Gel Documentation system.
2. Staining and microscopic observation of plant/animal cells and chromosomes
3. Study of Mitosis and Meiosis Cell Divisions
4. Isolation of genomic DNA from Bacteria/ Plant/ Animal cells
5. UV Spectrophotometric analysis of DNA and RNA
6. Calculation of Tm value of DNA of isolated DNA sample
7. Agarose gel electrophoresis and gel elution of DNA.
8. Isolation and estimation of Plasmid DNA
9. Extraction of Total RNA from different biological sources

Text Books /Reference Books:

1. Cell and Molecular Biology – A Lab Manual K V Chaitanya PHI Learning Private Limited Delhi – 110092, 2013.
2. Molecular Cloning Volumes I, II and III – Sambrook J *et al* (2000) Cold Spring Harbour Laboratory Press, 2000

Program: **Biotechnology**		
Course Title: Momentum Transfer Lab		**Course Code: 15EBTP206**
L-T-P: 0-0-1	**Credits:1.0**	**Contact Hours: 02 Hours/Week**
CIE Marks: 80	**SEE Marks: 20**	**Total Marks: 100**
Teaching Hours: 24	**Examination Duration: 03 Hours**	

List of Experiments:

1. Verification of Bernoulli's Equation.
2. Pressure drop through packed bed. (Verification of Ergun's Equation).
3. Studies on sedimentation. (Verification of Kynch Theory, Thickener area calculation).
4. Verification of stoke's law
5. Studies on agitation
6. Constant pressure filtration using leaf filter
7. Study on flow meters (Characteristics of Rotameter, venturimeter etc).
8. Pressure drop correlations through circular pipes (Friction factor correlations).
9. Study of laminar flow characteristics
10. Sieve Analysis

Text Books:

1. McCabe W. L. and Smith J. C, Unit operations of chemical engineering, Pub: McGraw-Hill, 7th edition, 2005.
2. C. J. Geankoplis, Transport Processes and unit operations, Pub: Prentice Hall of India, 4th edition, 2004

Reference Books:

1. John F. Douglas, Janusz M. Gasiorek, John A. Swaffield, Fluid Mechanics, Pub: Pearson education limited, 4th edition, 2007.

2. Alan S Foust, Principles of Unit operations, Pub: John Wiley & Sons, 2nd edition,1980.

Year of offering: 2017-18
Batch- 2015-19 (5th semester)

Program: Biotechnology		
Course Title: Genetic Engineering and Applications		Course Code: 15EBTC301
L-T-P: 4-0-0	Credits: 4.0	Contact Hours: 04 Hours/Week

CIE Marks: 50	SEE Marks: 50	Total Marks: 100
Teaching Hours: 50	Examination Duration: 03 Hours	

Unit I

1. Basics of Recombinant DNA technology

Development and Scope of Recombinant DNA Technology and Genetic Engineering. Emergence and commercialization of Molecular Biotechnology. Gene Cloning: Introduction and Steps involved in gene cloning. Subcloning and its applications. Vectors in GE - biology, features, types, cloning & expression vectors.

06 Hours

2. Enzymes in Genetic Engineering

DNA modifying enzymes and necessity of DNA modification in gene cloning. Enzymes used for DNA modification. Restriction Endonucleases, classification & mode of action, Role and applications of different DNA modifying enzymes in gene cloning process - DNA Polymerases, Reverse Transcriptase, RNA Polymerase, Alkaline Phosphatases, Polynucleotide Kinase and DNA Ligases etc.

05 Hours

3. Molecular Cloning Strategies and Genetic Transformation

Isolation and purification of nucleic acid (genomic/plasmid DNA and RNA), Quantification on and storage of nucleic acids, Construction of cDNA library , Construction of Genomic library ,Screening and preservation of DNA libraries. DNA Cloning – Methods and applications. Genetic Transformation of prokaryotes and DNA Transfection in Eukaryotic hosts. Biological and Non-biological methods of gene transfer in hosts. Chloroplast transformation.

09 Hours

Unit II

4. Selection, Screening and Analysis of Recombinants

Introduction to screening and analysis of recombinants. Genetic selection and screening methods - Selectable Marker genes, Reporter genes. Screening using Nucleic acid hybridization methods - Preparation of probes for hybridization experiments and different blotting techniques. Screening by PCR based methods. Screening by Immunological methods and Analysis of cloned genes.

07 Hours

5. Production of Proteins from Cloned Genes

Introduction to recombinant gene expression, scope and applications of recombinant gene expression. Special vectors for expression of foreign genes in E coli. General problems with the production of recombinant protein in E coli. Production of recombinant proteins by Eukaryotic cells.

07 Hours

6. Directed Mutagenesis and Protein Engineering

Oligonucleotide – Directed Mutagenesis with M13 DNA, Plasmid DNA, PCR Amplification etc. Protein Engineering – Meaning and Scope, Protein Engineering for adding disulphide bonds, increasing enzymatic activity, decreasing protease sensitivity, modifying protein specificity, Increasing enzyme stability and specificity etc.

06 Hours

Unit III

7. Genetic Engineering and Microbial Biotechnology

Genetic manipulation of Microorganisms – Introduction and scope. Applications of Recombinant Microorganism – Production of recombinant therapeutic proteins, Production of Antibiotics, Combating Human diseases, Microbial pesticides, Efficient utilization of Carbohydrates and Bioremediation or Environmental cleanup.

05 Hours

8. Plant and Animal Transgenic Technology and Applications.

Applications of Transgenic Plant Technology – Development of Insect resistant plants, Herbicide resistant plants, Pathogens resistant plants, and Abiotic stress tolerant plants. Plants as Bioreactors for large scale production. Applications of Animal cloning and Transgenic technology - Cloning in Domestic animals. Applications of Transgenic Animals - as research models, and as bioreactors for large scale production of substances for Human welfare.

05 Hours

Text Books

1. Genetic Engineering by Smitha Rastogi and Neelam Pathak, Oxford University Press, USA (2009)
2. Molecular Biotechnology – Principles and applications of Recombinant DNA by Bernard r Glick and Jack J Pasternak, ASM Press, American Society for Microbiology, Washington DC 2003

Reference Books

1. Gene Cloning and DNA Analysis by T A Brown. Wiley-Blackwell (2010)
2. An Introduction to Genetic Engineering – Third Edn By Desmond S T Nicholl, Cambridge University Press, Singapore 2008.

Program: Biotechnology		
Course Title: Bioinformatics		**Course Code: 15EBTC302**
L-T-P: 3-0-0	**Credits: 3.0**	**Contact Hours: 03 Hours/Week**
CIE Marks: 50	**SEE Marks: 50**	**Total Marks: 100**
Teaching Hours: 40	**Examination Duration: 03 Hours**	

Unit - I

1.Database

Introduction, meaning of databases, types of databases, Primary Database: NCBI, Genbank, DDBJ, EMBL. File formats, Secondary Database: PROSITE, PIR, UNIPROT, BLOCKS, Pfam, specialized databases: KEGG, OMIM. Structure Database: PDB, MMBD, CATH, SCOP & structure visualization tools. **6 Hours**

2.Pairwise Sequence Alignment

Meaning and significance of Sequence alignment, Pairwise sequence alignment, Global alignment, Local Alignment, overview of methods, Methods & Algorithms-dot matrix, dynamic programming, substitution matrices, gap penalties, FASTA, BLAST PSI-BLAST & PHI-BLAST.

6 Hours

3.Multiple Sequence Alignment

Meaning of Multiple Sequence Alignment, Global Multiple Sequence Alignment: Progressive Alignment methods, Iterative methods, Local Multiple sequence Alignment, Significance of Multiple Sequence Alignment, Multiple Sequence Alignment editors. Motifs and Patterns, PROSITE.

4 Hours

Unit - II

4.Molecular Phylogenetics

Meaning of phylogenetic analysis, Meaning & significance of evolutionary trees, Rooted and unrooted trees, Elements of phylogenetic Models, Phylogenetic Data Analysis, Distance based methods: Neighbor Joining (NJ) method, Fitch-Margoliash (FM) method, Minimum Evolution (ME) method, Character based methods:Maximum parsimony, Maximum Likelihood; Tree Evaluation methods, Phylogenetic Softwares: PHYLIP & PAUP.

6 Hours

5.Gene Prediction

Prokaryote and Eukaryote gene prediction, promoter site prediction. Gene Prediction tools-GRAIL, GENSCAN & GENEPARSER.

4 Hours

6.Protein Prediction

Protein structures: Secondary structure :Alpha helix, beta Sheets, phi & psi angles, Ramachandran plots. Protein Secondary Structure Prediction, Tertiary Structure Predictions: Homology modeling, conformational analysis and forces that determine protein structure, Protein Structure Comparison.

6 Hours

Unit - III

7.In-silico Drug Designing-I

Introduction to traditional drug designing, Introduction in-silico drug designing approach, Methodology for in-silico drug designing, different tools used for drug designing, molecular Modeling, Energy minimization methods.

4 Hours

8.In-silico Drug Designing-II

Identification of ligands, Lipinski's rule, Process of Docking, Quantitative structure-activity relationship (QSAR), Physical and Chemical basis of receptor ligand interactions.

4 Hours

Text Books

1. Andreas D. Baxevanis, B. F. Francis Ouellette, Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, 3rd, Wiley-Inte, 2005
2. David Mount, Bioinformatics: Sequence and Genome Analysis , 2nd, Cold Sprin, 2004

Reference Books

1. P. Rastogi, N. Mendiritta, S. C. Rastogi, Bioinformatics: Methods and Applications: Genomics, Proteomics and Drug Discovery, 4th, Prentice-H, 2013.
2. Anand Solomon K, Molecular Modelling and Drug Design , 1st, MJP Publis, 2015
3. Richard Durbin, Sean R. Eddy, Anders Krogh, Biological Sequence Analysis: Probabilistic Models of Proteins and Nucleic Acids, 1st, Cambridge , 1998

Program: Biotechnology		
Course Title: Reaction Engineering		**Course Code: 15EBTC303**
L-T-P: 4-0-0	**Credits: 4**	**Contact Hours: 50**
CIE Marks: 50	**SEE Marks:100**	**Total Marks: 100**
Teaching Hours: 50	**Examination Duration: 3 hrs**	

UNIT-I

1: Introduction

Introduction to homogeneous and heterogeneous reaction in ideal reactors. Elementary and Non-elementary reactions kinetics of homogeneous and heterogeneous reactionsystem.

06 hours

2: Interpretation of Batch Reactor data

Introduction to analysis of experimental reactor data, evaluation of rate equation, integral and differential analysis of kinetic data's, constant volume system and variable volume System. Total pressure technique of analyzing the kinetic data of gaseous reaction system.

08 hours

3. Introduction to Bioreactor Design.

General discussion on basics bioreactor design. General material balance equation for various conditions. Ideal reactors for a single reaction. Design equations for homogeneous system: batch, stirred tank and tubular flow reactor, size comparison of reactor systems. **08 hours**

UNIT-II

4: Design for Multiple Reactions

Introduction, general design approach to multiple reactions. Quantitative and qualitative analysis of product distribution. Effect of temperature and pressure on single reaction. General graphical procedure, optimum temperature progression. Factors affecting choice of reactors: optimum yield, conversion, selectivity and reactivity.

08 hours

5: Non-Ideal Reactors

Non-ideal reactors, residence time distribution studies, Stimulus Response Technique, pulse and step input response of reactors, RTD's for CSTR and PFR, Relationship between C, E and F-curve. Kinetic models for non Ideal reaction system, Axial Dispersion Model **04 hours**

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6: Microbial kinetics:

Introduction to microbial kinetics, Yield coefficients. Simple kinetic models for microbial growth, transient growth kinetics Factors affecting the kinetics of Monod model; Growth of Filamentous Organisms. kinetic Models for product formation and substrate degradation **08 Hours**

UNIT-III

7: Heterogeneous Reactor System:

Heterogeneous reactions in Bioprocessing. The rate equation for surface for kinetics, Pore diffusion kinetics with combined with surface kinetics. Porous catalyst particle Performance equation for reactor containing Porous catalyst particles. External and internal mass transfer effects.

04 Hours

8: Reactor Engineering

Bioreactor configurations: Bubble column, airlift reactor, packed bed, fluidized bed, trickle bed,

04 Hours

Text Books

1) Chemical Reaction Engineering by Octave and Levenspiel., John Wiley, 3rd Edition, 2006.
2) Elements of Chemical Reaction Engineering by Fogler, H.S., Prentice Hall, 1986.

Reference Books

1) Bioprocess Engineering Principles by Pouline M Doran Academic Press , 2003
2) Biochemical Engineering Fundamentals By Bailey and Ollies McGraw Hill 2nd Edition
3) Chemical Reactor Analysis and Design by Forment G F and Bischoff K B. John wiley,1976

4) Chemical engineering By J.F Richardson and J.M Coulson Volume 6

Program: Biotechnology		
Course Title: Biological Thermodynamics		**Course Code:15EBTC304**
L-T-P: 3-0-0	**Credits: 3**	**Contact Hours:40**
CIE Marks:50	**SEE Marks:50**	**Total Marks:100**
Teaching Hours:40	**Examination Duration:3 hours**	

Unit I

1. Basic concepts

System, Surrounding, State and Properties, Intensive and extensive properties, State and path functions, Heat reservoir, Hess Law, energy and biological world, energy flow transformation, energy conversions, energy, nutritional requirements of living systems, Flow of electrons in organism, energy flow in metabolic process, division of labor in cells, Numerical problems

06 hours

2. Basic laws of thermodynamics

Zeroth law, First law of Thermodynamics, cyclic process, non-flow process, flow Process, internal energy, Heat capacity, second law of thermodynamics, Concept of entropy, Calculation of entropy changes, Third law of thermodynamics. Numerical problems.

09 hours

Unit II

3. PVT behavior

P-V-T Behavior of pure fluid, Processes involving ideal gases, Equation of state for real gases: Vander Waals equation, Redlich-Kwong equation, Peng-Robinson equation, Virial equation. Compressibility charts: Principle of corresponding states, Numerical problems.

07 hours

4. Thermodynamic properties of Biological fluids

Classification of thermodynamic properties, Work function, Gibbs free energy, Gibbs-Helmholtz equation, ATP Synthesis in cell and Protein Folding, Metabolic reactions in cells. Entropy - heat capacity relationships, Relationships between C_p and C_v, Activity of molecule, Chemical potential, Oxidation-Reduction reaction, Cell Membrane Transportation & Protein Extraction, Osmosis, Nernst equation in membrane transportation, Numerical problems.

08 hours

Unit III

5. Statistical Thermodynamics

Boltzmann distribution & partition function, Protein folding and helix-coil transition, Binding equilibria, Oxygen biding to myoglobin & Hemoglobin.

04 hours

6. Reaction Equilibria

Reaction Stoichiometry, Effect of temperature on standard heat of reaction. energy coupling reactions, activation energy, Criteria of chemical reaction equilibrium, Relationship between Equilibrium constant and standard free energy change, Effect of temperature, pH and pressure on equilibrium constants and other factors affecting equilibrium conversion, Numerical problems.

06 hours

Text Books

1. Biological Thermodynamics by Donald T. Haynie, 2nd edition, Cambridge University Press,2008
2. Introduction to chemical engineering thermodynamics by J.M.Smith, H. C. VanNess, M.M. Abbott, 7th edition, Tata McGraw-Hill, NewDelhi, 2005.

Reference Books

1. Thermodynamics. An engineering approach, by Yunus A. Cengel, Michael A. Boles, 8th edition, McGraw- Hill, 2014.
2. Chemical Engineering Thermodynamics by Y.V.C. Rao. 2nd edition, Universities Press, 1997.
3. Chemical and Process Thermodynamics by B.G.Kyle. 3rd edition, Prentice Hall of India Private limited,2015.

Program: Biotechnology		
Course Title: Research Methodology		**Course Code:15EBTC305**
L-T-P: 3-0-0	**Credits: 03**	**Contact Hours: 40**
CIE Marks: 50	**SEE Marks: 50**	**Total Marks: 100**
Teaching Hours: 40	**Examination Duration: 03 hours**	

Unit I

1. Introduction to Research and Research Methodology

Introduction, Objectives and scope of research, Research methods and Methodology. Types of research – Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical Concept of Translatory research.

04 hours

2. Research Philosophy and Formulation of Research Problem

Concept of Research Philosophy- (Ontology, Logic, Method and Epistemeology) Formulation of Research Problem- Necessity of defining the research problem and framing the problem statement.

03 hours

3. Sources and Review of Literature

Introduction and need for Literature Review., Search Procedures and Gap analysis.

Sources of Literature - Research articles, review articles, Research communications, Book chapters. Bibliometrics- Citation index, Impact factor, H- Factor

08 hours

Unit II

4. Sampling & Data Collection

Explain sampling and its significance. Describe different methods of sampling. **03 hours**

5. Statistical Analysis of Data

Measures of Central Tendency, Measures of Dispersion and variance, Correlation and Regression Development of hypothesis and testing : Chi- square test, Student's t-test, ANOVA

07 hours

6. Design of Experiments

Introduction and significance of DOE, Types - Factorial Design, Plackett Burman Design, Central Composite Design, Introduction to Response Surface Methodology.

05 hours

Unit III

7. Research Communication

Written Communication- Introduction, Structure and components of scientific reports – Bibliography, referencing and footnotes . Oral Presentation – Developing and delivering presentation **05 hours**

8. Environment, Ethics and IPR in Research

Impacts of Research on Environment, - Ethical issues, ethical committees, Research Generated Intellectual Property Rights- Copy-right & royalty, Patent law, Trade mark, Trade secret, Geographical Indicator,

Industrial Design. Concept of Plagiarism **05 hours**

Text Books

1.C.R. Kothari and Guarav Garg, Research Methodology, III Edition, New Age International Publisher, New Delhi, 2014

2. N. Gurumani, Research Methodology for Biological Sciences, I Edition, MJP Publishers, Chennai, 2007

Reference Books

1. Design and Analysis of Experiments by Montgomery D. C. John Wiley Publishers

2. An Introduction to Research Methodology by Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K. RBSA Publishers

Program: Biotechnology		
Course Title: Genetic Engineering & Immunotechnology Lab		**Course Code: 15EBTP301**
L-T-P: 0-0-1	**Credits:1.0**	**Contact Hours: 2Hrs/week**
CIE Marks: 80	**SEE Marks: 20**	**Total Marks: 100**
Teaching Hours: 24	**Examination Duration: 03 Hours**	

List of Experiments:

1. Preparation of Competent *E coli* cells (Exercise)
2. Ligation of DNA fragment with vector and Transformation (Demonstration)
3. Restriction digestion analysis of plasmid DNA (Structured Inquiry)
4. Introduction to PCR –Programming, and amplification of DNA (Exercise)
5. Screening of Transformants by Colony PCR (Demonstration)
6. TA Cloning method for cloning of PCR product. (Demonstration)
7. Demonstration of Southern blotting (Demonstration)
8. Agglutination techniques – Heam agglutination techniques and Bacterial agglutination techniques (Exercise)
9. Radial diffusion and Rocket Immunoelectrophoresis (Exercise)

   Dot-ELISA(Enzyme Linked Immuno Sorbent Assay) (Exercise)

Text Books/Reference Books

1.Principles of Gene Manipulations- Introduction to Genetic Engineering, by R.W. Old and S.D. Primrose(2007), Blackwell Scientific Publications.

2. Molecular Cloning- By T.Maniatis, E.F. Fritsch and J. Sambrook, Cold spring Harbour (2009)

Program: Biotechnology		
Course Title: Bioinformatics Lab		**Course Code: 15EBTP302**
L-T-P: 0-0-1	**Credits:1.0**	**Contact Hours: 2Hrs/week**
CIE Marks: 80	**SEE Marks: 20**	**Total Marks: 100**
Teaching Hours: 24	**Examination Duration: 03 Hours**	

List of Experiments:

1. Searching bibliographic database for relevant information
2. Searching sequence and retrieve from nucleic acid and Protein sequence database

3. PDB: Protein Data Bank and structure visualization
4. Pair wise alignment of the sequences
5. Searching sequence database using BLAST and FASTA algorithm
6. Multiple Sequence Alignment: CLUSTALW.
7. Evolutionary Relationship/ Phylogenetic Analysis.
8. Gene structure Prediction
9. Protein Secondary Structure Prediction
10. Pattern searching in proteins.
11. Define gene structure and design primers specific to the identified gene of microorganisms and draw restriction digestion map for sequence identified

Text Books/Reference Books

1. Andreas D. Baxevanis, B. F. Francis Ouellette, Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, 3rd, Wiley-Inte, 2005
2. David Mount, Bioinformatics: Sequence and Genome Analysis , 2nd, Cold Sprin, 2004

Laboratory Title: Mini Project	**Lab. Code: 15EBTW301**
Total Hours: 90	**Duration of SEE Hours: 3**
SEE Marks: 50	**CIE Marks: 50**

Guidelines:

- Mini project to be carried out in a group of maximum 4 students.
- Every student needs to maintain laboratory work book which should contain the details of all the work carried out in the laboratory.
- Entries to be done in log books for instrument usage.
- Timely report submission to the coordinator.
- Requisitions for chemicals and glassware's to be provided in advance for the project work

Review committee:

Review committee is formed by the project coordinator taking into consideration that review committee consists of faculty experts from all domains. Review committee consists of the guide of the respective project group also.

Reviews:

- Continuous internal evaluation will be done by the respective guides/review committee as per the rubrics.
- Total of 3 **reviews** per semester will be carried out to evaluate the progress of the project.
- At each review students have to submit a report duly signed by guide.
- Final evaluation will be done by examiners during semester end examination as per the SEE evaluation scheme.

Phases of Minor Project:

Sl. No	Phases	Reviewed	Activities
1	Review-1	By Review committee	Need analysis, Detail Review of literature, Objectives, Overall plan of work.
2	Review-2	By Project Guide	Development of protocols, Standardization and screening. Design of experiments, Conduct of experiments, Initial experimental data.
3	Review-3	By Review committee	Final experimentation, Data interpretation and analysis, Conclusion.

Year of offering: 2017-18
Batch- 2015-19 (6th semester)

Program: Biotechnology		
Course Title: Bioprocess Engineering		Course Code:15EBTC306
L-T-P: 4-0-0	Credits: 4	Contact Hours: 4 hours/week
CIE Marks:50	SEE Marks:50	Total Marks:100
Teaching Hours:50	Examination Duration:3 hrs	

Unit - 1

1.Media and Inoculum development for industrial fermentations

Bioprocess development: An interdisciplinary challenge, Biotechnology & Bioprocess Engineering, steps in bioprocess development, Media ingredients, medium formulation, oxygen requirements, antifoams, medium optimization, Ingredients for mammalian cell culture and plant cell culture.

Introduction, Criteria for transfer of inoculum, development of inocula for bacterial processes, yeast processes and mycelial processes. Inoculum development for plant Fermenter.

8 Hours

2.Sterilization

Media sterilization, Design of sterilization process: Batch Process (Dell factor, holding time, and thermal death kinetics), continuous sterilization process; sterilization of fermenter and other ancillaries. Scale up of sterilization, filter sterilization of air and media.

5 Hours

3.Design of bioreactors

Basic objective of fermenter design, aseptic operation & containment regulation, achievement and maintenance of aseptic conditions, body construction, agitator and sparger design, baffles, stirrer glands and bearings. Animal cell bioreactors.

7 Hours

Unit - II

4.Scale Up of Bioreactor

Scale up of bioreactors: Introduction, Scale-Up methods: Geometric and Dynamic Similarity, Criteria for scale-up: Constant power consumption/volume, constant KLa, constant mixing time, constant tip speed, Regime analysis: Time constant for transport phenomena, time constant for conversion. Scale down approach.

5 Hours

5.Heat Transfer

Heat transfer in Bioprocess: Design equation for heat transfer process, Energy balance, Logarithmic and arithmetic mean temperature difference, Calculation for heat transfer coefficient, applications of design equations, Relationship in between heat transfer, cell concentrations and stirring conditions, Numerical based examples on above.

4 Hours

6.Mass Transfer

Mass transfer in Bioprocess: Role of diffusion in bioprocessing, Different equations in mass transfer (liquid-solid, liquid-liquid and gas-liquid) , Oxygen uptake in cell culture: Factors affecting cellular oxygen demand, Oxygen transfer from gas bubble to cells, Oxygen transfer in fermenter, measuring dissolved oxygen concentrations, Measurement of KLa: Oxygen balance method, Gassing out techniques (static method of Gassing out and dynamic method of Gassing out) Sulphite oxidation, Factors affecting KLa, Oxygen transfer in large vessels, Numerical based examples on above.

5 Hours

7.Fermenter fluid rheology

Fermentation broth: Viscosity, Viscosity measurement, Rheological properties of fermentation broths, Factors affecting broth viscosity , Mixing in Fermenters: Mechanism of mixing, Assessing mixing effectiveness, estimation of mixing time, Power requirement for mixing: Ungassed Newtonian fluids,ungassed non-Newtonian fluids, Gassed fluids, Calculation of power requirements,Scaleupof mixing systems, Improving mixing in Fermenters, Effect of rheological properties on mixing, Role of shear in stirred fementers: Interaction between cells and turbulent eddies,Bubble shear, operating conditions for shear damage. Numericals

6 Hours

Unit - III

8.Bioreactor kinetics

Batch reactor kinetics, CSTR kinetics, Fedbatch kinetics and plug flow kinetics, Numericals

5 Hours

9.Solid State fermentation:

Introduction, SSF v/s SMF, Types of SSF reactors, Microbial growth kinetics in SSF, Heat & Mass Transfer in SSF

5 Hours

Text Books

1. Pauline M. Doran, Bioprocess Engineering Principles, 2, Academic Press, 2003
2. Stanbury & Whittaker, Principles of Fermentation Technology, 2, Pergamum Press, 2000

Reference Books

1. Michael L. Shuler & Fikret Kargi, Bioprocess Engineering, 2, Prentice Hall, 2001
2. Bailey, James E.; Ollis, David F., Biochemical Engineering Fundamentals, McGraw-Hill Education, 1986

Program: Biotechnology		
Course Title: Bioprocess Control and Automation		**Course Code:15EBTC307**
L-T-P: 3-0.5-0	**Credits: 3.5**	**Contact Hours: 3 hours/week**
CIE Marks:50	**SEE Marks:50**	**Total Marks:100**
Teaching Hours:40	**Examination Duration:3 hrs**	

Unit I

1: Instrumentation & Process Dynamics: Introduction to Measurement of important physicochemical and biochemical parameters in bioprocess. Methods of on line and off line estimation of biomass, substrates and products. Brief introduction to typical automatic control system and its components. Open loop and closed loop control systems.

05 hours

2: First & Second Order Systems: Mathematical representation of physical systems. Transfer function representation of linear first order systems, Examples: mercury in glass thermometer & Liquid level system. Mathematical forms of standard Input function/Forcing Functions such as Step input, Impulse Input, Linearly increasing Input and Sinusoidal Input. Response of first order system for step input, Features of step response, Response of linearly increasing input. Conceptual numerical. First Order Systems in Series: Interacting and Non-Interacting systems & their Transfer function representation. Second Order Systems: Transfer function representation of Second order systems, Example: Pneumatic Control Valve.

10 hours

Unit II

3: Controller and Final Control Elements: Different types of controllers-P (Special case of P-controller i.e ON-OFF controller), PI, PD, PID controllers. Derivation of Transfer Functions of different types of controllers.Final control element: The role of Final control Element in control system. Example: Pneumatic Control Valve: Working of Pneumatic control valve, Types of Pneumatic Control Valves i.e. Air to close & air to open.

08 hours

4: Block Diagram Reduction: Block diagram representation of control systems, Block diagram reduction in case of Servo and Regulatory control systems. Reduction of block diagrams for single input & Single output systems (SISO) & Multiple Input & Multiple Output Systems (MIMO), Problems on block diagram reduction.

07 hours

Unit III
5: Transient response of different controllers for Servo & Regulatory control Problems: Transient response of P, PI, PD & PID controllers for servo and regulatory problems. The determination of offset in all cases. **05 hours**
6: Analysis of Stability: Concept of stability, stability criterion. Routh test for stability. Theorems of Routh Array test, Conceptual numerical on Routh test for stability. **05 hours**
Text Books 1. Process System analysis and control by Donald R Coughnowr, 2nd Edn.Mc Graw Hill,1991 2. Chemical Process Control by George Stephanopoulos, Prentice Hall of India, 1999
Reference Books 1. Process Control-Peter Harriott, Tata McGraw-Hill Publishing Company Limited, 2004.

Program: Biotechnology		
Course Title: Bio Analytical Techniques		**Course Code: 15EBTC308**
L-T-P: 3-0-0	**Credits: 3.0**	**Contact Hours: 03 Hours/Week**
CIE Marks: 50	**SEE Marks: 50**	**Total Marks: 100**
Teaching Hours: 40	**Examination Duration: 03 Hours**	

Unit I

1. Introduction to Bio-analysis

Introduction to instrumentation, Functional elements of an instrumentation system, static and dynamic characteristics, calibration of instrumental methods, Types of errors, Methods of expressing precision and accuracy, Confidence limits, Uncertainties in Instrumental measurements – Sensitivity and detection, preparation & storage of solutions, usage of laboratory glasswares, statistical analysis of experimental data, Electrodes and Biochemical preparation.

05 Hours

2: Spectroscopy

General principles–Radiation, energy and atomic structure- types of spectra and their biochemical usefulness basic laws of light absorption. Electromagnetic radiation & Spectrum, Beer – Lambert's Law and apparent deviations; UV – VIS Spectrophotometer

05 Hours

3: Advanced Spectroscopy

Spectroflourimetry, Atomic absorption spectroscopy, IR spectroscopy, FTIR, Nuclear Magnetic Resonance, Mass spectroscopy, ORD, CD, X-ray diffraction.

05 Hours

Unit II

4: Chromatographic techniques

Analytical techniques for biomolecules purification, Paper chromatography, thin layer chromatography, Column chromatography, Gas chromatography, Ion-exchange chromatography, molecular exclusion chromatography, affinity chromatography, High performance liquid chromatography & UPLC- Principles, Methods, Instrumentation, Detectors, Analysis of data.

09 Hours

5: Electrophoretic techniques

Theory & application of polyacrylamide & Agarose gel electrophoresis for protein & nucleic acids, capillary electrophoresis, pulsed field gel electrophoresis, Iso-electric focusing, 2D-gel electrophoresis and Immunoelectrophoresis

06 Hours

Unit III

6: Centrifugation techniques

Basic principles of sedimentation, centrifuges and their uses, preparative ultracentrifuges, density gradient ,analytical ultra centrifuges, applications

06 Hours

7. Advanced Instrumental methods

LC-MS, GC-MS, HPTLC, SEM, Atomic Force Microscopy, transmission electron microscopy (TEM)

04 Hours

Text Books

1. Wilson K & Walker J., Principles and Techniques of Practical Biochemistry, 5th edition, Cambridge Univ. Press., 2000.
2. Rodney Boyer, Modern Experimental Biochemistry, 3rd edition, Pearson Education, 2002
3. Chatwal and Anand, Spectroscopy, Himalaya Publishing house-New Delhi, 2016

Reference Books

1. Willard H. W. & Meritt L. L, Instrumental methods for chemical analysis, 7th edition. CBS Publishers & Distributors, 2004
2. Chatwal and Anand, Instrumental methods for chemical analysis, Himalaya Publishing house, 2012

Program: Biotechnology		
Course Title: Bioprocess Engineering Lab		Course Code: 15EBTP303
L-T-P: 0-0-1.5	Credits:1.5	Contact Hours: 3Hrs/week
CIE Marks: 80	SEE Marks: 20	Total Marks: 100
Teaching Hours: 36	Examination Duration: 03 Hours	

List of Experiments:

1. Study of Lab fermenter
2. Determination of thermal death kinetics of microorganism.
3. Batch growth kinetics
4. Fed Batch kinetics
5. Determination of kinetic parameters of microorganism using batch mode.
6. Kinetics of product formation
7. Kinetics of substrate degradation
8. Design an experiment to determine mixing time and power requirement of fermenter
9. Determination of K_{La}
10. Solid state fermentation
11. Design an experiment to study the effect of mass transfer on microbial growth.

Text Books/Reference Books

1. Pauline M. Doran, Bioprocess Engineering Principles, 2, Academic Press, 2003
2. Stanbury & Whittaker, Principles of Fermentation Technology, 2, Pergamum Press, 2000

Laboratory Title: Minor Project	Lab. Code: 15EBTW302
Total Hours: 12	Duration of SEE Hours: 3
SEE Marks: 50	CIE Marks: 50

Experiment wise Plan

List of experiments/jobs planned to meet the requirements of the course.

Category: Open Ended		Total Weightage: 50.00		No. of lab sessions: 40.00
Expt./ Job No.	**Experiment / Job Details**	**No. of Lab Session(s) per batch (estimate)**	**Marks / Experiment**	**Correlation of Experiment with the theory**
1	Production of Protease/Amylase and study of effect of physico-chemical parameters	40.00	50.00	
	Learning Outcomes: The students should be able to: 1. Prepare the media and inoculum for enzyme production 2. Operate different instruments by using SOP 3. Analyze the effect of parameters on enzyme production 4. Conduct the statistical analysis of the results and correlate to the theortical concepts and principles 5. Work effectively in a group to fulfill the defined objectives 6. Write the technical report and present the results orally by using the media effectively			Minor project is related to the courses studied in 3rd, 4th and 5th semester

Year of offering: 2018-19
Batch- 2015-19 (7th semester)

Program: Biotechnology		
Course Title: Downstream Processing and Technology		**Course Code: 15EBTC401**
L-T-P: 3-0-0	**Credits: 3.0**	**Contact Hours: 03 Hours/Week**
CIE Marks: 50	**SEE Marks: 50**	**Total Marks: 100**
Teaching Hours: 40	**Examination Duration: 03 Hours**	

Unit I

1.Introduction

Role and importance of downstream processing in biotechnological processes. Characteristics of biological mixtures, Process design criteria for various classes of byproducts (high volume, low value products and low volume, high value products), Steps involved, case studies

05 Hours

2. Primary separation techniques

Cell disruption methods for intracellular products, Removal of insoluble, Biomass (and particulate debris) separation techniques; Flocculation and Sedimentation, Centrifugation filtration methods.

09 Hours

Unit II

3. Membrane separation processes

Membrane – based separations theory; Design and configuration of membrane separation equipment; Concentration polarization and fouling – causes, consequences and control techniques; Applications: Reverse osmosis, Dialysis, Ultra filtration, Micro filtration **09 Hours**

4. Enrichment operations

Precipitation methods with salts, organic solvents, and polymers, Extraction methods for separations. Aqueous two-phase extraction, Supercritical extraction; In situ product removal / integrated bio-processing. **07 Hours**

Unit III

5. Product recovery I

Introduction to chromatography, Van Deemter equation, Reversed Phase Chromatography, Hydrophobic Interaction Chromatography, Ion Exchange Chromatography.

05 Hours

6. Product recovery II

Gel Filtration Chromatography, Affinity Chromatography, Polishing Operations: Crystallization, Drying **05 Hours**

Text Books:

1. Product Recovery in Bioprocess Technology - BIOTOL Series,VCH,1990
2. Bioseparations: Principles and Techniques by B. Sivasankar, 2005

Reference Books:

1. Separation Process Principles by J D Seader and Ernest J Henley, 1998.
2. Bioprocess Engineering by Shuler and Kargi Prentice Hall, 1992.
3. Separation Processes in Biotechnology by Asenjo J. and Dekker M, 1993.
4. Bioseparations by Belter P.A. and Cussier E., Wiley, 1985

Program: Biotechnology		
Course Title: Bioprocess Equipment Design		**Course Code: 15EBTC402**
L-T-P: 3-0-0	**Credits: 3.0**	**Contact Hours: 03 Hours/Week**
CIE Marks: 50	**SEE Marks: 50**	**Total Marks: 100**
Teaching Hours: 40	**Examination Duration: 03 Hours**	

Unit – I

1. Notation and terminologies

Pipe Joints: Flanged pipe joint, Hydraulic pipe joint, Gland & stuffing box expansion joint, Union joint, Socket & spigot Joint. Welded joints: Butt, Fillet, lap welded joint. Vessel openings: Manholes, nozzles, drains, sight Glasses. Pipe design: Basic notation and terminologies, Schedule 10 and 40. Introduction to design.

04 Hours

2. Materials of Construction

Material properties: Mechanical & types of Corrosion; Materials used: Stainless steel and their alloys, properties of different metals used in stainless steel, Selection criteria, Different Standards (Indian steel codes, American Society for Mechanical Engineers-Bioprocess Engineer (ASME BPE) standard, AISI (American Iron & Steel Institute) standard), different Stainless steel grade: 304, 316.

08 Hours

Unit – II

3. Design of Bioreactor

Fermenter: Steps involved in the design: Volume of Reactor, H/D ratio, impeller design, baffle design, shaft design, Thickness of the shell, thickness of the top & bottom Cover, thickness of jacket, heat transfer area of jacket, Power number**,** Power required to drive the Impeller.

09 Hours

4. Design of shell and tube Heat exchanger

Heat exchangers: Steps involved in the design, Energy balance, LMTD, Tubing characteristics, Tube side heat transfer coefficient, baffle spacing, shell side heat transfer coefficient, Fouling, Overall heat transfer coefficient, Tube side & shell side Pressure drop calculations.

09 Hours

Unit – III

5. Equipment qualification & Validation

Design qualification, FAT (factory acceptance test), Site acceptance test, Commissioning, Installation Qualification, Operational qualification, Performance qualification, Equipment validation.

05 Hours

6.Bioreactor Accessories

Sterilization by filters, Design criteria for filters, filter housing, Filter Integrity test: Diffusive air flow test, Bubble point test, Pressure drop test, Water intrusion test; Valves: Diaphragm valve, Pneumatic valve, pinch valve, Non-return safety Valve; Aseptic seals in fermenter (Gasket, Lip seal, O rings).

05 Hours

Text Books:

1. Chemical Engineering Design by R K Sinnott, vol-6, 4th edition, Butterworth-Heinemann, 2005.
2. Process Equipment Design by M. V. Joshi & V. V. Mahajani, 3rd edition, Macmillan India Ltd, 1996.

Reference Books:

1. Fermentation & Biochemical engineering handbook by H. C. Vogel & C. L. Todaro, 2nd edition, Standard publishers distributors.
2. Introduction to chemical equipment design by B. C. Bhattacharyya, 1st edition, CBS Publishers & distributors, 1985

Program: Biotechnology		
Course Title: Industrial Biotechnology		**Course Code: 15EBTE401**
L-T-P: 3-0-0	**Credits: 3.0**	**Contact Hours: 03 Hours/Week**
CIE Marks: 50	**SEE Marks: 50**	**Total Marks: 100**
Teaching Hours: 40	**Examination Duration: 03 Hours**	

Unit I

1. Beverage products

Fermentative production Alcoholic beverages: Beer, Wine, Whisky.

05 Hours

2. Fermentation of food products

Cheese and types of cheese, biomass production (single cell protein, baker.s yeast), L-Glutamic Acid

05 Hours

3. Industrial Chemicals

Citric Acid, Ethanol, Lactic Acid, Acetone & Butonol

05 Hours

Unit II

4. Biomolecules

Microbial Flavors & fragrance, Amino acid production: Phenylanine, L-Lysine, Aspartic Acid

05 Hours

5. Enzymes

Amylases, Proteolytic enzymes, Pectinases, Lipases, Glucose Isomerase

05 hours

6. Biopharmaceuticals

Production of penicillin, Streptomycin, Cephalosporins

05 Hours

Unit III

7.a. Health Care Products:

Interferon’s, Anticancer agents, Steroid fermentation

05 Hours

7.b. Health Care Products:

Insulin, Vaccines, Monoclonal Antibodies

05 Hours

Text Books:

1. L.E.Casida,JR ,Industrial Microbiology, New Age International (P) Ltd Publication.
2. Prescot and Dun, Industrial Microbiology, McGraw-Hill Book Company, Inc. New York

Reference Books:

1. D.Lanch,Drew,Wang, Comprehensive Biotechnology-Volume 3,Elsevier Publication.
2. George T. Austin, Nicholas Basta; Shreves Chemical Process Industries Handbook; McGraw Hill Professional, 1998

Program: Biotechnology		
Course Title: Food Processing Technology		**Course Code: 15EBTE402**
L-T-P: 3-0-0	**Credits: 3.0**	**Contact Hours: 03 Hours/Week**
CIE Marks: 50	**SEE Marks: 50**	**Total Marks: 100**
Teaching Hours: 40	**Examination Duration: 03 Hours**	

Unit I

1. Fundamentals of Food Processing Technology

Basic concepts about properties of foods: liquid, solid and gases; Introduction to food processing: scope and significance; Principles of food processing and preservation

04 Hours

2. Microbial Food Spoilage

Food as substrate for microorganisms, Primary sources of micro organisms in foods, Microbes induced biochemical changes in foods, Microbiological Examination of foods , Food poisoning, and types. , A brief account of various organisms related with food poisoning- *E. coli, Clostridium, Bacillus, Staphylococcus and Vibrio*

. **07 Hours**

3. Food biotechnology and Applications

Enzymes, organic acids, antibiotics, baker's yeast, single cell protein and Mushrooms. Biocolours, Concept of fermented foods and beverages, Probiotics, Prebiotics & Symbiotics, Genetically Modified Foods

04 Hours

Unit II

4. Unit Operations in Food Processing

Introduction, Food Engineering operations- raw material preparation, cleaning, sorting, grading and peeling. Food conversion operations- size reduction, emulsification, filtration, membrane separation, centrifugation and extraction. Pulsed Electric Field processing, High-Pressure Processing, **04 Hours**

5. Thermal Processing of Foods

Heat processing using steam or water, Blanching, Pasteurization, Heat Sterilization, Evaporation, Distillation, Extrusion and Canning. dielectric heating, ohmic and infrared heating. Dehydration, Intermediate Moisture Foods, Baking and Roasting, Heat processing using hot oils- Frying.

06 Hours

6. Non-Thermal Processing of Foods

Chilling, Freezing, Freeze-drying, Vacuum Concentration, Processing by chemical methods-sugar, salt, curing, smoking, acid and chemicals. Irradiation of foods. Controlled and Modified–Atmosphere Packaging. Concept of hurdle technology. **05 Hours**
Unit III **7. Food Product Development** Concept and need of new product development, testing and sensory evaluation,Development of product formulation and development,, Role of food ingredients in human health Packaging and shelf life of food products. Concept of Functional Foods and Nutraceuticals. **05 Hours** **8. Food laws, Labeling and Regulatory Bodies** Food Laws- General Standards and Regulations as per FSSAI, . Regulatory bodies governing food laws. Certification and labeling of foods. Concept of HACCP and AGMARK **05 Hours**
Text Books: 1. P.J.Fellows, Food Processing Technology. Principles and Practices, Second Edition, Woodland Publishing Ltd,Cambridge,England,2002 2. Avantina Sharma, Text Book of Food Science and Technology, International Book Distributing Co, Lucknow, UP, 2006
Reference Books: 1. Ramaswamy H & Marcotte M. Food Processing: Principles and Applications. Taylor & Francis. 2006

Program: Biotechnology		
Course Title: Bioprocess Modeling and Simulation		**Course Code: 18EBTE401**
L-T-P: 3-0-0	**Credits: 3.0**	**Contact Hours: 03 Hours/Week**
CIE Marks: 50	**SEE Marks: 50**	**Total Marks: 100**
Teaching Hours: 40	**Examination Duration: 03 Hours**	
Unit I **1.Introduction to modeling:** Introduction, Mathematical Modeling of Bioprocess Engineering System, General Aspects of the Modeling Approach, General Modeling Procedure: Fundamentals uses of mathematical model, scope of coverage, principles of formulation; Fundamental Laws of Modeling: continuity equation, energy equation with examples 05 Hours **2.Fundamental Laws of Modeling:** Equation of motion, transport equation, equation of state, phase and chemical equilibrium, chemical kinetics; Lumped and distributor parameters with examples 05 Hours **3. Mathematical models of Biochemical Engineering Systems:** Modeling of Batch reactors, modeling of CSTR, Numericals. Plug flow reactor, Fluidized bed		

reactor, Reactors used in effluent treatments, packed bed reactor. 05 Hours

Unit II

4. Use of MATLAB in Process Simulation:

Basics-Data analysis-curve fittings, Numerical integration, Euler and fourth order RungeKutta method, Input and Output in MATLAB. Solving problems using MATLAB by numerical integration, Euler and fourth order Runge Kutta methods. Simulation of CSTR and Batch Reactor, Simulation of Plug flow reactor. 10 Hours

4.Introduction to Process Design:

Steps involved in process design, Process flow diagram structure and hierarchical approach, importance of Material and Energy balance, selection of unit operations,

05 Hours

Unit III

5.Introduction to process simulation software

Bioprocess design with example: Process Description, Specifying Process Sections, Specifying Equipment Sharing, Initialization of Reaction Operations, Process Analysis, Cost Analysis and Economic Evaluation, Environmental Impact.

05 Hours

6. Use of Super Pro in Process Simulation:

Components and mixtures, Physical and Chemical properties of components, material and energy balance simulation, adding unit operation, scheduling the unit process, process cost estimation, sizing of the unit operation.Case study: Monoclonal antibody production, Enzyme production

05 Hours

Text Books:

1.Luyben W.L., Process Modeling Simulation and Control for Chemical Engineers., McGraw Hill, 1988.

2. Pauline M. Doran, “Bioprocess Engineering Calculation”, Blackwell Scientific Publications.

Reference Books:

1. Kenneth J. Beers. “Numerical Methods for Chemical Engineering Applications in MATLAB®”, Massachusetts Institute of Technology, Cambridge University press 2007 edition.

2. Bailey and Ollis, “Biochemical Engineering Fundamentals”, 2 nd ed.,McGraw Hill, 1986.

Program: Biotechnology		
Course Title: Plant and Animal Biotechnology		**Course Code: 15EBTE403**
L-T-P: 3-0-0	**Credits: 3.0**	**Contact Hours: 03 Hours/Week**
CIE Marks: 50	**SEE Marks: 50**	**Total Marks: 100**
Teaching Hours: 40	**Examination Duration: 03 Hours**	

Unit I

1. Introduction to plant tissue culture

Introduction and scope of plant tissue culture. Historical events in the development of plant tissue culture method. Practical applications and recent advances. Laboratory organization, Cell culture media and its components. Aseptic manipulation in plant tissue culture laboratory.

05 Hours

2. Methods and Techniques in Plant tissue Culture.

Callus and suspension culture, Micropropagation, Protoplast culture & Somatic Hybridization, Anther & Ovary Culture, Somatic Embryogenesis, Embryo & Endosperm culture, Somaclonal variation Germplasm storage by cryopreservation – pretreatment for cryopreservation, freezing, thawing, plant growth and regeneration and applications. **04 Hours**

3. Introduction to animal cell and tissue culture

History and Scope of Animal cell and Tissue culture, Advantages and Disadvantages of Cell culture, laboratory facilities for tissue culture. Culture media for cells and tissues. Laboratory layout, Essential equipments and Consumable items, Aseptic Techniques- elements of aseptic environment and culturing vessels Types of tissue culture – Primary cultures and Cell lines maintenance of cell line cultures **06Hours**

Unit II

4.Culture characterization and culture maintenance

Need for characterization, Parameters of Characterization, Cell Morphology, Confocal microscopy, DNA content analysis, Enzyme activity and Antigenic markers. Contamination in cell culture – sources, monitoring and eradication of contamination Cryopreservation and transportation. **04 Hours**

5. Animal Cell culture Scale up and Automation

Introduction to scale up and automation. Scale up in suspension culture: Continuous culture, Scale & complexities, Mixing & Aeration. Scale up in Monolayer culture: Multi surface propagators, Roller culture, Microcarriers, and Perfused Monolayer culture. Process control and Automation: Robotic cell culture and High throughput screening. **05 Hours**

6. Animal cell culture and Biopharmaceuticals production

Mammalian cells as desired expression systems for protein biopharmaceuticals, Construction and selection of high-producing cell lines, Medium development for mammalian cell culture, and Process development for mammalian cell culture. Single use disposable animal cell culture technologies for biopharmaceutical manufacturing. **06 Hours**

Unit III

7. Plant Cell culture and Secondary Metabolite production

Introduction, Selection of high yield cells and Mass cultivation of plant cells: Free cell suspension culture, Immobilized plant cell culture, and Two phase system culture. Elicitor induced accumulation of products. Biotransformation using plant cell cultures, Genetic modification and factors limiting large scale production of useful compounds. **05 Hours**

8. Animal cell culture applications and Tissue engineering

Hybridoma Technology and Animal cell culture applications in Monoclonal antibodies production. Products of Animal tissue culture – Erythropoietin, Tissue Plasminogen Activator & Factor VIII etc. Tissue Engineering – Introduction, Cell types, Extracellular matrix and Tissue engineering concepts. Artificial skin development by tissue engineering and its applications.

05 Hours

Text Books:

1. Introduction to Plant tissue culture Second edition. M K Razdan Oxford & IBH Publishing Co Pvt Ltd, New Delhi. 2003
2. Animal Cell Culture – Concept and Application by Sheelendra M Bhatt, Narosa Publishing House, New Delhi ISBN: 978-81-7319-926-4

Reference Books:

1. Introduction to Plant Cell, Tissue and Organ culture Sunil D Purohit PHI Learning Private Ltd, New Delhi 2013. ISBN – 978-81-203-4677-2
2. Culture of Animal Cells - A Manual of Basic Technique by R. Ian Freshney A John Wiley & Sons, Inc., Publication New York (2000)

Program: Biotechnology		
Course Title: Biopharmaceuticals		**Course Code: 15EBTE404**
L-T-P: 3-0-0	**Credits: 3.0**	**Contact Hours: 03 Hours/Week**
CIE Marks: 50	**SEE Marks: 50**	**Total Marks: 100**
Teaching Hours: 40	**Examination Duration: 03 Hours**	

Unit I

1. Introduction:

Introduction to pharmaceutical industry, API and pharmaceutical products, Formulation Industry, Introduction to dosage forms, Biopharmaceuticals & Biotechnology, Biopharmaceuticals: Current status & future prospects. Drug discovery & development process, Sources of Biopharmaceuticals, Dosage forms and routes of drug administration.

06 Hours

2. Pharmacokinetic and Pharmacodynamics of Peptide & Protein Drugs:

Introduction to pharmacokinetics and pharmacodynamics, drug as agonist & antagonist, Pharmacokinetics of protein therapeutics, ADME study for small molecules & protein therapeutics, optimization of pharmacokinetic profile, Pharmacodynamics of protein therapeutics, PK/PD

Models.

10 Hours

Unit II

3. The Drug Manufacturing Process:

Pharmacopeias, good manufacturing practices (GMP), good laboratory practices (GLP), manufacturing facilities, clean rooms, water plant & grades of water, production of final product & formulation, analysis of final product (Qualitative & Quantitative), documentation: SOP, specifications & records, batch manufacturing records (BMR), batch packaging records (BPR).

08 Hours

4. Therapeutic Agents:

The cytokines (Interleukins & Interferons), haemopoetic growth factors (erythropoietin), hormones of therapeutic interest (insulin & glucagon), preservation and clinical use of blood products, therapeutic enzymes, monoclonal & polyclonal antibodies, vaccines and vaccine technology (with appropriate case studies).

08 Hours

Unit III

5. Quality in Pharmaceutical Industry:

Quality Assurance & Quality Control, validation & qualification studies, aseptic fill-process validation, cleaning validation, Validation Master Plan, Qualification: IQ, OQ and PQ. Calibration of analytical instruments.

04 Hours

6. Regulatory issues and Drug product approval

Drug approval process (NDA & ANDA), Regulatory framework: Quality, Safety & Efficacy, Biosimilars and follow-on biologics, FDA & its Organizational structure, European regulations, Drug Registration in Japan, World harmonization of drug approvals (The ICH).

04 Hours

Text Books:

1. Biopharmaceuticals: Biochemistry & Biotechnology. Author: Gary Walsh. Second Edition, 2011. Pub: John Wiley & Sons.
2. Pharmaceutical Biotechnology: Fundamentals and Applications. Ed: Daan J.A. Crommelin et al. Third Edition. Publisher: Informa Healthcare.

Reference Books:

1. Molecular Biotechnology: Principles & Applications of r-DNA. Author: Bernard Glick & Jack Pasternak. 2002. Pub: Panima Books.
2. Manual of Industrial Microbiology & Biotechnology by Arnold L. Demain. 1999 Pub: ASM Press.
3. Biopharmaceuticals: An Industrial perspective. Authors: Gary Walsh & Brendan Murphy. 2009. Pub: Spring Books.

Program: Biotechnology

Course Title: Bioprocess Plant Design and Economics		Course Code: 15EBTE406
L-T-P: 3-0-0	Credits: 3.0	Contact Hours: 03 Hours/Week
CIE Marks: 50	SEE Marks: 50	Total Marks: 100
Teaching Hours: 40	Examination Duration: 03 Hours	

Unit I

1. Introduction to Process Design Development

Design project procedure, design information from the literature and other sources of information, flow diagrams, preliminary design, and comparison of different processes, Equipment design and specialization, factors affecting the investment. **06Hours**

2. General Design Considerations

Marketability of the product, availability of technology, Health and safety hazards, raw materials, human resources, loss prevention Environmental protection and utilities, site characteristics, plant location, plant layout, plant operation and control, utilities, structural design, storage, materials handling, materials and fabrication Selection, optimum design and design strategy. Waste disposal, physical treatment, chemical treatment and biological treatment, govt. regulations and other legal restrictions, community factors. Safety and hazard control measures.

10 Hours

Unit II

3. Cost Analysis and Manufacturing Cost

Cost Analysis: Factors involved in project cost estimation. Cash flow diagrams for the industrial operation, Cumulative cash position, factors affecting the Investment and production cost, Different methods employed for the estimation of the capital investment. Estimation of equipment cost by sixth tenth rule, Cost index. Marshall and swift installed – equipment indexes, Engineers News-Record construction index, Nelson –Farrar refinery construction index. and Chemical Engineering plant cost index Manufacturing Costs: Direct Production costs, indirect cost and fixed charges (including depreciation, taxes, insurance, rental costs etc.)

10 Hours

4. Bioprocess Economics:

Economic analysis for the production of following Products.(Historical Perspective, Fermentation Technology, Recovery of product and process economics of following products)

- High volume, low value products. (Citric acid, Ethanol and Amino acids etc)
- Medium volume, medium value products.(Antibiotics, Crude Enzymes and Vitamins etc)
- Low volume, high value products. (MAb, purified Enzymes and Therapeutic proteins etc)

06 Hours

Unit III

5. Profitability Analysis and Optimization Technique

i) Importance of profitability analysis in investment decision making. Different Methods for calculating the profitability. Minimum Acceptable Rate of return. Methods that Do not consider Time value of money. **04 Hours**

ii) General procedure to find the optimum conditions, factors affecting the optimization, comparison of analytical and graphical methods. Linear programming, Simultaneous Equations and dynamic programming **04 Hours**

Text Books:

1. Peters and Timmerhaus, Plant Design and Economics for Chemical Engineers, McGraw Hill 5^{th} edition, 2004.
2. Chemical Engineering plant design, Frank C Vilbrandt and Charles E Dryden , McGraw Hill 4^{th} edition, 1959

Reference Books:

1. Rudd and Watson, Strategy of Process Engineering, Wiley, 1987.
2. Backhurst, J.R And Harker, J. H - Process Plant Design, Heieman Educational Books, (1973).
3. Biochemical Engineering Fundamentals, James E Baily David F Oillis. McGraw-Hill 2^{nd} Internatio Edition

Program: Biotechnology		
Course Title: Quality Assurance & Regulations		**Course Code: 18EBTE403**
L-T-P: 3-0-0	**Credits: 3.0**	**Contact Hours: 03 Hours/Week**
CIE Marks: 50	**SEE Marks: 50**	**Total Marks: 100**
Teaching Hours: 40	**Examination Duration: 03 Hours**	

Unit I

1. Introduction

Introduction to Quality and Quality Regulation, Validation and Regulatory Affairs in Bio (Pharmaceutical) Manufacturing: An Introduction to FDA Operations & Industry Compliance Regulations, The Fundamentals of Regulatory Compliance with respect to Good Clinical Practice (GCP), Good Manufacturing Practice (GMP) & Good Laboratory Practice (GLP).

06 Hours

2. Quality and Quality Management

Terms Relating to Quality Management System, Quality Policy, Quality Objectives, Quality Planning, Quality Control, Quality Assurance, Quality Improvement, Continual Improvement, Effectiveness, Efficiency; Relating to Process and Product, Quality Characteristics; Terms Relating to Conformity, Non-Conformity, Defect, Preventive Action, Corrective Action, Rework, Repair, Scrap, Concession, Deviation Permit, Release; Terms Relating to Documentation.

10 Hours

Unit II

3. Process Validation

Definition and concept of validation, An introduction to process validation, Validation and Qualification, IQ, OQ and PQ. A Review of Prospective, Concurrent, Retrospective Validation Calibration and performance evaluation. Validation of Water & Thermal Systems, including HVAC Facilities & Cleaning Validation. Validation septic Processes, Computer software validation in pharmaceuticals (CSV).

10 Hours

4. Analytical Method Validation

FDA and ICH guidelines. Analytical method validation, Specificity, Linearity, Accuracy, Precision, Limits of detection (LOD) and quantification (LOQ), Minimum detectable amount (MDA), Sample stability and method robustness, System suitability, Statistical process control for HPLC, Troubleshooting out-of-control systems, Case studies, Validation of Analytical Methods.

06 Hours

Unit III

5. Quality Standards

Introduction, ISO 9000 Series of Standards, Management Responsibility, Quality System, Contract Review, Design Control, Document and Data Control, Control of Quality Records, Internal Quality Audits, Training, Servicing, Environmental Management System.

04 Hours

6. Implementation and Regulation

Role of QC and QA in Bio/Pharmaceutical organization, Quality System, Contract Review, Design Control, Document and Data Control, Product Identification and Traceability, Process Control, Control of Quality Records, Internal Quality Audits, Training.

04 Hours

Text Books:

1. Pharmaceutical Process Validation by Robert Nash and Alfred Wachter, Marcel Dekker. Publisher: Marcel Dekker Inc. 2011.
2. Good Manufacturing Practices for Pharmaceuticals: A Plan for Total Quality Control From Manufacturer to Consumer, Sidney J. Willig, Publisher: Marcel Dekker Inc. 2005.

Reference Books:

1. Validation of Pharmaceutical Processes: Sterile Products, Frederick J. Carlton (Ed.) and James Agalloco (Ed.), Marcel Dekker, 2008.
2. Validation Standard Operating Procedures: A Step by Step Guide for Achieving Compliance in the Pharmaceutical, Medical Device, and Biotech Industries, Syed Imtiaz Haider, Saint Lucie Press, 2004.

Program: Biotechnology		
Course Title: Downstream Processing Technology Lab		**Course Code: 15EBTP401**
L-T-P: 0-0-1	**Credits: 1.0**	**Contact Hours: 02 Hours/Week**
CIE Marks: 80	**SEE Marks: 20**	**Total Marks: 100**
Teaching Hours: 24	**Examination Duration: 03 Hours**	

List of Experiments

1. Cell disruption technique: Sonication.
2. Solid-liquid separation method: Filtration.
3. Solid-liquid separation methods: Centrifugation.
4. Product enrichment operations: Two – phase aqueous extraction.
5. Isoelectric precipitation of proteins
6. Membrane Separation methods: Tangential Flow Filtration
7. Chromatography techniques: Gel exclusion chromatography
8. Chromatography techniques: Ion exchange chromatography
9. Determination of protein molecular weight: SDS-PAGE
10. Estimation of metabolite using high performance liquid chromatography

Text Books/ Reference Books:

1. Bioseparations: Principle & Technique; Shiv Shankar B.; PHI LEARNING PRIVATE LIMITED;2009
2. Bioseparations: Downstream Processing for Biotechnology; Paul A. Belter E. L. Cussler Wei-Shou Hu; WILEY INDIA PVT. LTD.-NEW DELHI; 2011
3. Separation Processes in Biotechnology; Juan A. Asenjo; CRC Press (28 June 1990).
4. Protein Purification : Principles and Practice; Robert K Scopes;Springer; 2010 December

Year of offering: 2018-19
Batch- 2015-19 (8^{th} semester)

Program: Biotechnology		
Course Title: Biological Data Analysis		**Course Code: 18EBTE402**
L-T-P: 3-0-0	**Credits: 3.0**	**Contact Hours: 03 Hours/Week**
CIE Marks: 50	**SEE Marks: 50**	**Total Marks: 100**
Teaching Hours: 40	**Examination Duration: 03 Hours**	

Unit I

1.Introduction to Basic statistics:

Strategy of Experimentation, History of the Design of Experiments, Basic Principles of DOE: Randomization, Replication, Blocking, Multi-factor Designs, Confounding; Steps for Planning, Conducting and Analyzing an Experiment, Typical applications of Experimental design, Basic Principles, Guidelines for Designing, Concepts of random variable, probability, density function,cumulative distribution function. Concept of confidence level. Statistical Distributions: Normal, Log Normal &Weibull distributions. Hypothesis testing, Probability plots.

04 Hours

2. Screening Design:

Introduction, Terminology: factors, levels, interactions, treatment combination, Orthogonal array, PB design, analysis of PD design, Numericals. **05 Hours**

3.Full Factorial Design:

Basic Definitions and Principles, The Advantage of Factorials, The Two-Factor Factorial Design, Statistical Analysis of the Fixed Effects Model, Model Adequacy Checking, Estimating the Model Parameters, Concept of the General Factorial Design, 2^k Factorial Design, The 2^2Design, The 2^3 Design, The General 2^k Design. **07 Hours**

Unit II

4. Response surface methods:

Introduction, Central composite design, Box Behnken design, importance of counter and surface plots. **05 Hours**

5. R Programming Basics:

Overview of R programming, Environment setup with R Studio, R Commands, Variables and Data Types, Control Structures, Vectors, Factors, Functions, Matrices, Arrays and Lists. **06 Hours**

6. Interfacing:

Interfacing R to other languages, Parallel R, Basic Statistics: Linear Model, Generalized Linear models, Non-linear models, Time Series, Autocorrelation and Clustering. **05 Hours**

Unit III

7. Introduction to Bioconductor for Sequence Data:

Sequencing Resources, Ranges Infrastructure, DNA /amino acid sequence from FASTA files, Reads from FASTQ files, Aligned Reads from BAM files, Called Variants from VCF files, Genome Annotations from BED, WIG, GTF files. **04 Hours**

8. Biological Data Analysis:

Preparing count matrices, The DESeq, DataSet, sample information, and formula design, exploratory analysis and visualization, Differential expression analysis, Plotting results, Annotating and exporting results **04 Hours**

Text Books:

1. R for Everyone: Advanced Analytics and Graphics: b y Jared P. Lander Addison Wesley Data & Analytics Series, 2013.
2. Design and analysis of experiments" by D.C. Montgomery, 7th edition John Wiley and sons, NewYork

Reference Books:

1. A Little Book of R for Bioinformatics: by Avril Coghlan, Release 0.1
2. Das. M.M. and Giri N.C. : - Design and Analysis of Experiments

Program: Biotechnology		
Course Title: Nano Biotechnology		**Course Code: 17EBTE401**
L-T-P: 3-0-0	**Credits: 3.0**	**Contact Hours: 03 Hours/Week**
CIE Marks: 50	**SEE Marks: 50**	**Total Marks: 100**
Teaching Hours: 40	**Examination Duration: 03 Hours**	

Unit I

1. Introduction to Nanobiotechnology

Historical background, nature, scope and content of the subject, multidisciplinary aspects, industrial, economic and societal implications of Nanotechnology. Nanolithography, Nanofabrication, Bottom-Up versus Top-Down approaches. **08 Hours**

2. Nanomaterials and Nanostructures

Buckyballs, Nanotubes, Fullerenes, Magnetic systems, Carriers, Dendrimers, Nanoparticles, Membranes &Matrices, Nanoshells, Quantum Dot, Nanocrystals, hybrid biological: inorganic devices, Other Biological Nanostructures **06 Hours**

Unit II

3. Characterization of Nanoparticles and Nonmaterial - I

Optical methods, Electron microscope, Scanning tunneling microscopy, Transmission Electron Microscopy, Atomic force microscopy, XRD, etc. **07 Hours**

4. Characterization of Nanoparticles and Nonmaterial - II *In-vitro* laboratory tests on the interaction of nanoparticles with cells. Assessment of the toxic effects of nanoparticles based on *in-vitro* laboratory tests. Identification of pathogenic organisms by magnetic nanoparticle-based

techniques	**07 Hours**

Unit III

5. Nanobiology

Biosynthesis of nanoparticles by microbes/plants, self assembly, interaction between biomolecules and nanoparticles, hybrid-nano bio assemblies, nano-probes and nano-devices, Analytical applications. **06 Hours**

6. Applications of Nanobiotechnology

Molecular Nano-machines, Nanobiotechnology and drug discovery and delivery, Nanodiagnotics, Nanorobots, Molecular Motors. Health risks and challenges **06 Hours**

Text Books

1. Biological molecules in Nanotechnology by Stephen Lee and Lynn M Savage
2. Nanobiotechnology Protocols, Rosenthal, Sandra J and Wright, David W., Humana Press, 2005

Reference Books

1. Nanotechnology in biology & medicine by tuan vo-dinh, Taylor Francis.
2. Nanotechnology By M. KARKARE (2008), IK Intl. Publishers

Program: Biotechnology		
Course Title: Project Work		**Course Code: 15EBTW402**
L-T-P: 0-0-14	**Credits: 14**	**Contact Hours: 42 Hours/Week**
CIE Marks: 50	**SEE Marks: 50**	**Total Marks: 100**
Teaching Hours: NA	**Examination Duration: 03 Hours**	

Preamble:

The engineering graduate's capstone project is an essential part of the curriculum structure which integrates all the skills acquired during all the theory and laboratory courses addressing Bioprocess Engineering and Molecular Biotechnology verticals. The capstone project work requires exhaustive literature survey to define the problem statement and research objectives. Various optimization strategies help the student to select the best alternative and feasible solution. Capstone project emphasizes on solving real time problems depicting societal benefits and industrial applications. Students gain hands on experience during their capstone Project implementation. Projects also facilitate students to present their work on different platforms likes seminars, national and international conferences. Capstone project help students in their jobs opening and higher studies as well in higher research careers.

Guidelines:

1. Project has to be carried out in teams.
2. Every team needs to maintain laboratory work book which contains details of all the work carried out in the laboratory.
3. Make entries in log books for instrument usage.
4. Adhere on timely report submission to the coordinator.
5. Provide requisitions hand before for any project work

Review committee:

Review committee is formed by the project coordinator taking into consideration each review committee has faculty experts of all the domains. Review committee consists of the guide of the respective project group also.

Project evaluation:

Sl. No	Phase	Marks	Review
1	Definitive Phase	25	Guide/s
2	Final submission	25	Committee
3	SEE	50	External
	TOTAL	100	

Program: Biotechnology		
Course Title: Project Work		Course Code: 20EBTW402
L-T-P: 0-0-11	Credits: 11	Contact Hours: 33 Hours/Week
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hours: NA	Examination Duration: 03 Hours	

Preamble:

The engineering graduate's capstone project is an essential part of the curriculum structure which integrates all the skills acquired during all the theory and laboratory courses addressing Bioprocess Engineering and Molecular Biotechnology verticals. The capstone project work requires exhaustive literature survey to define the problem statement and research objectives. Various optimization strategies help the student to select the best alternative and feasible solution. Capstone project emphasizes on solving real time problems depicting societal benefits and industrial applications. Students gain hands on experience during their capstone Project implementation. Projects also facilitate students to present their work on different platforms likes seminars, national and international conferences. Capstone project help students in their jobs opening and higher studies as well in higher research careers.

Guidelines:

6. Project has to be carried out in teams.
7. Every team needs to maintain laboratory work book which contains details of all the work carried out in the laboratory.
8. Make entries in log books for instrument usage.
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Review committee:

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Project evaluation:

Sl. No	Phase	Marks	Review
1	Definitive Phase	25	Guide/s
2	Final submission	25	Committee
3	ESA	50	External
	TOTAL	100	

CURRICULUM SCHEME & SYLLABUS OF 2015-2020 BATCH
I Semester - II Semester

(Year of introduction-2015, Faculty-A, Architecture-AT, Core course-C, Humanities-H, Lab-L, Elective-E, Internship-I, Practice-P, W-Project)

B. Arch. Semester I (2015-20)

No	Code	Course	Category	L-S-P	Credit	Contact Hours	ISA	ESA	Total	Exam Duration
1	15AATC101	Architectural Design – I	Design	2-3-0	5	6	70	30	100	NA
2	15AATC102	Building Const & Materials – I	Construction	1-3-0	4	6	70	30	100	NA
3	15AATC103	Graphics – I	Communication	1-3-0	4	6	70	30	100	NA
4	15AATC104	Visual Art & Basic Design	Design	2-1-0	3	4	70	30	100	NA
5	15AATC105	Architecture & Culture	Design	0-1-0	1	2	70	30	100	NA
6	15AATC106	Skill Development Workshop I	Design	2-0-0	2	2	70	30	100	NA
7	15AATC107	Structures – I	Construction	3-0-0	3	3	50	50	100	3 HOURS
8	15AATH101	Constitution law	Profession	0-0-0	Audit	1	50	50	100	3 HOURS
TOTAL				11-11-0	22	30	520	280	800	

ISA :Internal Semester Assessment , ESA : End Semester Assessment , P : Practical, S : Studio , L : Lecture,

Credit	Lecture Hours	Studio Hours	Practical Hours
1	1	1.5	2

Program Head

Signature of Dean (Academic Affairs)

B. Arch. Semester II (2015-20)

No	Code	Course	Category	L-S-P	Credits	Contact Hours	ISA	ESA	Total	Exam Duration
1	15AATC108	Architectural Design – II	Design	1-4-0	5	7	70	30	100	NA
2	15AATC109	Building Const & Materials – II	Construction	1-3-0	4	6	70	30	100	NA
3	15AATC110	Graphics – II	Communication	0-3-0	3	5	70	30	100	NA
4	15AATC111	Measure Drawing	Design	0-2-0	2	4	70	30	100	NA
5	15AATC112	History of Architecture I	Design	2-0-0	2	2	70	30	100	NA
6	15AATC113	Skill Development Workshop II	Design	0-1-0	1	2	70	30	100	NA
7	15AATC114	Structures – II	Construction	3-0-0	3	3	50	50	100	3 HOURS
8	15AATP101	Surveying	Construction	2-0-0	2	2	50	50	100	3 HOURS
TOTAL				9-13-0	22	31	520	280	800	

ISA :Internal Semester Assessment , ESA : End Semester Assessment , P : Practical, S : Studio , L : Lecture,

Credit	Lecture Hours	Studio Hours	Practical Hours
1	1	1.5	2

Program Head

Signature of Dean (Academic Affairs)

I SEMESTER

Program : Architecture		
Course Title: ARCHITECTURAL DESIGN - I		**Course Code: 15AATC101**
L-S-P: 2-3-0	**Credits: 5**	**Contact Hours: 6**
ISA : 70	**ESA: 30**	**Total Marks: 100**
Teaching Hours: 96	**Examination Duration: NA**	

UNIT I: Introduction to Human proportions, Anthropometry and space standards

Detailed study of spaces requirements with respect to single unit dwellings such as living, dining, bedrooms, kitchen, toilet etc. minimum standards for movements and vehicular data expression of design using the following.

- Spatial perception of spaces
- Study of anthropometrics
- Circulation
- Forms and integrity
- Space planning
- Architectural expression

UNIT II: Introduction to Space making elements.

Defining the core space making elements like wall, openings, column, floors, roofs, stairs etc. its usage and importance in designing spaces of various needs. Measuring and plotting existing buildings to understand element and its role in space creation.

UNIT III: Designing a multi room space.

Designing and organizing spaces of various purposes with respect to movement, circulation, furniture layout, aesthetical relation of traditions, culture etc. expression of creativity in form making
The design issues to be addressed are

- Various basic human functions and their spatial implications
- Formulation of concepts
- Anthropometry and furniture layout
- Movement and circulation diagram
- Interior volumes and space articulation through different materials.
- Integration of form and function.
- Study models.

The design projects could be, my dream house, guest house, farm house, tree house, cottage, etc.

Text Books:NIL

Reference Books: Ching, Francis DK, Architecture: Form, Space and Order, 2nd ed.Van Nostrand Reinhold, New York, 1999

Scheme for End Semester Examination (ESA)
Evaluation of Portfolio, assignments by internal and external examiners / Viva.

Program : Architecture

Course Title: BUILDING CONSTRUCTION & MATERIALS - I		**Course Code: 15AATC102**
L-S-P: 1-3-0	**Credits: 4**	**Contact Hours: 6**
ISA: 70	**ESA Marks: 30**	**Total Marks: 100**
Teaching Hours: 96	**Examination Duration: NA**	

UNIT I:

Introduction to various building components and their function, various conventions used for drawing in plan, section and elevations for different construction materials. Introduction to various tools commonly used for excavation, masonry and carpentry work.

Brick Construction – Types of brick masonry walls including bonds, pilasters, lintels and arches.

UNIT II:

Stone construction – Types of walls including bonds, lintels and arches.

Foundation – Types and behavior of soils. Functions and types of foundations, foundations for load bearing structure in brick and stone. Plinth formation, coping and damp proof course (DPC).

UNIT III:

Bricks and Clay products – Types, properties, uses and manufacturing process in brief.

Stones – Types, properties and uses, methods of quarrying in brief

Lime – Varieties, properties and uses in construction

Cement – Types, properties, uses, field tests.

Sand – Availability, properties

Aggregate – Sources and types

Mortar – Preparation and application

Blocks – Hollow and solid blocks in concrete, adobe (stabilized mud) blocks.

Reference Books:

- McKay J.K Building Construction Metric Vol 1-4, 4th edi Orient Longman Pvt. Ltd, Mumbai,2002
- “Construction Technology” volume-I by R Chudley, ELBS & Longman group Ltd.
- Barry R, “The construction of buildings” , Vol-2, 5th Edi, East West Press, New Delhi 1999.
- Bindra S.P and Arora S.P, Building Construction-Planning Techniques and Method of Construction, 19th edi, Dhanpat Rai Pub ,NewDelhi, 2000
- “Building Construction” by Janardhan Jha, Khanna New-Delhi.
- Rangawal S.C ,“Building Construction” 22nd Edi, charotar Publishing house, Anand, 2004
- “Building Materials” by S K Duggal, IBH New Delhi.
- Sushil Kumar T.B of Building Construction 19th edi, Standard Pub House, NewDelhi, 2003.

Text Books:NIL

Scheme for End Semester Assessment (ESA)

Evaluation of Portfolio, assignments by internal and external examiners / Viva

Program : Architecture		
Course Title: GRAPHICS - I		Course Code: 15AATC103
L-S-P: 1-3-0	Credits: 4	Contact Hours: 6
ISA: 70	ESA: 30	Total Marks: 100
Teaching Hours: 96	Examination Duration: NA	

UNIT I:

1: Introduction to the basic principles of drawing

Introduction to the basic principles of drawing, introduction to drawing equipments and their uses, sign conventions, Lettering and Dimensioning, Architectural Scale

2: Plane geometry – Lines, Angles, Curves and regular Polygons

Construction of triangles, quadrilaterals, curves and regular polygons

3: Solid Geometry – Points and Lines

Introduction to solid geometry, Orthographic projections of points and lines

4: Solid Geometry – Planes and Solids

Problems on Orthographic projections of planes and solids

UNIT II:

5: Three Dimensional Representation – Oblique, Axonometric & Isometric

Problems on Oblique, axonometric & Isometric projection of solids

6: Technical drawing

Simple floor plans, elevation, sections, of simple building.

UNIT III:

7: Architectural Detailing

Reading and representing building components details such as door frames fixing,chejja, plinth formation,steel joinery etc.

Text Books:

I. Bhat N.D. and Panchal V.M, Engineering Drawing, Plane and solid geometry, Charotar Publishing house, Anand 2002.

II. Francis D.K. Ching, Architectural Graphics, 4th Edition, John Wiley & Son, New York

References:

III. I H Morris, Geometrical Drawing for Art students.

IV. K R Gopalkrishna, Engineering Drawing Vol I & II combined edition, Bangalore, 2001,

V. K. Venugopal, “Engineering Drawing and Graphics” New Age

i. International (P) Ltd, New Delhi 2001.

VI. Francis D.K. Ching, Design Drawing, 4th Edition, John Wiley & Son, New York

Scheme for End Semester Assessment (ESA)

Evaluation of Portfolio of Term Work and tests.

Program : Architecture		
Course Title: Visual Art & Basic Design		Course Code: 15AATC104
L-S-P: 2-1-0	Credits: 3	Contact Hours: 4
ISA: 70	ESA: 30	Total Marks: 100
Teaching Hours: 64	Examination Duration: NA	

ISA :Internal Semester Assessment, ESA : End Semester Assessment

UNIT I:

1. **FREE HAND AND OBJECTS DRAWING**: Observation and recording through free hand drawing by using various drawing and sketching tools like pencil, pen, charcoal crayons etc.
2. **ARCHITECTURAL SKETCHING**: Drawing of human figures, vehicles, small buildings, furniture, simple and complex geometrical objects with an emphasis on the perception of details and expressing them in lines, colour texture etc.
3. **PAINTING** : Understanding of colour wheel, components , types of colour, colour schemes, value and intensity by using painting tools and materials like brushes, paper, water color, poster colour etc.

UNIT II:

4. **Elements of Visual Composition:** Understanding role of the following basic elements of visual design existing in paintings, compositions, murals, sculptures, building and in a nature – Dots, Lines, Planes, Patterns, Shapes, Forms, Spaces, Colour, Texture, Levels, Light, Fenestration's. Study of Textures and Textures Schemes.
5. **Principles of Visual Compositions :** Understanding and using principles like Repetition, Rhythm, Radiation, Focal point, Symmetry, Asymmetry, Background, Foreground, Sense of Direction, Harmony, Balance and Proportion.

UNIT III:

6. **SCULPTURE**: Creating and carving sculpture, understanding the different media used for sculpture like plaster of paris, clay, wire, wax etc.
7. **EXPLORATION OF ART FORMS**- study of traditional and contemporary art forms, relation between art and architecture from earliest times to present.

Reference Books:

Robert Gill : Rendering with pen & ink , Thames & Hudson New York 1984
Robert Gill : Basic Rendering ,Thames & Hudson New York 1991
John Chen : Architecture in pen & ink, McGraw-Hill Inc- USA 1995
Colin Saxton : Art School, Chartwell Books Inc New Jersy.

Scheme for End Semester Assessment (ESA)

Evaluation of Portfolio, assignments by internal and external examiners

Program : Architecture		
Course Title: Architecture and Culture		**Course Code: 15AATC105**
L-S-P: 0-1-0	**Credits: 1**	**Contact Hours: 2**
ISA: 70	**ESA: 30**	**Total Marks: 100**
Teaching Hours: 32	**Examination Duration: NA**	

UNIT I:

- Introduction to Culture- Relevance & influence of Culture on Architecture.

CULTURAL INFLUENCES IN ANCIENT INDIA

Indus valley civilization Town -planning in Mohenjo-Daro –Tree & mother goddess worship . Harappa and lothal –the great bath, the great granary – sumps, manholes, underground drainage etc

Symbolism in early Buddhist architecture in India – Stupas at Sanchi and Amaravati

Symbolism in Tibetan Buddhism manifestation in the architecture of monasteries (gompa) and palaces – Potala palace, Palpung monastery

UNIT II:

- TRADITIONAL ART &ARCHITECTURE OF WEST COAST OF INDIA

Salient features of the house –
Elevation -
Roof wood frame details
Contemporary expressions

UNIT III:

- TRADITIONAL ART &ARCHITECTURE OF KARNATAKA

Salient features of the house –
Elevation -
Roof wood frame details

- Contemporary expressions

Reference Books:

1. A.Thampuran "Study of Architecture Forms in Malabar coast" Wiley and sons Inc
2. George Mitchell - Temple towns of Tamilnadu- Marg publications Bombay 1993 .
3.Raj Rewal, etal – Architecture in India – Ministere des relations exteriieres , frances

Scheme for End Semester Assessment (ESA)

The evaluation of portfolio worked during the course by internal and external examiners.

Program : Architecture		
Course Title: SKILL DEVELOPMENT WORKSHOP – I		**Course Code: 15AATC106**
L-S-P: 2-0-0	**Credits: 2**	**Contact Hours: 2**
ISA: 70	**ESA: 30**	**Total Marks: 100**
Teaching Hours: 32	**Examination Duration: NA**	

UNIT I:

Allied skills for Architecture

Introduction to Basics of the following associated skills to enhance and understand spatial, scale, material, and aesthetical requirements of design, construction and presentation.

- Model making
- Wood working
- Murals and sculpting (Using Metal, Wood, Clay & POP)

UNIT II:

Tools and materials

Hands-on working of advance model making and working tools. Various types of materials used for making scaled models, sculpting etc. (Paper, card sheet, mount board Art card, foam, metal, plaster, clay, wax glass etc.)
Methods of cutting, joining, texture development, glue welding and joinery

UNIT III:

Reusing and Recycling

Designing, remoulding and producing useful products from waste materials. Various Methods of working and handling trash. Adding aesthetical, artistic and product value to used and waste materials or byproducts.

Text Books: NIL

Reference Books: NIL

Scheme for End Semester Assessment (ESA)

Checking of Models and products by external and internal exam

Program : Architecture		
Course Title: Structure-I		Course Code: 15AATC107
L-S-P: 3-0-0	Credits: 3	Contact Hours: 3
ISA: 50	ESA: 50	Total Marks: 100
Teaching Hours: 48	Examination Duration: 3 HOURS	

1. **UNIT I: Evolution of Structures:** Historical perspective and definition of structure as a device for channeling loads that result from the use or presence of the building in relation to ground.

2. **Structural systems and its elements overview:** Vertical/lateral systems: wall, cantilever, moment frame, braced frame, horizontal one-way and two-way systems: truss, arch, vault, dome, shell, cable stayed, suspended, membrane.

3. **Experiment with Structures:** Example-1: Build a structure using drawing sheet paper having three and four supports to carry a weight of 2 to 3 kg on it. Example-2: Make a column of height 30mm to carry a weight of 3kg. Example-3: Build a beam of span 450mm simply supported to carry a weight of 1kg at mid span.
4. **Basic structural Materials:** Qualities of building materials Mechanical properties of Structural materials: wood, masonry, steel, concrete, fabric; energy use and rupture length. Advantages and disadvantages of Structural Materials and choice of Structural Material for domestic buildings, Industrial buildings, Tall buildings and Long Span buildings.
5. **Loads on Structures:** Dead load (DL), live load (LL), static, dynamic, impact, and thermal loads. Principle of transmissibility of forces. Understanding load flow by tributary load and load path (slab, beam, and girder) and vertical members (post, wall, and footing); load path.

6. **Sectional properties:** Centroid, difference between centroid and centre of gravity, role of symmetry in locating centroid, moment of inertia, obtaining moment of inertia of unsymmetrical by applying parallel and perpendicular axis theorems.

UNIT II

7. **Equilibrium of Forces:** Force, characteristics of a force, Reaction, Moment of a force and Principle of Support conditions and their significance in resistance to forces and to maintain equilibrium.

8. **Basic principles of mechanics:** Tension, compression, shear, bending, torsion; symbols and notations; force and stress.

9. **Stress/strain relations (Hooke's Law):** Material response to applied loads, intensity of stress, strain and types. Stress strain diagrams for major building materials, Modulus of Elasticity, linear and non-linear materials, elastic, plastic, and elastic-plastic materials; Poisson's Ratio; Thermal stress and strain.

10. **Graphic vector analysis:** Resultant and equilibrant of coplanar, concurrent and non-concurrent force systems. Parallelogram, force polygon, resultant, equilibrant, components; numeric method.

UNIT III

11. **Truss**: Truss concept of triangulation, common truss configurations, innovative forms for truss of given span.

12. **Truss loads and reactions**: For a given configuration of the trusses and center to center spacing, calculations of the dead weight of the truss and the dead weight of the roof cover and support reaction loads analysis of simple trusses by method of joints..

Text Books:Engg Mechanics by S.S.Bhavikatti III-edition .Vikas publications New Delhi.

Reference Books:

***REFERENCES*:**

1) STRUCTURES - Martin Bechthold, Daniel L Schodek, and PHI Learning Private limited, Sixth Edition 2) Structure in Architecture, the building of buildings, by Mario Salvadori 3) Structure and Design, by G. G. Schierle 4) Engg Mechanics – R K Bansal & Sanjay Bansal, Laxmi publications, New Delhi, 3rd ed 5) Engg Mechanics, Ferdinand L Singer, Harper Collins publications, 3rd ed.

Scheme for Semester End Examination (ESA)

Sl.No	8 Questions to be set of 20 Marks Each	Chapter Number	Instructions
I	Q.No.-1, Q.No.-2, Q.No.-3	1,2,3,4,5	Solve Any **2** out of **3**
II	Q.No.-4, Q.NO – 5 Q.No.-6,	6,7,8,9	Solve Any **2** out of **3**
III	Q.No.-7, Q.No.-8	10,11	Solve Any **1** out of **2**

Program : Architecture		
Course Title: CONSTITUTIONAL LAW		Course Code: 15AATH101
L-S-P: 1-0-0	Credits: 0	Contact Hours: 1
ISA: 50	ESA: 50	Total Marks: 100
Teaching Hours: 16	Examination Duration: 3 HOURS	

UNIT I:

- Preamble to the Constitution of India
- Evolution of Constitutional Law.
- Scope and extent of fundamental rights under part-III
- Details of exercises of rights,
- Limitations and important cases
- Relevance of Directive principals of State Policy under part IV.
- Significance of Fundamental duties under part IV (a)

UNIT II:

- Union Executive-President, Vice President, Prime Minister, Council of Ministers, Parliament and Supreme Court of India
- State Executive-Governor, Chief Minister, Council of Ministers, Legislature and High Courts.
- Functions of Panchayats, Muncipalities and Corporations.
- Constitutional Provisions for scheduled castes and tribes, women and children and backward classes.

UNIT III:

- Emergency provisions.
- 42^{nd}, 44^{th}, 86th Constitutional amendments and Amendment procedure under Article 368.
- Electoral Process

Text Books:

1. "Introduction to the Constitution of India" by Durga Das Basu 2004

Reference Books:

1. "An Introduction to Constitution of India" by Pylee
2. "Constitution of India" -- by VN Shukla

Scheme for Semester End Examination (ESA)

Sl.No	8 Questions to be set of 20 Marks Each	Chapter Number	Instructions
I	Q.No.-1, Q.No.-2, Q.No.-3	1	Solve Any **2** out of **3**
II	Q.No.-4, Q.NO – 5 Q.No.-6,	2	Solve Any **2** out of **3**
III	Q.No.-7, Q.No.-8	3	Solve Any **1** out of **2**

II SEMESTER

Program : Architecture		
Course Title: ARCHITECTURAL DESIGN – II		Course Code: 15AATC108
L-S-P: 1-4-0	Credits: 5	Contact Hours: 7
ISA: 70	ESA: 30	Total Marks: 100
Teaching Hours: 112	Examination Duration: NA	

UNIT I:

1. **Introduction to Design theory**

- Principles of architectural composition:
- General principles like unity, Balance, Proportion, Scale, Contrast, Harmony, Accentuation, and Restraint. Repose, Vitality, Strength in the built environment
- Underlying Ordering Principles Symmetry, hierarchy, datum, axis, scale and proportion rhythm in the built environment.

UNIT II

1. **Introduction Multiuser/ public spaces**

Defining and understanding various design aspects needed for multi /semipublic/public user spaces.

UNIT III:

Designing a multi user multi level room space.

To develop skills for comprehensive understanding and dealing with Architecture Provide skills for designing multi-user and multi level spaces.

The design issues to be addressed are

- Multi user and multi level space formation
- Integration of material and form.
- Integrate the horizontal and vertical circulation.
- Develop skills to correlate the materials and the resulting form.
- Details pertaining to the disabled, aged people and children.

The tentative list of suggested projects to be covered as design problems: Architectural Exhibition / display spaces Multi level museum, academic spaces, kindergarten school, Recreational spaces fast food/ restaurant

Text Books:NIL

Reference Books:

1. Bernard Rudofsky, *Architecture without Architects* .a short introduction to Non-Pedigreed Architecture. Academy Edition London
2. *Francis D K Ching,* Form Space and Order
3. *J.M.Zunde* ,Design Procedures – level 4
4. *Mike Dartion,* The illustrated Book of Architect & Architecture

Scheme for End Semester Assessment (ESA) Evaluation of Portfolio, assignments by internal and external examiners/viva

Program : Architecture		
Course Title: BUILDING CONSTRUCTION & MATERIALS - II		**Course Code: 15AATC109**
L-S-P: 1-3-0	**Credits: 4**	**Contact Hours: 6**
ISA: 70	**ESA: 30**	**Total Marks: 100**
Teaching Hours: 96	**Examination Duration: NA**	

UNIT I:

Construction: Introduction to Doors**:**

Study of various types of timber doors viz, Ledged & Battened, Ledged, Battened & Braced door, Framed & Paneled door, partly glazed & Partly Paneled door, Flush doors

Materials : Timber, Commercial wood

UNIT II:

Introduction to Windows:

Study of various types of glazed timber windows viz, Casement window, Corner window, Bay window

Introduction to Roofs:

Study of conventional timber roofs for moderate spans: Flat roof, Lean to roof, Couple roof, Collar beam roof, King and Queen Posts.

UNIT III:

Introduction and study of:

Bamboo, Cane, Thatch, Roofing materials, paints for interior and exterior.

Reference Books:

I. McKay J.K Building Construction Metric Vol 1-4, 4th edi Orient Longman Pvt. Ltd, Mumbai,2002
II. “Construction Technology” volume-I by R Chudley, ELBS & Longman group Ltd.
III. Barry R, “The construction of buildings” , Vol-2, 5th Edi, East West Press, New Delhi 1999.
IV. Bindra S.P and Arora S.P, Building Construction-Planning Techniques and Method of Construction, 19th edi, Dhanpat Rai Pub ,NewDelhi, 2000
V. Rangawal S.C ,“Building Construction” 22nd Edi, charotar Publishing house, Anand, 2004

- “Building Materials” by S K Duggal, IBH New Delhi.
- Sushil Kumar T.B of Building Construction 19th edi, Standard Pub House, NewDelhi, 2003.

Text Books: NIL

Scheme for End Semester Assessment (ESA)

Evaluation of Portfolio, assignments by internal and external examiners / Viva

Program : Architecture		
Course Title: GRAPHICS - II		**Course Code: 15AATC110**
L-S-P: 0-3-0	**Credits: 3**	**Contact Hours: 5**
ISA: 70	**ESA: 30**	**Total Marks: 100**
Teaching Hours: 80	**Examination Duration: NA**	

UNIT I:

1. Section of Solids - section of simple and composite objects.
2. Perspective View**-** Parallel and Angular perspective projection
   - Principles and visual effects of three dimensional objects
   - Study of picture plane, station point, vanishing point, eye level, ground level etc., their variation and their resultant effects.

UNIT II:

1. Perspective view drawings of simple geometrical forms by office method and by measuring point method.
2. Sciography **-** Introduction of basic principles of sciography and its application to the field of architecture. Sciography of line and plane in plan and elevation.
3. Sciography of three dimensional objects in perspective views.

UNIT III:

1. Perspective drawing including (one point & two point) of building exteriors including rendering.
2. Perspective drawing including (one point & two point) of building interiors including rendering.

Text Books: NIL

Reference Books:

I. Perspective Drawing, Shah Patki Kale
II. Geometrical Drawing for Art students, I H Morris,
III. Engineering Drawing, Prof, VeeEss, MSRIT, V.K.Publishers, BNG-10,1990
IV. Basic Perspective" by Robert Gill, Rendering with Pen & Ink by Robert Gill.
V. "Perspective and Sciography" by S.H.Mullik.
VI. Perspective for Interior Desingners by John Pile.
VII. Applied perspective by John Holmes.
VIII. Building Drawing by M.G.Shah, C.M.Kale & S.Y.Patki

Scheme for End Semester Assessment (ESA) Evaluation of Portfolio of Term Work and tests.

Program : Architecture		
Course Title: MEASURE DRAWING		**Course Code: 15AATC111**
L-S-P: 0-2-0	**Credits: 2**	**Contact Hours: 4**
ISA: 70	**ESA: 30**	**Total Marks: 100**
Teaching Hours: 64	**Examination Duration: NA**	

The students can study any buildings and document, measured drawing to be prepared. The site visits/documentation could be carried out during vacation, weekends. The assignment may be given as group work.

UNIT I:

Detailed plans with all measurements to be compiled and submitted including site plan. The report comprising of historic evolution, climatic influence, construction techniques, materials applications to be prepared along with drawings.

UNIT II:

Detailed sectional drawings, elevation drawings along with details of individual elements to be submitted. Study the construction techniques

UNIT III:

Digital documentation in the form of photography, videography & analysis of the entire project.

Note – Two minor assignments covering the above topics in the form of drawings, reports, reviews at important stages, shall be for CIE.

A final submission covering all topics shall be for SEE along with a final portfolio of the drawings and report of the building /study area.

Text Books:

NIL

Reference Books:

NIL

Scheme for End Semester Assessment (ESA)

Evaluation of Portfolio, assignments by internal and external examiners.

Program : Architecture		
Course Title: HISTORY OF ARCHITECTURE - I		**Course Code: 15AATC112**
L-S-P: 2-0-0	**Credits: 2**	**Contact Hours: 2**
ISA: 50	**ESA: 50**	**Total Marks: 100**
Teaching Hours: 32	**Examination Duration:3 HOURS**	

UNIT I:

Pre-classical – Persian, Mycenean, Etruscan

The Palace of Persepolis, The Palace Tiryns , The Temple of Juno Sospita, Lanuvium.

Greek Architecture

Orders of Greek, The Acropolis: Athens, Parthenon, Theatres and Temples

UNIT II:

Roman Architecture

Colosseum, Pantheon, Forums, Temples, Theatres and Amphitheaters, Aqueducts

Early Christian Architecture & Byzantine Architecture

Basilica church , Evolution of Churches, Hagia Sophia

UNIT III: Romanesque Architecture

New Construction Methods, Pisa Cathedral, The Abbey Church, Cluny Gothic Architecture

Cathedrals, Gothic Churches with construction of pointed arch, Rose windows, etc

Text Books: NIL

Reference Books:

I.Sir Banister Fletcher - History of Architecture

II.Henri Stierlin - Architecture of the World – Greece

III.Henri Stierlin - Architecture of the World – The Roman Empire

IV.Henri Stierlin - Architecture of the World – Romanesque

Scheme for End Semester Examination (ESA)

Evaluation of Portfolio, assignments by internal and external examiners.

Program : Architecture		
Course Title: SKILL DEVELOPMENT WORKSHOP - II		**Course Code: 15AATC113**
L-S-P: 0-1-0	**Credits: 1**	**Contact Hours: 2**
ISA: 70	**ESA: 30**	**Total Marks: 100**
Teaching Hours: 32	**Examination Duration: NA**	

UNIT I: Interior Detailed Model Making

Introduction to materials and scaled textures development to be used in interior detailed modeling. Using some of the following materials :

- Paper, Card Board & Paper mash
- Soap
- Wax
- Wood
- POP
- Acrylic Sheet / Foam Sheet

UNIT II: Graphic Design

Introduction to Theory of Graphic Design & Composition Design
Understanding of Different print medias, fonts & paper types.

UNIT III:

Tapestry Design:

Hands on workshop to produce tapestry products using the following materials

- Glass
- Wood
- Clay
- Metal
- Sand

Text Books: NIL

Reference Books: NIL

Scheme for Semester End Examination (ESA)

Evaluation of Models and products by external and internal examiners.

Program : Architecture		
Course Title: STRUCTURES - II		Course Code: 15AATC114
L-S-P: 3-0-0	Credits: 3	Contact Hours: 3
ISA: 50	ESA: 50	Total Marks: 100
Teaching Hours: 48	ExaminationDuration:3 HOURS	

Unit I

1. **Determinate and indeterminate structures:** Difference between determinate and indeterminate structures, implication of indeterminacy, obtaining the redundancy of beams and frames.

2. **Bending moment and shear force:** Concept of shear force and bending moment, types of beams, concept of concentrated load, uniformly distributed load, uniformly varying load and couple. Construction of SFD and BMD for simple cases of cantilever and simply supported beams. Bending moment and shear force diagrams for two and three span continuous beams.
3. **Stresses in beams:** Concept of pure or simple bending, bending equation, section modulus and moment of resistance, obtaining bending stress distribution for simple cases of beams. Shear stress distribution across the symmetrical and unsymmetrical beam cross sections.

Unit II

4. **Deflection of beams:** Relation between deflection, bending moment, shear force and rate of loading, deflection equation, obtaining slope and deflections for cantilever and simply supported beams using standard formulae.

5. **Torsion in structures:** Concept of torsion, torsion equation, elements subjected to torsion in structural system.

6. **Columns and struts:** short and long columns, buckling of column, boundary conditions for columns, effective length, slenderness ratio and critical load. Euler's and Rankine's theories.

Unit III

1. **Design of compression members**: Design of steel posts using IS:800-1984, Design of short RC column by using IS: 456-2000 and SP-16. Design of RC columns experiencing axial load and uniaxial bending, using SP – 16.

REFERENCES:

1) STRUCTURES - Martin Bechthold, Daniel L Schodek, and PHI Learning Private limited, Sixth Edition 2) Structure in Architecture, the building of buildings, by Mario Salvadori 3) Structure and Design, by G. G. Schierle 4) Engg Mechanics – R K Bansal & Sanjay Bansal, Laxmi publications, New Delhi, 3rd ed

Scheme for Semester End Examination (ESA)

Sl.No	8 Questions to be set of 20 Marks Each	Chapter Number	Instructions
I	Q.No.-1, Q.No.-2, Q.No.-3	1,2,3,4,5	Solve Any **2** out of **3**
II	Q.No.-4, Q.NO – 5 Q.No.-6,	6,7,8,9	Solve Any **2** out of **3**
III	Q.No.-7, Q.No.-8	10,11	Solve Any **1** out of **2**

Program : Architecture		
Course Title: SURVEYING		**Course Code: 15AATP101**
L-S-P: 2-0-0	**Credits: 02**	**Contact Hours: 02**
CIE Marks: 50	**SEE Marks: 50**	**Total Marks: 100**
Teaching Hours: 32	**Examination Duration: 3 HOURS**	

UNIT I:

1. Surveying- definition, scope of surveying, applications of surveying in architecture projects, principles, classification and character of work. Shrunken scale. Direct and reciprocal ranging, offsets types. Basic problems in chaining, well-conditioned triangle and chain triangulation. Errors in chain surveying.

2. Principles of plane table surveying, accessories and methods of plain tabling. Merits and demerits of plane table survey as compared to chain survey.

UNIT II:

3. Levelling, terms used, instruments, classification of leveling, Temporary adjustments of dumpy level. Plane of collimation and rise and fall methods. Booking and reduction of levels related numerical on the topics. and errors in levelling. .

4.Introduction to contouring, definitions contour interval, factors affecting contour interval. Characteristics of contours, location of contours, direct and indirect methods of contouring, interpolation of contours. Application of contour maps in architecture field.

UNIT III:

5.Introduction to Theodolite temporary adjustments and field work.

6. Introduction to Geographical Information systems and Total station.

Text Books:

- B.C. Punmia, Surveying and Levelling, Vol-IChirator Publications.
- Kanetkar T. P. and Kulkarni S.V, Surveying and Levelling Part-

Reference Books:

- Duggal, Surveying and Levelling. Vol-I

Scheme for End Semester Assessment (ESA)

Sl.No	8 Questions to be set of 20 Marks Each	Chapter Number	Instructions
I	Q.No.-1, Q.No.-2, Q.No.-3	1,2,3,4,5	Solve Any **2** out of **3**
II	Q.No.-4, Q.NO – 5 Q.No.-6,	6,7,8,9	Solve Any **2** out of **3**
III	Q.No.-7, Q.No.-8	10,11	Solve Any **1** out of **2**

B. Arch. CURRICULUM SCHEME & STRUCTURE OF 2015-2020 BATCH

III Semester - IV Semester

School of Architecture, KLE Technological University. BVBCET Campus, Vidyanagar, Hubli.

(Year of introduction-2015, Faculty-A, Architecture-AT, Core course-C, Humanities-H, Lab-L, Elective-E, internship-I, Practice-P, W-Project)

B. Arch. Semester III 2015-20

No	Code	Course	Category	L-S-P	Credits	Contact Hours	ISA	ESA	Total	Exam Duration
1	15AATC201	Architectural Design III	Design	1-8-0	6	9	50	50	100	NA
2	15AATC202	Building Const & Materials III	Construction	1-5-0	4	6	50	50	100	NA
3	15AATC203	Services – I (w s & sanitation)	Construction	1-2-0	2	3	50	50	100	2 HOURS
4	15AATC204	Climatology	Design	1-2-0	2	3	50	50	100	NA
5	15AATC205	History of Architecture II	Design	2-0-0	2	2	50	50	100	3 HOURS
6	15AATC206	Structures – III	Construction	3-0-0	3	3	50	50	100	3 HOURS
7	15AATP201	Digital Tool-I	Communication	0-0-2	1	2	50	50	100	NA
8	15AATE201 15AATE202 15AATE203 15AATE204 15AATE205	Elective I Vernacular Architecture Photography. Space, culture & architecture Digital rendering Space Making	Design	2-0-0	2	2	50	50	100	NA
		TOTAL		11-17-2	22	30	400	400	800	

ISA: Continuous Internal Evaluation ESA: Semester End Examination L: Lecture S: Studio P: Practical

Credit	Lecture Hours	Studio Hours	Practical Hours
1	**1**	**1.5**	**2**

Program Head

Signature of Dean (Academic Affairs)

B. Arch. Semester IV 2015-20

No	Code	Course	Category	L-S-P	Credits	Contact Hours	ISA	ESA	Total	Exam Duration
1	15AATC208	Architectural Design IV	Design	1-8-0	6	9	50	50	100	NA
2	15AATC209	Building Const & Materials IV	Construction	1-5-0	4	6	50	50	100	NA
3	15AATC210	Services II (Electricity & Illumination)	Construction	1-2-0	2	3	50	50	100	2 HOURS
4	15AATC211	History of Architecture III	Design	2-0-0	2	2	50	50	100	3 HOURS
5	15AATC212	Theory of Architecture	Design	1-2-0	2	3	50	50	100	3 HOURS
6	15AATC213	Landscape Design	Design	1-2-0	2	3	50	50	100	NA
7	15AATP202	Digital Tool- II	Communication	0-0-2	1	2	50	50	100	NA
8	15AATC214	Structures – IV	Construction	3-0-0	3	3	50	50	100	3 HOURS
TOTAL				10-19- 2	22	31	400	400	800	

III SEMESTER

Program : Architecture		
Course Title: DESIGN STUDIO – III		**Course Code: 15AATC201**
L-S-P: 0-8-0	**Credits: 6**	**Contact Hours: 9**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 144	**Examination Duration: NA**	

Course contents:

To develop skills for comprehensive understanding and dealing with Architecture Provide skills for designing multi-user and multi level spaces.

The design issues to be addressed are

- Multi user and multi level space formation
- Integration of material and form.
- Integrate the horizontal and vertical circulation.
- Develop skills to correlate the materials and the resulting form.
- Details pertaining to the disabled, aged people and children.

The list of suggested spaces to be covered as design problems: Architectural Exhibition / display spaces Multi level Accommodation spaces, higher level academic spaces, multi activity Recreational spaces, Neighbor hood Community spaces, Healthcare Centers etc.

Necessary theoretical inputs to be given highlighting the norms and design issues. At least one major exercise and one minor design/ time problem should be given. The topics covered as design problems will have to be covered by the studio faculty members through lecture/slide show session and site visits.

The Portfolio covering the given topics and the study models shall be presented

The evaluation shall be through periodic internal reviews.
The students have to present the entire semester work for assessment along with Models.

Text Books: NIL

Reference Books:

1. Time Saver Standard for Architectural Data by John Hancock.
2. Architectural Graphic Standards by Ramsey and Sleeper.
3. Magazines and Design related books
4. Architecture: Form, Space and Order, Ching, Francis DK
5. Design and Form: The basic course at the Bauhaus, Itten, Johannes.
6. Elements of space forming, Yatin Pandya.

7. Architectural Composition, Kerier, Roab
8. Building construction and materials, Rangawala.
9. Building construction, Choudley.

Scheme for Semester End Examination (ESA)

Checking of Portfolio of Term Work / Viva.

Program : Architecture		
Course Title: BUILDING CONSTRUCTION&MATERIALS- III		Course Code: 15AATC202
L-S-P: 0-6-0	Credits: 4	Contact Hours: 6
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hours: 96	Examination Duration: NA	

UNIT I: RCC FOUNDATION, COLUMNS AND BEAMS

SHALLOW FOUNDATION- Types, with reinforcement arrangements for i) isolated ii) combined iii) combined with strap beam iv) eccentric v) raft, etc.

DEEP FOUNDATION- Introduction to and study of pile, grouping of piles & pile cap.

RCC COLUMNS - Various shapes of columns and types of reinforcement arrangements.

BEAMS – Reinforcement arrangement for i) simply supported ii) continuous iii) cantilever iv) brackets.

UNIT II: MATERIALS, FORMWORK, STAIRS

REINFORCEMENT - Types, properties & uses of plain, ribbed, twisted, TMT, weld mesh, HT wires etc.

CONCRETE- Ingredients, grades of concrete, properties of concrete, proportioning, mixing, transporting, placing, compaction & curing.

SPECIAL CONCRETE - RMC, concreting under water, light and heavy weight, dense, etc

ADMIXTURES - Admixtures used in concrete to improve quality i.e. i) retarder ii) accelerator iii) plasticizer iv) water proofer v) hardener vi) pigments, etc.

FORM-WORK- Purpose of form work in concrete works. Various materials used, precautions to be taken and removal time

STAIRS - Introduction to, types & calculation of stairs. Study of stairs in i) stone ii) brick iii) timber iv) steel v) RCC. Construction details for timber, fabricated steel & RCC, including fixing of handrail in various materials

UNIT III: RCC JOINTS IN BUILDING

Study, necessity & construction details of construction joint and expansion joints

Note – The Portfolio covering the above topics shall be presented for Term work. Site visits shall be arranged by studio teacher. Study of material application shall be submitted in the form notes, sketches and photo brief as a part of portfolio

Text Books:NIL

Reference Books:

- McKay J.K Building Construction Metric Vol 1-4, 4th edi Orient Longman Pvt. Ltd, Mumbai,2002

- "Construction Technology" volume-I by R Chudley, ELBS & Longman group Ltd.
- Barry R, "The construction of buildings" , Vol-2, 5th Edi, East West Press, New Delhi 1999.
- Bindra S.P and Arora S.P, Building Construction-Planning Techniques and Method of Construction, 19th edi, Dhanpat Rai Pub ,NewDelhi, 2000
- "Building Construction" by Janardhan Jha, Khanna New-Delhi.
- Rangawal S.C ,"Building Construction" 22nd Edi, charotar Publishing house, Anand, 2004
- "Engineering Materials" by Surendra Singh, Vikas Delhi.
- "Building Materials" by S K Duggal, IBH New Delhi.
- Sushil Kumar T.B of Building Construction 19th edi, Standard Pub House, NewDelhi, 2003.
- Chowdhary K.P. Engineering Materials used in India, 7th Edi, Oxford and IBH Pub ltd New Delhi, 1990.

Building Construction Hand book : By R Chudly & R Greeno, Bullerworth Heinemann, New-Delhi.

Scheme for internal Assessment (ISA): Evaluation of term work regularly and tests conducted

Scheme for Semester End Examination (ESA): Evaluation of term work portfolio & Viva

Program : Architecture		
Course Title: SERVICES – I (WATER SUPPLY & SANITATION)		**Course Code: 15AATC203**
L-S-P: 1-2-0	**Credits: 2**	**Contact Hours: 3**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 48	**Examination Duration: 32HOURS**	

UNIT I:

1: Sources and purification of water

Surface and underground sources of water supply, pollution and preventive measures.

Purification ----filtration, disinfection, softening, miscellaneous methods of water treatment.

2: Domestic water supply

Water requirement for different types of buildings, pipes, valves, wash basins, sink, bath tubs, flushing cisterns, showers, jets, faucets. Cold and hot water supply for ground and multi-storied buildings. Provision for fire fighting, solar heating systems, geysers.

UNIT II:

3: Sanitation

Importance of sanitation, definitions, types of refuse, collection and disposal systems. Rural sanitation. Types of fixtures and materials. Sanitary requirements for various types of buildings.

4: . Drainage systems

Principles, location of sanitary units, separate and combined systems, septic tanks, aqua privy. Drainage system for ground and multistoried buildings incl. storm water drainage, rain water harvesting.

UNIT III:

5: Recycling

Sewage pumping stations, waste water treatment, oxidation. recycling of sewage water.

6: Site planning

Roads and pavements, drainage of roads, drainage on sloping sites, sub soil drainage. Site planning from drainage and water supply point of view.

Text Books:

NIL

Reference Books:

Husain, S. K. T. B. of *water Supply and Sanitary Engineering,* 3rd ed. Oxford and IBH Pub. Ltd. New Delhi, 1994.

Kshirsagar,S.R. Water Supply Engineering, 6th ed. Roorkee Pub, Roorkee, 1980.

Rangawala, S.C. Water Supply and Sanitary Engineering ; Envirornmental Engineering, 19th ed. Charotar Pub. House, Anand, 2004.

S.C. Rangawala, fundamentals of water supply and sanitary engineering. Charotar Pub. House, Anand,

Ilussain S. K. water supply and sanitary engineering, Dhanapat Rai and Sons, Delhi Relevant I.S. Codes

Basic Plumbing techniques, Orthobooks, Chevron Chemical Company, Consumer products Div., Box 5047, San Ramon, CA 94583

G.M. Fair, J.C. Geyer and D.A. Oku, Water and Waste Water Enineering, vol.II, John Wiley and Sons, Inc. New York, 1968

Manual of water Supply and Treatment , 2nd edition , CPHEEO, Ministry of works And HOUSING New DELHI , 1980
Manual ON sewage Treatment , CPHEEO, Ministry of works And HOUSING New DELHI , 1977

Scheme for Semester End Examination (ESA)

SI.No	8 Questions to be set of 20 Marks Each	Chapter Number	Instructions

Program : Architecture		
Course Title: CLIMATOLOGY		**Course Code: 15AATC204**
L-S-P: 1-2-0	**Credits: 2**	**Contact Hours: 3**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 48	**Examination Duration: NA**	

UNIT I:

Introduction – Elements of Climate, Enumerating and representing climatic data.

Classification of Climate, major Climatic Zones of the World, tropical Climate further Classification.

Climatic Zones of India, Classifications, case study of one city within each Zone.

UNIT II:

Thermal Comfort, effect of Climatic Elements on thermal Comfort, Heat Exchange Process, Effective Temperature

Natural Ventilation, effect of openings in internal and external features, Design Considerations etc. Effect of Landscape elements and site topography

UNIT III:

Construction Techniques for Improving Thermal Performance of Walls and roofs at various climatic Zones in India

Design Consideration for various climatic zones of INDIA, with respect to Shading devices, Day Lighting Factors, Components of day light factor and design considerations Rains etc.

Text Books:

1. Arvind Kishan , Baker & Szokolay, Climate Responsive Architecture.
2. "Manual of Tropical Housing & Buildings (PartII)" Koenigsberger.
3. Buildings in the tropics by Maxwell Fry
4. Housing , Climate and Comfort by Martin Evans

Reference Books:

NIL

Scheme for Semester End Examination (ESA)

NOTE: ALTHOUGH THE MODULES IN CORPORATED IN 3 UNITS IN LESSON PLAN, TO BE IN CORPORATED IN SYLLABUS

Program : Architecture		
Course Title: HISTORY OF ARCHITECTURE - II		**Course Code: 15AATC205**
L-S-P: 0-2-0	**Credits: 2**	**Contact Hours: 2**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 32	**Examination Duration: 3 HOURS**	

UNIT I:

1: Evolution of Buddhist Architecture

Characteristic features of Buddhist Architecture, Sanchi Stupa, Viharas and Chaitya Halls

2:Introduction to temple architecture

Essential characteristics of Indian temple,different types of temple architecture

Evolution of Hindu Temples

Temples at Udayagiri, Tigawa, ,Bhitargoah

3. Evolution of Indo Aryan Temples

Orissan Group of Temples - The Sun temple of Konark , The Lingraja Temple at Bhubaneswar ,

Khajuraho Group of Temples - Kandariya Mahadev Temple, Laksmanan Temple

UNIT II:

4 - Early Chalukyan Architecture –

Aihole , Pattadakal and Badami

5 : Rastrakuta Architecture

Rockcut Temple, Elephanta , Kailasa Temple Ellora

6: Evolution of Pallava , Cholla and Pandya style

Pallava Style - Rathas at Mamallapuram , Shore temple, Kailasanath temple

Kanchipuram , Vaikunthaperumal temple at Kanchipuram,

Chola Style – Brihadeshwar Temple & Gangaikondacholapuram Temple

Pallava Style – Characteristics, Gopuram

UNIT III:

7: Later Chalukyan or Hoyasala style

Chennakeshwa Temple, Belur, Hpysaleshwar Temple, Halebidu and Keshava Temple, Somnathpur

8: Evolution of later Dravidian Temples

Vijaynagar Architecture - Vithala temple complex at Vijaynagar , Hazara Ram Temple

- **Madurai Style - Meenakshi Temple at Madurai. Srirangam Temple**

Text Books:

NIL

Reference Books:

- Satish Grover: The Architecture of India

- Percy Brown : Indian Architecture(Buddhist and Hindu Period0
- Tadgell Christopher:The History of Architecture in India
- Rowl Benjamin. Art and Architecture of India
- Vistara . The Architecture of India
- Yatin Pandya: Concept of space making in Indian traditional Architecture

Scheme for Semester End Examination (ESA)

NOTE: ALTHOUGH THE MODULES IN CORPORATED IN 3 UNITS IN LESSON PLAN, TO BE IN CORPORATED IN SYLLABUS

SI.No	8 Questions to be set of 20 Marks Each	Chapter Number	Instructions

Program : Architecture		
Course Title: Digital Tool- I		Course Code: 15AATP201
L-S-P: 0-2-0	Credits: 1	Contact Hours: 2
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hours: 32	Examination Duration: 3 HOURS	

UNIT I:

- **Basic Hardware and components of computer.**

Introduction to a Brief history of computers, hardware components of computer, knowledge of different types of OS. Introduction to Digital tools of Architecture and Design, (scanner, Digitizer, plotters).

- **Introduction to Windows, Office and PowerPoint**

Introduction to Windows OS History and present OS. Understanding various components of OS like desktop, Short cuts, Etc. creating file structure, files, folders, Installing and managing software's, working with MS office and PowerPoint creatively for various presentations in sync MS paint and note pad,

UNIT II:

- **Introduction to Sketch up.**

Basic drawing and editing tools, measuring and dimensioning tools, etc

- **Introduction to Advance Sketch up**

Advance tools for developing and creating architectural design using advanced features

UNIT III:

- **Rendering techniques with Sketch Up.**

Setting up Lights, camera, foreground and background, adding landscaping elements like trees human figures, introduction to rendering and animation.

Text Books

1. **NIL**

Reference Books:

1. **Online Sketch Up Manual.**

Note:

- Journal Submission of commands related to the software and its tools.
- Assignments in form of soft copy & hard copy worked during the course.

Program : Architecture		
Course Title: STRUCTURES - III		**Course Code: 15AATC206**
L-S-P: 3-0-0	**Credits: 3**	**Contact Hours: 03**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 48	**Examination Duration: 3 HOURS**	

UNIT I:

1. Reinforced cement concrete, grades of concrete, water cement ratio and its effect on strength of concrete, admixtures, retarders and use of high strength concrete in building structures.
2. Introduction to working stress method, assumptions, theory of singly reinforced sections.Moment of resistance and design of a section for flexure. Related elementary numerical.

UNIT II:

1. Design philosophy of limit state method. Limit state for collapse for flexure.
2. Analysis of continuous beam by using IS 456-2000 and design by using SP16.
3. Design of beams by using SP 16
4. Analysis of one way continuous slabs by using IS 456-2000and design by using SP16.
5. Design of columns axial load and axial load plus uniaxial moment by using SP 16

UNIT III:

1. Case study of ongoing RC building structuresto correlate knowledge to on site during construction.
2. Typical reinforcement detail for beams isolated column with footing, slabs (one way and two way), staircases.

Text Books:

1. A.K. Jain, Reinforced concrete: Limit state design, 5th edition, New Chand and brothers, Roorkee.
2. S.N. Sinha, Reinforced concrete design, Tata McGraw Hill Publications, New Delhi.

Reference Books

1. Karve S. R. and Shah V. L: .Limit state Theory and design of Reinforced Concrete, Structures Publishers, Pune
2. S.N. Sinha, Reinforced Concrete Tata Mc.Graw Hill Companies. Second Revised Edition.
3. B.C.Punmia Ashok Kumar Jain, Arun kumar Jain, Reinforced Concrete Structures Laxmi Publications Pvt. Ltd. New Delhi.
4. Ashok K. Jain. Reinforced Concrete Limit State Nemchand & Bros.Roorkee
5. I S 456, SP 24, SP 16

Scheme for Semester End Examination (ESA)

Sl.No	8 Questions to be set of 20 Marks Each	Chapter Number	Instructions
I	Q.No.-1, Q.No.-2, Q.No.-3	1, 2	Solve Any **2** out of **3**

II	Q.No.-4, Q.NO – 5 Q.No.-6,	3 to 7	Solve Any **2** out of **3**
III	Q.No.-7, Q.No.-8	8, 9	Solve Any **1** out of **2**

Program : Architecture		
Course Title: Elective – Vernacular Architecture		**Course Code: 15AATE201**
L-S-P: 0-2-0	**Credits: 2**	**Contact Hours: 2**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 32	**Examination Duration: NA**	

UNIT I:

Introduction and Definitions.

Review of Vernacular Architecture in different parts of India in context to the Lifestyle and culture, House forms, climate, materials and construction techniques prevailing in these regions.

UNIT II:

Study of Vernacular styles of North and North East, North West, South India.

UNIT III:

Case study and documentation

Case study of a house form to collect data regarding lifestyle and culture, climate, materials, construction techniques and documentation of the same.(1field,book or net study)

Note – assignments**,** Seminars and a portfolio of the documentation of case study for evaluation.

Text Books:

NIL

Reference Books:

1. Paul Oliver (Ed), Encyclopedia of Vernacular Architecture of the world, vol 1,2,3,
2. Fletcher Bannister*:* History of Architecture
3. Rappoport Amos: History and Precedent of Environmental Design
4. Rappoport Amos: House Form and Culture
5. Rappoport Amos: Meaning of the built environment
6. Paul Oliver (Ed), Encyclopedia of Vernacular Architecture of the world, vol 1,2,3, Cambridge University press,Cambridge, 1977.
7. Bernard Rudofsky Architecture without architects.
8. Paul Oliver: Dwellings. Cambridge University press, Cambridge, 1977.
9. Galion and Eisner, ‘Urban Pattern’: City planning and Design. Ed, Van Nostrand Reinhold, New York, 1986.

Scheme for Semester End Examination (ESA)

Term work.

Documented measure drawing portfolio

Program : Architecture		
Course Title: Elective – Photography		**Course Code: AATE202**
L-S-P: 0-2-0	**Credits: 2**	**Contact Hours: 2**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 32	**Examination Duration: NA**	

UNIT I:

1. Introduction
   a. Introduction to Architectural Photography
   b. Theory of Photography
   c. Understanding Light, aperture, Shutter speed and ISO
   d. Types of Camera, Lens, and other accessories.

UNIT II:

2. Composition.
   a. Understanding composition like rule of third, S- curve, balance etc..
   b. Shooting Out-doors and In-doors
   c. Colour management and post editing using software's
   d. Camera Tricks to create special effect photography.
   e. Analysis of Photographs.

UNIT III:

3. Documentation of Architectural buildings and interiors
   a. Importance and use of architectural journalism
   b. Documentation methods.
   c. Presentation and compilation of Images and text.
   d. Printing.

Text Books:

NIL

Reference Books:

1) Better photography monthly magazine
2) Basic photography for dummies

Scheme for Semester End Examination (ESA)

Assignments, Checking of Portfolio of Term Work / Viva.

Program : Architecture		
Course Title: Elective – Space, Culture & Architecture		**Course Code:** 15AATE203
L-S-P: 0-2-0	**Credits: 2**	**Contact Hours: 2**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 32	**Examination Duration: NA**	

UNIT I:

Introduction to Space, Culture & Architecture

Sociological theories and cultural theories in relation to architecture Critical thinking – its basis and intent

UNIT II:

Study and analysis of few Important Architectural Spaces of Cultural Significance

Study and Documentation of Cultural Landscape.

UNIT III:

Research Paper on Space, Culture & Architecture

Text Books:

NIL

Reference Books:

1) J Habraken *Sociologic of space*
2) Rappoport Amos*: House Form and Culture*

Program: Architecture		
Course Title: Elective – Digital Rendering		**Course Code: 17AATE204**
L-T-P:0-0-1	**Credits: 1**	**Contact Hours: 2**
ISA Marks:50	**ESA Marks:50**	**Total Marks:100**
Teaching Hours:28	**Examination Duration: NA**	
Unit I **Digital Rendering Techniques** Rendering techniques of plans, elevations & sections using digital tool.		
Unit II **Detail Rendering** Adding details like human figures, furniture, trees, vehicles etc.		
Unit III **Publish to various media** Various print and web file formats		
Text Books		
Reference Books: Online tutorials		

Scheme for Semester End Examination (ESA)

Assignments, Checking of Portfolio of Term Work / Viva.

Program : Architecture		
Course Title: Elective – Space Making		**Course Code:** 15AATE205
L-S-P: 0-2-0	**Credits: 2**	**Contact Hours: 2**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 32	**Examination Duration: NA**	

UNIT I:

Introduction to different space making elements.

Understanding and appreciating different space perceptions.

UNIT II:

Study and analysis of few Important Architectural Spaces with different parameters

UNIT III:

Understanding contemporary approaches in space making.

Understanding of the term space formation and its importance in Architecture.

Text Books:

Nil

Reference Books:

1) Space making elements by Yatin Pandya.
2) J Habraken *Sociologic of space*

IV SEMESTER

Program : Architecture		
Course Title: DESIGN STUDIO – IV		**Course Code: 15AATC208**
L-S-P: 0-8-0	**Credits: 6**	**Contact Hours: 9**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 144	**Examination Duration: NA**	

Course contents:

Project

1. Scale of a project shall be limited to allow for intensive study rather than repetition of typical configuration of housing
2. Project can be attempted with added complexities like dense context, occupation based, traditional urban fabric, social status & prevalent social strata.
3. Detail from the dwelling cell to immediate shared space to communal space shall be emphasized and worked out. Socio-cultural layer of the occupants shall form a strong fabric in ultimate way of the design.
4. project shall aim at developing a very sensitive attitude toward micro level human habitation & role of architecture in enhancing or curbing the quality of living
5. Examples apartment for IT employees, government servants, teaching faculty, textile workers, Luxury flats in the center of the city, group housing in suburbs, etc.

Students may be required to develop a brief, translate it in to requirements and Design. At least one major exercise and one minor design/ time problem should be given. The topics not covered as design problems will have to be covered by the studio faculty members through lecture/slide show session and site visits.

The evaluation shall be through periodic internal reviews.

The students have to present the entire semester work for assessment along with Model.

Text Books: NIL

Reference Books:

1. **Joseph De Chiara & John Hancock Calendar**, Time Saver Standards for Building Types
2. Various books and magazines about architectural design

Scheme for Semester End Examination (ESA)

Checking of Portfolio of Term Work / Viva.

Program : Architecture		
Course Title: BUILDING CONSTRUCTION & MATERIALS - IV		Course Code: 15AATC209
L-S-P: 0-6-0	Credits: 4	Contact Hours: 6
ISA Marks: 70	ESA Marks: 30	Total Marks: 100
Teaching Hours: 96	Examination Duration: NA	

UNIT I: RCC SLABS

Introduction to, types & selection criteria of slabs like i) spanned in one direction ii) spanned in both directions i.e. iii) continuous iv) cantilever v) slope vi) ribbed vii) coffered vii) filler, showing construction & reinforcement arrangements.

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UNIT II:RCC FLAT SLAB, VAULTS & DOMES AND RETAINING WALLS

FLAT SLAB- Introduction to, advantages over regular slabs, including construction details & reinforcement arrangements for i) solid slab ii) drop panel iii) flared column top.

VAULTS AND DOMES - Introduction to, types, construction details with reinforcement arrangement.

RETAINING WALLS – Introduction to and study of walls for retaining earth & water, with i) brick masonry ii) stone masonry iii) RCC. Construction details & reinforcement arrangements there in.

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UNIT III:FLOOR FINISHES

- Various types, method of laying & maintenance for floor finishes using,
- Naturally available - i) clay & murrum ii) stone slab & tiles iii) timber
- Timber products - i) parquet tiles ii) plywood/ block board & engineered wood (plain & laminated) etc.
- Cement concrete - i) rough and rendered (IPS, oxide, epoxy) surface ii) VDC (vacuum de-watered concrete)
- Cement concrete products - marble mosaic, terrazzo, designer tiles & in-situ work
- Mineral products – clay, ceramic & vitrified tiles.
- Other products – i) metal ii) glass
- **PAVING -** Various types, preparation of base, method of laying using i) burnt bricks ii) flag stone iii) stone slabs iv) cobbles v) in-situ concrete vi) precast concrete slabs vii)concrete designer tiles viii) interlocking blocks etc

Note – The Portfolio covering the above topics shall be presented for Term work. Site visits shall be arranged by studio teacher. Study of material application shall be submitted in the form notes, sketches and photo brief as a part of portfolio

Text Books:

- McKay J.K Building Construction Metric Vol 1-4, 4th edi Orient Longman Pvt. Ltd, Mumbai,2002
- “Construction Technology” volume-I by R Chudley, ELBS & Longman group Ltd.
- Barry R, “The construction of buildings” , Vol-2, 5th Edi, East West Press, New Delhi 1999.
- Bindra S.P and Arora S.P, Building Construction-Planning Techniques and Method of Construction, 19th edi, Dhanpat Rai Pub ,NewDelhi, 2000
- “Building Construction” by Janardhan Jha, Khanna New-Delhi.

- Rangawal S.C ,“Building Construction” 22nd Edi, charotar Publishing house, Anand, 2004
- “Engineering Materials” by Surendra Singh, Vikas Delhi.
- “Building Materials” by S K Duggal, IBH New Delhi.
- Sushil Kumar T.B of Building Construction 19th edi, Standard Pub House, NewDelhi, 2003.
- Chowdhary K.P. Engineering Materials used in India, 7th Edi, Oxford and IBH Pub ltd New Delhi, 1990.
- Building Construction Hand book : By R Chudly & R Greeno, Bullerworth Heinemann, New-Delhi.

Scheme for internal Assessment (ISA): Evaluation of term work regularly and tests conducted

Scheme for Semester End Examination (ESA): Evaluation of term work portfolio & Viva

Program : Architecture		
Course Title: SERVICES – II (ELECTRICITY & ILLUMINATION)		**Course Code: 15AATC210**
L-S-P: 1-2-0	**Credits: 2**	**Contact Hours: 3**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 48	**Examination Duration: 2 HOURS**	

UNIT I:

1. Brief Introduction to electricity, its uses in everyday life and as an architectural application.
2. Terminology used in electricity.
3. Supply and distribution of electricity to the end user (consumer) - generators and overhead and underground distribution systems, high tension and low tension cables, substations, transformers, service connections, panel board, energy meter. Internal supply and distribution.

UNIT II:

3. Systems of wiring in building and their merits. Types of conduits, wires and cables. Accessories used in wiring.
4. Various devices used to protect shock, over loading, leakages and short circuits.(Fuses-definition and types, ELCB, Earthing-definition and its types, MCB'S)
5. Branch circuits, calculation of electrical load for a residential building. Electrical symbols and Indian electricity rules-relevant codes of practice(NBC).
6. Electrical layout for different buildings. Ways and methods of saving electricity in buildings.

UNIT III:

7. Introduction and terminologies, quality and quantity of light. Necessity of artificial lighting, combination of day light and artificial lighting.
8. Methods of lighting- accent, ambient and task lighting.
9. Various types (incandescent, fluorescent/CFL, HID's, neon lamps) and selection criteria considering their temperament for residential, commercial, industrial, public buildings, for street and landscape lighting.

UNIT IV:

10. Criteria's for selecting lamps for different occupanISAs.
11. Lighting design for different types of occupanISAs - landscape, parking areas, different tasks, street lighting, commercial building, residence.

Text Books:

1) H Cotton, Electrical Technology
2) L. Uppal, Electrical wiring, Estimating & Costing
3) Anwari., Electrical Engg.
4) M.S.N. Swamy, Lighting, MSN Marketing, Bangalore.
5) Torquil Barker,Concepts in Practice lighting, 1997, B.T. Batsford Ltd, 583,fullham Road, London.
6) Dr. Frith Abnwos and others. Electrical Engineering handbook.
7) S.L.Uppal and G.C. Garg. Electrical wiring (Estimating & Costing), Khanna Publishers,New Delhi.

Reference Books:

A manufacturer catalogues and journal references on electricity.

Scheme for Semester End Examination (ESA)

Sl.No	8 Questions to be set of 20 Marks Each	Chapter Number	Instructions

Program : Architecture		
Course Title: HISTORY OF ARCHITECTURE - III		**Course Code: 15AATC211**
L-S-P: 3-0-0	**Credits: 2**	**Contact Hours: 2**
ISA Marks:50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 32	**Examination Duration: 3 HOURS**	

UNIT I:

Evolution of Imperial Indian Islamic Architecture in the following dynastic rule of

- Imperial style
- Provincial Style -I
- Provincial Style -II

UNIT II:

Evolution of provincial Indian Islamic Architecture in the following provinces of

- Provincial Style -II
- Mughal Architecture-I
- Mughal Architecture-II

UNIT III:

Evolution of Indian British Colonial architecture Architecture in the dynastic rule of

- Early British Colonial Style
- Late British Colonial Style

Text Books:

1. **Christopher Tadgel**, The History Of Architecture Of India
2. **Satish Grover,** Architecture of India – Islamic
3. **Percy Brown,** Indian Architecture - Islamic

Reference Books:

NIL

Note:

- A student (individually / group) in course of the semester shall present at least two seminars from above topics or as suggested by the subject teacher

Scheme for Semester End Examination (ESA)

NOTE: ALTHOUGH THE MODULES IN CORPORATED IN 3 UNITS IN LESSON PLAN, TO BE IN CORPORATED IN SYLLABUS

SI.No	8 Questions to be set of 20 Marks Each	Chapter Number	Instructions
I	Q.No.-1, Q.No.-2, Q.No.-3	1, 2	Solve Any **2** out of **3**
II	Q.No.-4, Q.NO – 5 Q.No.-6,	3, 4	Solve Any **2** out of **3**
III	Q.No.-7, Q.No.-8	5, 6	Solve Any **1** out of **2**

Program : Architecture		
Course Title: THEORY OF ARCHITECTURE		**Course Code: 15AATC212**
L-S-P: 2-0-0-1	**Credits: 2**	**Contact Hours: 3**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 48	**Examination Duration: 3 HOURS**	

UNIT I:

1. Principles of architectural composition:
   Unity, Balance, Proportion, Scale, Contrast, Harmony, Accentuation, Restraint.
   Repose, Vitality, Strength in the built environment
2. Underlying Organizing Principles
   Symmetry, hierarchy, datum, axis, rhythm in the built environment, examples drawn from both historical and urban context
3. Underlying Spatial Organizations of built fabric
   Linear, centralized, radial, Clustered, Grid. Examples drawn from both historical and urban context.

UNIT II:

Theory in Antiquity & Renaissance
18th century theory
19th century theory

UNIT III:

Contribution of architectural theoreticians
Architectural Criticism

Self Study:

: Understanding the Built environment

Students will explore such questions as:
What is the built environment? What role does it play in our life?
How does it come about? How are ideas and meaning embedded in the world we make?

Students will comprehend conceptual basis of the design disciplines, terminology regarding form, function, and technology of buildings; and methods used in the design process.

Students will explore issues related to intent, values and design; site, and context; buildings and cities, and relationships between culture, place and meaning;

Students will increase their understanding of the human significance of the built environment.

Student Performance Criteria addressed:
Communication Skills
Design Thinking Skills
Visual Communication Skills
Investigative Skills
Fundamental Design Skills
Use of Precedents
Ordering System Skills
Historical Traditions and Global Culture
Cultural Diversity
Site Design
Structural Systems
Human Behavior
Leadership
Community and Social Responsibility

Topical Outline

The built environment as human habitat
Theoretical constructs for understanding & analyzing the built environment
Architecture as a combination of form, function, technology
Urban environments
Exploring the relationships between culture, values, meaning and place

Prerequisites: None
None.

Deliverables:
Application of the theoretical base to the human settlement site , analysis and interpretation of the same.

Four hours are incorporated after the completion of respective chapters

Text Books:
NIL

Reference Books:

1. Bernard Rudofsky, *Architecture without Architects* .a short introduction to Non-Pedigreed Architecture. Academy Edition London
2. *Francis D K Ching,* Form Space and Order
3. *Parmar* V S, *Design* Fundamental in Architecture
4. *Howard Robertson,* The Principles of Architectural Compositions
5. *J.M.Zunde* ,Design Procedures – level 4
6. *Barbara lee Dia Monstein,* Architect ,Architecture in Collaboration
7. *Mike Dartion,* The illustrated Book of Architect & Architecture

8. *Kenshiro Takamii, Decora,* Ornamental Motif of the World.
9. *Enrico Guidon,*Primitive Architecture
10. *Arthur Statton*, Elements of Forms & Design in Classic Architecture
11. *Tim Charlotte,* Forms & Function - a source book for the History of Architecture
12. *Christian* Norberg Shulz, Genius Locii
13. *Vitruvious* : Ten Books on Architecture
14. *Alberti Leon:* Ten Books on Architecture
15. *Alexander Christopher ;*Urban Pattern
16. *Alexander Christopher:* Timeless way of Building
17. *Alexander Christopher*: New Theory of Urban Design
18. *Alexander Christopher:* Nature of Order,vol.1,2,3
19. *Alexander Christopher*: Synthesis of Form
20. *Alexander Christopher:* City is not a Tree
21. *Rappoport Amos:* Human Aspect of Urban Form
22. *Rappoport Amos:* History and Precedent of Environmental Design
23. *Rappoport Amos:* House Form and Culture
24. *Rappoport Amos:* Meaning of the built environment
25. *Geoffrey Broadbent*: Design in Architecture
26. *Geoffrey Baker*: Design strategies in architecture: An approach to analysis of form
27. *Attoe Wayne:* Architectural and critical imagination
28. *Hale A Jonathan:* Building Ideas, An introduction to Architectural Theory
29. *Lynch Kevin: City Sense*
30. *Lynch Kevin: Image of the City*
31. *Sociologic of space*
32. *J Habraken :*The Structure of the ordinary

Course Title: LANDSCAPE DESIGN		Course Code: 15AATC213
L-S-P: 1-1-0	Credits: 2	Contact Hours: 3
ISA Marks: 70	ESA Marks: 70	Total Marks: 100
Teaching Hours: 42	Examination Duration: NA	

UNIT I:

Introduction to landscape architecture and role of Landscape design in built environment. Evolution of concepts in landscape design in integrating built spaces to open spaces

UNIT II:

Landscape elements-land forms, water and vegetation. Principles of landscape design, and built environment. Selection and management of plant material in relation to built environment, taxonomy and classification of plants. Study and analysis of existing landscaped areas Introduction to study of plant materials in relation to landscape architecture and design. Appearance, functional and visual effects of plants in landscape design Selection and management of plant material in relation to built environment, taxonomy and classification of plants, trees, shrubs

UNIT III:

Site planning and site analysis with reference to different characteristics like topography, vegetation, hydrology, access, surroundings etc. Philosophical and design issues related to site development-spatial and contextual relationships of built and outdoor space and circulation, site and its relationship to surroundings, importance of climate and social factors in development of site.

Natural and manmade landscape in urban and rural landscape. Contemporary attitude to development and design of open spaces-like urban spaces, courtyards, gardens, parks, Streetscape, street furniture, lampposts, pavements and other architectural elements in relation to architectural design

Studio exercises emphasizing relationship between built form and outdoor areas and site planning issues.

Note – The Portfolio covering the above topics shall be presented for Term work. Minimum one plate from each unit., site visits to be arranged by studio teacher. Study of material application shall be submitted in the form of journal.

Text Books: NIL

Reference Books:

).Blane Alan, Landscape Construction and detailing B T Batsford Ltd, London 1996.
2) Colise Brenda, Land and Landscape.
3) G. Eckbe “Landscape for Living”
4) Trivedi, P. Pratibha, Beautiful Shrubs. Indian Council of Agricultural Research, New Delhi, 1990.
5) Lynch, Kevin, Site Planning, IT Press, Massachusetts, 1962.
6) Laurie, Michael, An introduction to Landscape, II Ed, Prentice Hall, New Jersey, 1986
7).Santapau. H. Common Trees, National Book Trust, NewDelhi, 1981.
8) J.O. Simmonds, “Landscape Architecture”

Scheme for End Semester Assessment (ESA)

Evaluation of Portfolio of Term Work / Viva

Program : Architecture		
Course Title: DIGITAL TOOL - II		Course Code: 15AATP202
L-S-P: 0-0-2	Credits: 2	Contact Hours: 2
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hours: 32	Examination Duration: NA	

UNIT I:

- **Introduction to CAD Environment**: Introduction to The world space, user co-ordinate system (ucs). Command line and menus, to learn basic commands like, units, limits, line, circle, arc. Etc. Use editing commands like trim, extend, erase, offset to create basic shapes.

UNIT II:

- **2D Drafting**: Use basic drawing and editing commands to create 2d architectural plans, elevations, and sections, adding text and dimensions creating layers using advance editing commands.
- **Composing and printing**: Creating detail sanction drawings, Using plot for output saving drawings in different file formats. Creating 2d drawings from google earth and importing images in cadd.

UNIT III:

- **Introduction to Photoshop:** file formats, importing and enhancing cad drawing images using masks, layers, fills, and editing tools.

Text Books:

NIL

Reference Books:

1.) AutoCAD 2007 For Dummies. by David Byrnes, Mark Middle brook.
Publisher: For Dummies; Revised edition (May 8, 2006)
ISBN-10: 0471786497, ISBN-13: 978-0471786498

2.)Enhancing CAD Drawings with Photoshop by Scott Onstott
Publisher: Sybex (January 21, 2005) Language: English
ISBN-10: 0782143865 ISBN-13: 978-0782143867

Program : Architecture		
Course Title: STRUCTURES - IV		**Course Code: 15AATC214**
L-S-P: 3-0-0	**Credits: 3**	**Contact Hours: 3**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 48	**Examination Duration: 3 HOURS**	

UNIT I:

1. Structural steel properties, available steel grades in India, loads on steel structures as per IS 875- 1987 (Part I and II) and standers rolled steel sections.
2. Fasteners – welded, bolt and nut connections in steel structures, to find the strength of a joint may subjected to axial load and eccentric load. Merits and demerits as compared to each other.

UNIT II:

1. Design of roof truss elements strut and tie.
2. Design of elements of braced streel structural system, compression members of single and built up sections. Design of compression members using SP 6 part I.
3. Design of slab base and foundation subjected to axial laod.

UNIT III:

1. Design of laterally restrained beams.
2. Moment resisting frames, comparison with braced frames, different types, composite structures.
3. Case study of steel building structures.

Text Books:

1. *Ram Chandra Design of Steel Structures Vol I Standard Publishers New Delhi*

Reference Books:

1. P Dayaratnam Design of Steel Structures S Chand Publications New Delhi . !999
2. Vaziranzi & Ratwani Design of Steel Structures Khanna Publications New Delhi. !998
3. Duggal. Design of Steel Structures Tata McGraw Hill Publications New Delhi . !999
4. I.S.875-1978
5. S.P.6 (6)
6. IS 800 - 1984

Scheme for Semester End Examination (ESA)

Sl.No	8 Questions to be set of 20 Marks Each	Chapter Number	Instructions
I	Q.No.-1, Q.No.-2, Q.No.-3	1, 2	Solve Any **2** out of **3**
II	Q.No.-4, Q.NO – 5 Q.No.-6,	3, 4, 5	Solve Any **2** out of **3**
III	Q.No.-7, Q.No.-8	6, 7, 8	Solve Any **1** out of **2**

B.ARCHCURRICULUM SCHEME & STRUCTURE OF 2015-2020 BATCH

V Semester - VI Semester

School of Architecture,
KLE Technological University,
BVBCET Campus, Vidyanagar, Hubli.

(Year of introduction-2015, Faculty-A, Architecture-AT, Core course-C, Humanities-H, Lab-L, Elective-E, internship-I, Practice-P, W-Project)

B. Arch. Semester V 2015-20

No	Code	Course	Category	L-S-P	Credits	Contact Hours	ISA	ESA	Total	Exam Duration	
1	15AATC301	Architectural Design V	Design	1-5-0	6	9	50	50	100	NA	
2	15AATC302	Building Const& Materials V	Construction	1-3-0	4	6	50	50	100	NA	
3	15AATC303	Services III (HVAC)	Construction	2-0-0	2	2	50	50	100	3 HOURS	
4	15AATC304	Modern Architecture	Design	2-0-0	2	2	50	50	100	3 HOURS	
5	15AATC305	Working Drawing	Construction	0-2-0	2	3	50	50	100	NA	
6	15AATC306	Quantity survey & specification	Profession	1-1-0	2	3	50	50	100	3 HOURS	
7	15AATC307	Structures – V	Construction	3-0-0	3	3	50	50	100	3 HOURS	
8	 15AATE301 15AATE302 15AATE303 15AATE304 15AATE305	Elective II Sustainable development of living cultural heritage-I Advance Computers-I Productive landscape Hands on workshop Digital 3D	Design	0-1-0	1	2	50	50	100	NA	
TOTAL				11-11-0	22	30	400	400	800		

ISA: Continuous Internal Evaluation ESA: Semester End Examination L: Lecture S: Studio P: Practical

Credit	Lecture Hours	Studio Hours	Practical Hours
1	1	1.5	2

B. Arch. Semester VI 2015-20

No	Code	Course	Category	L-S-P	Credits	Contact Hours	ISA	ESA	Total	Exam Duration
1	15AATC308	Architectural Design VI	Design	1-5-0	6	9	50	50	100	NA
2	15AATC309	Building Const& Materials VI	Construction	1-3-0	4	6	50	50	100	NA
3	15AATC310	Services IV (Acoustic)	Construction	2-0-0	2	2	50	50	100	3 HOURS
4	15AATC311	Contemporary Architecture	Design	2-0-0	2	2	50	50	100	3 HOURS
5	15AATC312	Professional Practice - I	Profession	1-1-0	2	3	50	50	100	3HOURS
6	15AATC313	Interior Design	Design	0-3-0	3	5	50	50	100	NA
7	15AATC314	Structures – VI	Construction	3-0-0	3	3	50	50	100	3HOURS
TOTAL				10-12-0	22	30	350	350	700	

ISA: Continuous Internal Evaluation ESA: Semester End Examination L: Lecture S: Studio P: Practical

Credit	Lecture Hours	Studio Hours	Practical Hours
1	1	1.5	2

V SEMESTER

Program : Architecture		
Course Title: Architectural Design – V		**Course Code: 15AATC301**
L-S-P: 1-5-0	**Credits: 6**	**Contact Hours: 9**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 144	**Examination Duration: NA**	

Course contents:

To develop skills for comprehensive understanding and dealing with Architecture Provide skills for designing multi-user and multi level spaces.

The design issues to be addressed are

- Multi user and multi level space formation
- Integration of material and form.
- Integrate the horizontal and vertical circulation.
- Develop skills to correlate the materials and the resulting form.
- Details pertaining to the disabled, aged people and children.

The list of suggested spaces to be covered as design problems: Architectural Exhibition / display spaces Multi level Accommodation spaces, higher level academic spaces, multi activity Recreational spaces, Neighbor hood Community spaces, Healthcare Centers etc.

Necessary theoretical inputs to be given highlighting the norms and design issues. At least one major exercise and one minor design/ time problem should be given. The topics covered as design problems will have to be covered by the studio faculty members through lecture/slide show session and site visits.

UNIT I:

Design Analysis : Research of the given design project, Analysis of precedents

Site analysis / Concept Development: Site plan, Site analysis, site synthesis and zoning, formulation of design brief, conceptual sketches, design development

Preliminary Design Development stage: Schematic drawings of plans with furniture Layout, sections, elevations and study models

UNIT II: **Secondary Design Development stage :**Development of detail plans, elevations and sectional details, Models, Development of Three dimensional massing with corresponding fenestrations, etc.
UNIT III: **Finalization of design:** Presentation (computer aided) and rendering **Esquissee :** Given design topic to be completed within the time limit. **Model Making :** Final three dimensional model/views
Text Books: NIL
Reference Books: 1. Time Saver Standard for Architectural Data by John Hancock. 2. Architectural Graphic Standards by Ramsey and Sleeper. 3. Magazines and Design related books 4. Architecture: Form, Space and Order, Ching, Francis DK 5. Design and Form: The basic course at the Bauhaus,Itten, Johannes. 6. Elements of space forming, Yatin Pandya. 7. Architectural Composition, Kerier, Roab

Scheme for Semester End Examination (ESA)

Evaluation of Portfolio, assignments by internal and external examiners

The students have to present the entire semester work for assessment along with Models.

A viva-voce (Approximate 15 minutes /student) shall be conducted by a jury comprising of an external examiner and an internal examiner. The drawings, models and shall be presented by the student.

Program : Architecture		
Course Title: BUILDING CONSTRUCTION&MATERIALS- V		Course Code: 15AATC302
L-S-P: 1-3-0	Credits: 4	Contact Hours: 6
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hours: 96	Examination Duration: NA	

UNIT I: DOORS FOR LARGER OPENINGS

Folding Door in Timber. Sliding Door in Aluminum and PVC

Various types of Doors in steel viz Rolling shutter, fabricated in Pressed M.S. Sheet panel.

UNIT II: METAL AND PVC WINDOWS

Various types of Windowsin steel fabricated with “Z” section and pressed metal (box) sections.

Sliding windows in Aluminum and PVC including safety arrangement.

UNIT III: PARTITIONS AND FALSE CEILINGS

Partition systems using various materials like Timber, metal, PVC, various boards, glass etc.

False ceiling system with Timber, metal framing and various panel materials.

Materials:-

Properties, types, manufacturing in brief and architectural uses of glass, and glass products, Plastics and Rubber

Note – The Portfolio covering the above topics shall be presented for Term work. Site visits shall be arranged by studio teacher. Study of material application shall be submitted in the form notes, sketches and photo brief as a part of portfolio

Text Books:NIL

Reference Books:

- McKay J.K Building Construction Metric Vol 1-4, 4th edi Orient Longman Pvt. Ltd, Mumbai,2002
- “Construction Technology” volume-I by R Chudley, ELBS & Longman group Ltd.
- Barry R, “The construction of buildings” , Vol-2, 5th Edi, East West Press, New Delhi 1999.
- Bindra S.P and Arora S.P, Building Construction-Planning Techniques and Method of Construction, 19th edi, Dhanpat Rai Pub ,NewDelhi, 2000
- “Building Construction” by JanardhanJha, Khanna New-Delhi.
- RangawalS.C ,“Building Construction” 22nd Edi, charotar Publishing house, Anand, 2004
- “Engineering Materials” by Surendra Singh, Vikas Delhi.
- “Building Materials” by S K Duggal, IBH New Delhi.
- Sushil Kumar T.B of Building Construction 19th edi, Standard Pub House, NewDelhi, 2003.
- Chowdhary K.P. Engineering Materials used in India, 7th Edi, Oxford and IBH Pub ltd New Delhi, 1990.

Building Construction Hand book : By R Chudly& R Greeno, Bullerworth Heinemann, New-Delhi

Scheme for internal Assessment (ISA): Evaluation of term work regularlyand tests conducted

Scheme for Semester End Examination (ESA): Evaluation of term work portfolio & Viva

Program : Architecture		
Course Title: SERVICES – III (HVAC)		Course Code: 15AATC303
L-S-P: 2-0-0	Credits: 2	Contact Hours: 3
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hours: 32	Examination Duration: 3 HOURS	

UNIT I:

1.Passive and Mechanical/Artificial ventilation- Need for mechanical ventilation in buildings, Applications in different criteria's.

Air conditioning- Definition, Refrigeration cycle. Compressor, Condenser, evaporator in air-conditioning.

2.Different types of Air conditioning –Ductable non ductable air conditioners, Location analysis of different equipments in different types of buildings. Air distribution systems- ducts, diffusers etc and architectural requirements of the same. Zoning purpose, advantages and disadvantages of the same

UNIT II:

3.Factors responsible for calculation of air conditioning load. Application of appropriate AC system for different types of occupancies like Residential, commercial, industrial etc.

Elevators: Introduction, different types of elevators like traction, hydraulic, double deck elevators, sky lobby, structure and interiors of lifts.

4.Passenger handling capacity, space and physical requirement and layout. Locational analysis of elevators, grouping of elevators.

Escalators: Definition, structure and different parts of escalator, Application, Location and arrangement in different types of buildings.

UNIT III:

5.Fire safety of buildings: Origin and causes of fire in buildings, fire load, fire hazards, material properties.

Passive fire protection: Application of fire resisting materials, Comapartmentation, fire escape routes.

6.Active fire protection: Portable fire extinguishers and different types. Non portable fire extinguishers, required water supply for the same, automatic fire detection and Alarm systems.

Rules for fire protection and fire fighting requirements for high rise buildings in India.

Text Books:NIL

Reference Books:

1). P. N. Anant Narayana., *Refrigeration and Air conditioning,* Third edition, Tata McGraw-Hill publishing Company Ltd, New Delhi.

2). Manohar Prasad., *Air conditioning and Refrigeration Data Hand book*.

3). Blue star ltd*: Blue star Guide to Comfort Air conditioning*. India Published by Packaged Air conditioning division.

4). Roy J Dosat., *Principles of Refrigeration*.

5) Dagostino, F. R:(1982) *"Mechanical and Electrical systems in Building"*Vargínia, Reston Publishing Co.

Scheme for Semester End Examination (ESA)

Sl.No	8 Questions to be set of 20 Marks Each	Unit Number	Instructions
1	**Question Numbers 1, 2 & 3**	I	Solve Any **2** out of **3**
2	**Question Numbers 3, 5 & 6**	II	Solve Any **2** out of **3**
3l	**Question Numbers 7 & 8**	III	Solve Any **1** out of **2**

Program : Architecture		
Course Title: Modern Architecture		Course Code: 15AATC304
L-S-P: 2-0-0	Credits: 2	Contact Hours: 2
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hours: 32	Examination Duration: NA	

UNIT I:
characteristics of Renaissance architecture
Transitional period and Revival architecture
Early Industrial buildings Arts & Craft Movement and Art Noueavau.

UNIT II:
The Chicago school and Italian Futurism
De Style and Bauhaus
Ideas and Works of Le Corbusier andMies Van Der Rohe,
Ideas and Works of Le Corbusier and Louise Kahn in India

UNIT III:
Ideas and Works of Frank Llyod wright
Ideas and Works of architects AchyutKanvinde, B. V. Doshi and Charles Correa
Ideas and Works of architects Raj Rewal, Uttam Jain and Laurie Baker

NOTE:
The architects and ideas mentioned above are indicative only
The course teacher may choose the ideas and works of architects to explain modern architecture.

Text Books: Nil

Reference Books:

1. Kenneth Frampton, Modern Architecture- A critical History
2. Bannister Fletcher, History of Architecture William Curtis, Modern Architecture since 1900
3. William Curtis, Modern Architecture since 1900
4. Bannister Fletcher, History of Architecture

Scheme for Semester End Examination (ESA)

Sl.No	8 Questions to be set of 20 Marks Each	Unit Number	Instructions
1	**Question Numbers 1, 2 & 3**	I	Solve Any **2** out of **3**
2	**Question Numbers 3, 5 & 6**	II	Solve Any **2** out of **3**
3I	**Question Numbers 7 & 8**	III	Solve Any **1** out of **2**

Program : Architecture		
Course Title: Working Drawing		Course Code: 15AATC305
L-S-P: 0-2-0	Credits: 2	Contact Hours: 3
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hours: 48	Examination Duration: NA	

UNIT I:

Introduction and importance of detailed working drawings in architectural practice. Creating working details for a residential / commercial project starting with foundation/footing and wall details

UNIT II:

Introduction to creating working details of doors, windows, staircase and floors

UNIT III:

Introduction to creating working details of interior, bathrooms, electrical, &plumbing.

Text Books:NIL

Reference Books:

1.) Architectural Working Drawings: Residential and Commercial Buildings by William P. Spence Publisher: Wiley; ISBN-10: 0471574880

ISBN-13: 978-0471574880

2.) Architectural Drawing: A Visual Compendium of Types and Methods (3rd edition) by Rendow Yee Publisher: Wiley; 3 edition (July 20, 2008)

ISBN-10: 0471793663 ISBN-13: 978-0471793663

3.) AutoCAD 2008 For Dummies. by David Byrnes, Mark Middle brook.

Publisher: For Dummies; Revised edition (May 8, 2006)

ISBN-10: 0471786497, ISBN-13: 978-0471786498

Scheme for Semester End Examination (ESA)

Assignments, Checking of Portfolio of Term Work / Viva.

Program : Architecture		
Course Title: Quantity survey and specifications.		**Course Code: 15AATC306**
L-S-P: 1-1-0	**Credits: 2**	**Contact Hours: 3**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 48	**Examination Duration: 3 Hours**	

Unit - I
1)Types of Estimates
2) Detailed estimates for load bearing buildings.

Unit - II
3) Detailed estimates for R C C frame structure buildings.
4) Introduction to Schedule of Rates.
5) Rate analysis.

Unit – III
6) Abstract Specifications for building constructions.

Text Books: NIL

Reference Books: Datta B N

Scheme for Semester End Examination (ESA)

Sl.No	8 Questions to be set of 20 Marks Each	Unit Number	Instructions
1	**Question Numbers 1, 2 & 3**	I	Solve Any **2** out of **3**
2	**Question Numbers 3, 5 & 6**	II	Solve Any **2** out of **3**
3	**Question Numbers 7 & 8**	III	Solve Any **1** out of **2**

Program : Architecture		
Course Title: STRUCTURES – V		**Course Code: 15AATC307**
L-S-P: 3-0-0	**Credits: 3**	**Contact Hours: 3**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 48	**Examination Duration: 3 HOURS**	

UNIT I:

1. Introduction to the structural design project: Design of airport terminal building of dimension 50m X 100m as horizontal structural system.

2. Structural analysis and design: Determining the loads on structure as per IS 875-1984.Design the roof system

3. Analysis and Design of continuous beams and slabs using IS:456-2000. Design of column and isolated foundation for axial load.

UNIT II:

4. Structural behavior, classification and application of folded plates, shells, domes, pneumatic structures and tensile structures.
5. Study of typical reinforcement details of RCfolded plates, shells, domes.
6. Long span industrial building: Triangular and vierendeel roof truss structural system, general configuration of industrial building, spacing of trusses and design. Dead load, live load and wind load as per IS 875:1984
7. Cable and suspension structures: Design of long span system using cable and suspension system

UNIT III:

8. Design of dogged legged stairs

Text Books:

Reference Books:

1. S.R. Karve and V. L. Shah, Limit state theory and design of reinforced concrete structures publications Pune

Program : Architecture		
Course Title:Elective-Sustainable Development of Living CulturalHeritage		**Course Code: 15AATE301**
L-S-P: 0-2-0	**Credits: 1**	**Contact Hours: 2**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 32	**Examination Duration: NA**	

UNIT I:

Definition of Cultural Heritage ,Cultural Landscape, Monuments & site(UNESCO operational guidelines)

Documentation of the Heritage Site

Need for conservation of living cultural heritage sites .

Values & Ethics in heritage conservation

Charters

UNIT II:

Mapping

Analysis

Draft Proposals and report

UNIT III:

Final proposal and report

Text Books:

NIL

Reference Books:

1. Bernard Rudofsky, *Architecture without Architects* .a short introduction to Non-Pedigreed Architecture. Academy Edition London
2. Enrico Guidon,*Primitive Architecture*
3. Christian NorbergShulz, *Genius Locii*
4. Alexander Christopher *;Urban Pattern*
5. Alexander Christopher*: Timeless way of Building*
6. Feilden Bernard, *Guidelines for Conservation ,A technical manual*

7. *Jacobs,J* (1961) The Death and Life of Great American Cities, NewYork,Random House.
8. *Lynch,K* (1981) A Theory of Good City Form, MIT Press
9. UNESCO Operational Guidelines 2012
10. UNESCO Nomination Dossier manual 2012
11. UNESCO paper series

Website: *ICOMOS* , ICCROM , UNESCO

Project Report,,Place Making " A Synthesis of Professional Practice & Case studies about better living Environment , RUDI (Resource of Urban Design Information)

Scheme for Semester End Examination (ESA)

Checking of Portfolio of Term Work / Viva

Program : Architecture		
Course Title:Elective-ADVANCE COMPUTERS - I		**Course Code: 15AATE302**
L-S-P: 0-1-0	**Credits: 1**	**Contact Hours: 2**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 32	**Examination Duration: NA**	

UNIT I:

1. Introduction Raster and Vector graphics.
2. Introduction color modes and pixels.
3. Introduction typography, animation, video and sound.

UNIT II:

1. Introduction Adobe indesign software
2. Page layout tools and commands in adobe indesign software

UNIT III:

1 Interactive tools commands in adobe indesign software
1. Various export file formats

Text Books: Nil

Reference Books:

Online tutorials

Scheme for Semester End Examination (ESA)

Checking of Portfolio of Term Work / Viva

Program : Architecture		
Course Title:Elective-Productive landscape		**Course Code: 15AATE303**
L-S-P: 0-1-0	**Credits: 1**	**Contact Hours: 2**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 32	**Examination Duration: NA**	

UNIT I:

- Introduction to different types of productive landscape in interior and exterior spaces of building.
- Study of Different methods of productive landscape.
- Basics of different types of grow mediums, soil and plants.

UNIT II:

- Maintaining, pest and disease control of plants
- Water management and Fertilizers for the good health and food production of plants
- Organic and sustainable methods of growing plants in small spaces

UNIT III:

- Introduction to vertical farming.
- Literature and Case study.

Text Books: Nil

Reference Books:

1. Blane Alan, Landscape Construction and detailing B T Batsford Ltd, London 1996.
2. Laurie, Michael, An introduction to Landscape, II Ed, Prentice Hall, New Jersey, 1986

Website:

Project Report

Scheme for Semester End Examination (ESA)

Checking of Portfolio of Term Work / Viva

Program : Architecture		
Course Title:Elective- Hands on workshop		**Course Code: 15AATE304**
L-S-P: 0-1-0	**Credits: 1**	**Contact Hours: 2**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 32	**Examination Duration: NA**	

UNIT I:

- Introduction to different types of hands on projects
- Case study and literature study of the selected project.
- Data collection and material study of the project.

UNIT II:

- Development and execution of the project with hands on experience.
- Continual development and real time design and material application on scaled models and life scale models.

UNIT III:

- Hands on execution with improvements and Documentation of the project from start to finish.

Text Books: Nil

Reference Books:

1. Ching, Francis DK, Architecture: Form, Space and Order, 2nd ed.VanNostrand Reinhold, New York, 1999
2. Visual Intelligence: How We Create What We See by Donald D. Hoffman (Author) Publisher: W W Norton & Co Ltd; New Ed edition (29 Feb 2000)
3. Building Construction Hand book:By R Chudly& R Greeno,BullerworthHeinemann,New-Delhi.

Website:

Project Report

Scheme for Semester End Examination (ESA)

Checking of Portfolio of Term Work / Viva

Program: Architecture		
Course Title: Elective - DIGITAL 3D		Course Code: 15AATE205
L-T-P 0-0-2	Credits: 2	Contact Hours: 28
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hours: 28 hrs	Examination Duration: 2hrs	
Unit I 1. Understanding the Basics of Rhino 2. Working with the tools for design 3. Basic modeling using tools in Rhino		
Unit II 1. Understanding the Basics of Grasshopper 2. Working with the tools for design 3. Basic modeling using tools in Grasshopper 4. Simulating Rhino design with Grasshopper		
Unit III 1.Presenting the modeled design using the software knowledge		
Text Books - NIL		
Reference Books: - NIL		

Scheme for Semester End Examination (ESA)

UNIT	8 Questions to be set of 20 Marks Each	Chapter numbers	Instructions
I	8 designs of Rhino models	1	To be completed in class hours
II	8 designs of Grasshopper models	2	To be completed in class hours
III	8 simulation designs	3	To be completed in class hours

VI SEMESTER

Program : Architecture		
Course Title: Architectural Design – VI		**Course Code: 15AATC308**
L-S-P:1-5-0	**Credits: 6**	**Contact Hours: 9**
ISA Marks:50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 144	**Examination Duration: NA**	

Course objective:Application of an understanding of structures and services in the design of social infrastructure in an urban context.

Course contents:

1. Project shall be of multiple functions and with a need for imagery as one of the architectural goals.
2. Design project should be a complex building involving an advanced level of services and structural system. Example: Exhibition and display pavilions, theme based hotels, sports facilities, medical facilities and shopping centers etc
3. Design emphasis shall be on the use of innovations in materials and techniques of construction.
4. Alternative to the emphasis on imagery, projects involving large span structure like industrial Structures may be attempted. Design emphasis shall be on the skin and support of structural Systems and resulting architectural form.

UNIT I:Design Analysis : Research of the given design project, Analysis of precedents.

Site analysis / Concept Development: Site plan, Site analysis, site synthesis and zoning, formulation of design brief ,conceptual sketches,
design development.

Preliminary Design Development stage: Schematic drawings of plans with furniture Layout, sections , elevations and study models

UNIT II:Secondary Design Development stage : Development of detail plans, elevations andsectional details, Models, Development of Three dimensional massing with corresponding fenestrations, details of services and structural system.

UNIT III:Finalization of design: Presentation (computer aided) and rendering

Esquissee: Given design topic to be completed within the time limit.

Model Making : Final three dimensional model/views

Necessary theoretical inputs to be given highlighting the norms and design issues. At least one major exercise and one minor design/ time problem should be given.

The topics covered as design problems will have to be covered by the studio faculty members through lecture/ slide show session and site visits. The Portfolio covering the given topics and the study models shall be presented .

The evaluation shall be through periodic internal reviews.

Scheme for Semester End Examination (ESA)

Evaluation of Portfolio, assignments by internal and external examiners

The students have to present the entire semester work for assessment along with Models.

A viva-voce (Approximate 15 minutes /student) shall be conducted by a jury comprising of an external examiner and an internal examiner. The drawings, models and shall be presented by the student.

Course Title: BUILDING CONSTRUCTION & MATERIALS - VI		Course Code: 15AATC309
L-S-P: 1-3-0	Credits: 4	Contact Hours: 6
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hours: 96	Examination Duration: NA	

UNIT I: STEEL STRUCTURES

Various steel sections and its use as, single or composite for column and beams, including connection methods. Steel grillage foundation.

UNIT II: STEEL BEAMS AND GIRDERS, TRUSSES, PORTAL FRAME & PEB

Girders: Types of girders like, standard sections, lattice, plate, castellated, veirendiel and portal frame.

Trusses: Types of roof trusses. Detailing of ridged & North light roof truss, including fixing of roofing materials

PEB: Introduction, fabrication and selection criteria.

UNIT III: MATERIALS:

Waterproofing and weather proofing materials like chemical admixtures and surface application. and Properties and architectural uses of ferrous and non-ferrous metals.

Note – The Portfolio covering the above topics shall be presented for Term work. Site visits shall be arranged by studio teacher. Study of material application shall be submitted in the form notes, sketches and photo brief as a part of portfolio

Text Books:

- McKay J.K Building Construction Metric Vol 1-4, 4thedi Orient Longman Pvt. Ltd, Mumbai,2002
- “Construction Technology” volume-I by R Chudley, ELBS & Longman group Ltd.
- Barry R, “The construction of buildings” , Vol-2, 5th Edi, East West Press, New Delhi 1999.
- Bindra S.P and Arora S.P, Building Construction-Planning Techniques and Method of Construction, 19thedi, Dhanpat Rai Pub ,NewDelhi, 2000
- “Building Construction” by JanardhanJha, Khanna New-Delhi.
- RangawalS.C ,“Building Construction” 22nd Edi, charotar Publishing house, Anand, 2004
- “Engineering Materials” by Surendra Singh, Vikas Delhi.
- “Building Materials” by S K Duggal, IBH New Delhi.
- Sushil Kumar T.B of Building Construction 19thedi, Standard Pub House, NewDelhi, 2003.
- Chowdhary K.P. Engineering Materials used in India, 7th Edi, Oxford and IBH Pub ltd New Delhi, 1990.
- Building Construction Hand book : By R Chudly& R Greeno, Bullerworth Heinemann, New-Delhi.

Scheme for internal Assessment (ISA): Evaluation of term work regularlyand tests conducted

Scheme for Semester End Examination (ESA): Evaluation of term work portfolio & Viva

Course Title: SERVICES – IV(Acoustic)		Course Code: 15AATC310
L-S-P: 2-0-0	Credits: 2	Contact Hours: 2
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hours: 32	Examination Duration: 3 HOURS	

1. UNIT I:

Introduction to the study of acoustics

1. Basic terminology-propagation, frequency, pitch, tone, sound pressure, intensity of sound' velocity of sound,decibel scale, loudness, threshold of audibility, pain, masking effect, sound and distance.
2. Behavior of sound in an enclosed spaces----- reflection of sound from plane, convex and concave surfaces, diffraction of sound, masking effect, articulation test, echoes, whispering galleries, sound foci and dead spots.
3. Effect of noise, various types of noises, air borne and structure borne noise, impact noise, acceptable noise levels, transmission loss.

2. UNIT II:

Acoustic materials and Definition of noise.

1. Various sound absorptive materials, construction details, special sound absorptive materials used for multi-purpose activities, absorption coefficient, reverberation, reverberation time calculation
2. Environmental noise Road, rail and air traffic and means of controlling and insulation, Industrial noise air turbulence, friction, methods of reduction by enclosures and barriers, sound isolationthrough landscape elements, land use planning for noise control
3. Sound proof doors and windows, sound leaks in doors and windows, floating floors, cavity wall construction, discontinuous joints, noise reduction between rooms and floors, resilient hangers.
4. Noise reduction from mechanical equipment, rubber mounts, vibration isolation of machines, pumps and generators, noise in a.c. ducts, acoustical filters, electronic sound amplification and distribution. Systems, loud speaker layout.

UNIT III:

Study and development of ---Auditorium and theaters

1. Design details of---- audio visual room,
2. Seminar hall, Cinema Theater, auditorium with balcony used for drama, music and speech.
3. Lecture halls, office building

Case study of an auditorium acoustically treated with drawings---acoustical design for any one type of building with RT calculations.

Reference Books:

1. Acoustics and Noise Control: B.J. Smith, R.J. Peters, S owen, Longman Group Ltd. U.S.A., 1982

2. Acoustical Designing in architecture: Vern o. Knudsen and Cyril M. Harris, John Wiley & Sons, inc. London. 1963

3. Master Hand book of Acoustics: F.Alton Everest, 4ed, McGraw-Hill, Two Penn Plaza, New York, NY 10121-2298 (Delhi- India), 1945

4. Acoustics Noise and buildings: P.H. Parkin, H.R. Humphreys and J.R Cowell, 4ed, Ebenezer Balis and Son, Ltd., the Trinity Press, Worcester, and London, 1979

5. Acousics : R. L. Suri, 1ed, Asia Publishing, Mumbai, 1966

Internal Semester Assessment (ISA)

Minor tests and assignments

Scheme for Semester End Examination (ESA)

Sl.No	8 Questions to be set of 20 Marks Each	Unit Number	Instructions
1	**Question Numbers 1, 2 & 3**	I	Solve Any **2** out of **3**
2	**Question Numbers 3, 5 & 6**	II	Solve Any **2** out of **3**
3	**Question Numbers 7 & 8**	III	Solve Any **1** out of **2**

Program : Architecture		
Course Title: Contemporary Architecture		**Course Code: 15AATC311**
L-S-P: 2-0-0	**Credits: 2**	**Contact Hours: 2**
ISA Marks:50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 32	**Examination Duration: 3 HOURS**	

UNIT I:

1) Post-independence architecture in India –

1. Ideas and Works of architects i.e. AchyutKanvinde, B. V. Doshi, Charles Correa, etc
2. Ideas and Works of architects i.e. Raj Rewal, Uttam Jain, Laurie Baker, etc

UNIT II:

2) Contemporary western architecture –

1. Ideas and Works of post modern architects i.e. Richard Meier, Charles Moore, etc.
2. Ideas and Works of de-construction architects i.e. Bernard Tschumi, Frank Gehry, ZahaHadid, Daniel Leibskind, etc.
3. Ideas and Works of hi-tech architects i.e. Norman Foster, Renzo Piano, Richard Rogers, etc.
4. Ideas and Works of artist and architects i.e. Santiago Calatrava
5 Ideas and Works of Rem Koolas, Zahahadid, Daniel Liebskind

UNIT III:

1) Contemporary Indian architecture

1 Ideas and Works of Hafeez contractor, Sanjay mohe,RahulMehrotra ,ShirishBeri, Sanjay Puri, Christopher chares Benninger,etc

Text Books: Nil

Reference Books:

1. **Bahga, Bahga and Bahga**, Modern Architecture in India
2. **Jon Lang**, A Concise History of Modern Architecture in India
3. **Charles Jencks,** Currant Architecture
4. **Dennis Sharp,** 20th Century Architecture, A Visual History
5. **James Steel,** Architecture Toda

Internal Semester Assessment (ISA) - 2 Minor test and assignments

Scheme for Semester End Examination (ESA)

Sl.No	8 Questions to be set of 20 Marks Each	Unit Number	Instructions
1	**Question Numbers 1, 2 & 3**	I	Solve Any **2** out of **3**
2	**Question Numbers 3, 5 & 6**	II	Solve Any **2** out of **3**
3	**Question Numbers 7 & 8**	III	Solve Any **1** out of **2**

Program : Architecture		
Course Title: Professional practice - I		Course Code: 15AATC312
L-S-P: 1-1-0	Credits: 2	Contact Hours: 3
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hours: 48	Examination Duration: 3 HOURS	

UNIT I:

1. Tenders –Tender documents, Types, Tendering Procedure, Tender Notice, EMD, Mobilisation Fund, Security Deposit, Retention Amount, Mobilisation Fund, Contractor's Profit, Work Order, and Letter of Acceptance.

2. Contracts – Definition, General Principles, Types of Contract, Importance of Articles of Agreement and Appendix, Definition of various terms and their scope. Architect's power and duties with respect to execution of contract conditions, Contractor's Duties and Liabilities under contract. Problems arising out of contract – Virtual completion and defects liability, liquidated and unliquidated damage, Penalty Bonus, Extension of Time, Non tendered items, extra and additional work, variation, prime cost and provisional sum, fire insurance and conditions of claim

UNIT II:

3. Arbitration and Conciliation – Methods to settle disputes and differences, Arbitration – Types, Arbitrator, power and duties of Arbitral Tribunal, Umpire, Awards and Conduct of arbitration proceedings. Conciliation – Duties of Conciliator. Arbitration and Conciliation Act 1996.

4. Dilapidation and Easements –

Dilapidation - Definition, Characteristics, Schedule of Dilapidations, Preparation of Dilapidation Report

Easements – Definition, Various easement rights, process and precautions to be taken by the architect in protecting or preventing the concerned parties from acquiring such rights.

UNIT III:

5. Valuation – Introduction, Essential Characteristics, Value and its classification, purpose of Classification, methods of valuation, standard rent, cost of construction.

Text Books:NIL

Reference Books:

1. Professional Practice – Dr. Roshan Namavati
2. Architectural Practice and Procedure – Ar. V S Apte
3. The Business of Architectural Practice – Derek Sharp
4. Architectural Practice in India – Ar. MadhavDeobhakta
5. Professional Practice – Dr. K G Krishna Murthy and Prof S V Ravindra

Internal Semester Assessment (ISA)2 Minor test and assignments

Scheme for Semester End Examination (ESA)

Sl.No	8 Questions to be set of 20 Marks Each	Unit Number	Instructions
1	Question Numbers 1, 2 & 3	I	Solve Any 2 out of 3
2	Question Numbers 3, 5 & 6	II	Solve Any 2 out of 3
3	Question Numbers 7 & 8	III	Solve Any 1 out of 2

Program : Architecture		
Course Title: Interior Design		**Course Code: 15AATC313**
L-S-P: 0-3-0	**Credits: 3**	**Contact Hours: 5**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 80	**Examination Duration: NA**	

UNIT I:

- History of Interior Design
- Interior Space and its definitions

UNIT II:

- Material information and its application.
- Detailing

UNIT III:

- Hands on experiment with different materials and its usage in interior spaces.

Text Books - NIL

Reference Books:

1 CHING
2 Rendering with Pen & Ink.

Scheme for internal Assessment (ISA): Evaluation of term work regularlyand tests conducted
Scheme for Semester End Examination (ESA): Evaluation of term work portfolio & Viva

Program : Architecture		
Course Title: STRUCTURES - VI		Course Code: 15AATC314
L-S-P: 3-0-0	Credits: 3	Contact Hours: 3
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hours: 48	Examination Duration: 3 HOURS	

UNIT I:

1. Vertical/lateral structural systems: introduction. Structural design project of a 15 story of 40m X 40m X 32m. calculation dead load, live load and wind load as per IS 875-1984.
2. Seismic loading calculation as per IS1983-2002 part - I.
3. Introduction to the computer added structural analysis and design.

UNIT II:

4. Introduction to lateral load resisting system
5. Shear wall system
6. Dual system

UNIT III:

7.Braced frame

Text Books:

1. Dr. Ram Chandra, Design of Steel Structures, Vol I, 10th ed. Standard book house, New Delhi, 1999.
2. S. Ramambrutham and R Narayanan, Design of Steel Structures, 4th ed. Dhanpat Rai and Sons, Delhi 1995

Reference Books:

1. Structures Martin Bechthold, Daniel L Schodek. PHI Learning pvt. Ltd

Internal Semester Assessment (ISA)2 Minor test and assignments

Scheme for Semester End Examination (ESA)

Sl.No	8 Questions to be set of 20 Marks Each	Unit Number	Instructions
I	Q.No.-1, Q.No.-2, Q.No.-3	I	Solve Any **2** out of **3**
II	Q.No.-4, Q.NO – 5 Q.No.-6,	II	Solve Any **2** out of **3**
III	Q.No.-7, Q.No.-8	III	Solve Any **1** out of **2**

B.ARCHCURRICULUM SCHEME & STRUCTURE OF 2015-2020 BATCH

VII Semester - VIII Semester

School of Architecture, KLE Technological University, BVBCET Campus, Vidyanagar, Hubli.

(Year of introduction-2015, Faculty-A, Architecture-AT, Core course-C, Humanities-H, Lab-L, Elective-E, internship-I, Practice-P, W-Project)

B.Arch. Semester VII

No	Code	Course	Category	L-S-P	Credits	Contact Hours	ISA	ESA	Total	Exam Duration
1	15AATC401	Architectural Design VII (Urban Insert)	PC	0-7-0	7	10	50	50	100	NA
2	15AATC402	Building Const& Materials VII	BS&AE	1-3-0	4	6	50	50	100	NA
3	15AATC403	Settlement Planning	PC	2-0-0	2	2	50	50	100	3 HOURS
4	15AATC404	Dissertation	PAE	0-3-0	3	4	50	50	100	NA
5	15AATC405	Professional practice - II	PAE	3-0-0	3	3	50	50	100	3HOURS
6	15AATC406	Structures – VII	BS&AE	0-3-0	3	4	50	50	100	NA
TOTAL				6-16-0	22	29	300	300	600	

ISA: Internal Semester Assessment , ESA : End Semester Assessment , P : Practical, S : Studio , L : Lecture,
(PC-Professional Core, BS & AE- Building Sciences & Applied Engineering, PAE- Professional Ability Enhancement)

Credit	Lecture Hours	Studio Hours	Practical Hours
1	1	1.5	2

B.Arch. Semester VIII

No	Code	Course	Category	L-S-P	Credits	Contact Hours	ISA	ESA	Total	Exam Duration
1	15AATC407	Architectural Design VIII (Campus Planning)	PC	0-7-0	7	10	50	50	100	NA
2	15AATC408	Pre-thesis	PC	0-3-0	3	4	50	50	100	NA
3	15AATC409	Digital tool- 3 (Revit)	PAE	0-0-3	3	4	50	50	100	NA
4	15AATC410	Online Portfolio	PAE	0-0-2	2	3	50	50	100	NA
5	15AATC411	Construction Management	PAE	3-0-0	3	3	50	50	100	3 Hours.
6	15AATC412	Green Building Studio	PAE	0-2-0	2	3	50	50	100	NA
7	15AATE407 5AATE408 15AATE409 15AATE410	Elective-III Architectural Film Making-I Sustainable development of living heritage –II Transit Oriented Development Architectural Lighting	PAE	0-2-0	2	2	50	50	100	NA
TOTAL				3-14-5	22	29	350	350	700	

ISA: Internal Semester Assessment , ESA : End Semester Assessment , P : Practical, S : Studio , L : Lecture,
(PC-Professional Core, BS & AE- Building Sciences & Applied Engineering, PAE- Professional Ability Enhancement)

Credit	Lecture Hours	Studio Hours	Practical Hours
1	1	1.5	2

VII SEMESTER

Program : Architecture		
Course Title: DESIGN STUDIO-VII (Urban Insert)		CourseCode: 15AATC401
L-S-P: 0-7-0	Credits: 7	ContactHours:10
CIE Marks: 50	SEE Marks: 50	Total Marks: 100
Teaching Hours: 160	Examination Duration: NA	

Course Overview:

" Each generation writes its own biography in the cities it creates". *Lewis Mumford, The Culture of the City*

The course focuses on creating awareness in students in the subject of Urban Design as a specialization in the field of Architecture and urban planning

This studio will explore the discipline of urban design. Urban design is the creation of the physical structure for collective life: making places for people. It is a generalist discipline focused on the building of human settlements. We lay our cities, roads, parks and buildings, in order to create places where humanity can go about the complicated business of daily life.

As urban designers we are answerable not just to our clients but to everyone, generations past, present and future, all of whom must live together in the places on which we work. Ultimately we strive to make places for people that are sustainable, beautiful, inspiring and open, for the best places are never finished. Urban designers work at a range of scales, from street furniture all the way up to regions.

Objectives of the course:

- Identify and analyze how people perceive and navigate their communities
- To give an overview of urban design as an interface between the fields of architecture and urban planning.
- Our approach to urban design engages the city as an integrated design problem which is best solved through a participatory design process. Drawing on multiple disciplines, you will study the process of working directly with communities to create visions for future change.
- The studio is intended to both introduce you to urban design and inform your understanding of building design in relation to existing contexts.
- The first half of the semester is focused on introducing new skills of urban design which involves field studies and analysis of the built environment and its embedded issues while the second half is devoted to expanding and developing design skills at the block and neighborhood scale.
- The urban design studio seeks to educate architects to be leaders for vision-based change at the scales of neighborhood, city and region. This studio builds upon and expands your design skills in architecture, urban design and landscape architecture, and introduces new skills in community leadership and urban design.
- To impart the knowledge about various developments in the field of urban Design.

Expected skills/Knowledge Transferred:

Skills to understand the principles and methodology involved in urban design projects in public and private developments through active participation with the stake holders and the authority

Urban design as a complex interdisciplinary process requiring strong leadership and a combination of skills. The community and urban design studio is designed to introduce you to new skills regarding community leadership and urban planning and development while expanding your existing skills as a physical designer. The exercise sequence relates directly to these various skills over the course of the semester.

Course contents

Based on the currents issues affecting the built environment in India or abroad, the studio is aligned accordingly to address the complexity through solutions..

The studio is divided into three phases

The first phase involves Site (urban/peri-urban, rural laboratory)Identification, inventory and analysis

Pre visit research, archival study appreciating the natural, cultural,historical, economical socio-political context (Data collection: Maps ,drawings ,CDP, building regulation ,Demography study , socio economic survey)

Field study and inventory exercise

Meetings with the stakeholders

Site analysis inferences is carried out by the pre formed groups of four to five students each. The inferences,individual and shared views are presented. The emerging issues are discussed in a group.

All groups present and discuss their respective SWOT observation,vision statement, Objectives, Strategies leading to a common vision statement.

The second phase of work focus on the preparation of master plans and design guidelines based on the conclusion drawn from the inventory and analysis phase, through agreed objectives for development and strategies and individual demonstration projects

The master plan and accompanying guidelines will be formulated simultaneously and will serve as the basis for individual test projects during the third phase

Third Phase Individual project Proposals

Note: *The above said task will be carry out in the holidays before the commencement of the semester and will take approximately two-three weeks*

Unit-I:

Site Analysis

(5 weeks in the studio) (1-6 week)

2-3 weeks on the site during VI Semester end holidays

Research and inventory

Appreciating the context through maps, context model, digital model

Analysis and identification of issues and impact assessment

Communication of analysis and conclusions through situation maps, analytical drawings, photo documentation, sketches drawings and other graphical material as required to illustrate issues with potential to influence the master plan

This information will be published in a binder that will act as a primary resource for the next phase of work.

Working as a studio you will explore economic, social and physical aspects of the neighborhood through maps, demographics, diagrams, photographs, and a large physical model. The analysis provides an opportunity for you to learn about the community. More importantly, effective representation of conditions sets the frame for a future. Analysis is the foundation upon which urban design and development proposals stand.

Unit-II: Urban Design Framework

4 weeks(6-10 weeks)

Formulating the Vision of the place

Formulation of Objectives

Development strategy (Land use, Zoning regulations, setting FAR, Ground Coverage, defined sustainable measures)

Develop graphic and verbal recommendation for essential design character of the overall site and its individual development. Each group will produce one master plan for specific area of the city/town/neighborhood.

Policy and development framework

Working as a studio group, you will transform community issues and objectives into a unified vision for the neighborhood with a series of strategies and an urban design framework. The urban design framework will establish a future vision of the corridors, districts, and neighborhoods of the community. The framework will establish significant places for public investment as well as important civic design features of private development.

Unit-III. Urban Design Project

4 weeks(10-14 weeks)

This unit will involve reading task followed by class room discussions.

Once the overall vision for the place has been formulated and development objective are chalked out, the group disperses. Each individual designer will zoom in to there respective areas of intervention for:

Project identification

Formulation of design program

Urban Design Project framework

Formulation of areas

Design development

Draft proposal

Final Project

In the final phase you will develop a single area of focus in detail, exploring site forces, development typologies, three-dimensional place making and representation. Your vision for change will be embodied through the designs of a development proposal at a critical location in the community. A catalytic project must inspire continued investment and pursuit of the larger urban design goals for community reinvestment.

The individual design solutions itself is defined in terms of allowing and constricting a set of processes in time and space. The challenge you face in the Urban Design Studio involves expanding the scale of the problem not only in space (the site is much bigger than in your previous studios), but also in time: the solution itself must allow for multiple possibilities over an extended period of time. In this sense your solutions must be concrete spatial proposals, but they should also be thought of as flexible temporal frameworks for urban change.

(15th week) +1 week for Final Presentation of individual interventions)

General Reading

1) Katz Peter,The New Urbanism: Toward an Architecture of Community.McGraw -Hill, Inc
2) *Larict, M and Macdonald*,E.Ed.2013. The Urban Design Reader, *Second Edition, Routledge.*
3) *Bacon N. Edmund.* Design of cities. Penguin Books, New York 1976.
4) *Krier Rob*, Urban Space 3rd Ed, Academy Editions, London 1984.
5) *KrierRob,*Town Spaces(Contemporary Interpretations in Traditional Urbanism),*Birkhauser-Publishers for Architecture*
6) Mumford Lewis City in History, Its origin transformation and its prospects.
7) SpreiregenPaul ,Urban Design: The Architecture of Towns and cities
8) *Alexander Christopher ;*Urban Pattern
9) *Alexander Christopher:* Timeless way of Building
10) *Alexander Christopher*: New Theory of Urban Design
11) *Alexander Christopher: Nature of Order,vol.1,2,3,4*
12) *Alexander Christopher*: Synthesis of Form
13) *Alexander Christopher:* City is not a Tree
14) *Rappoport Amos:* Human Aspect of Urban Form
15) *Rappoport Amos:* History and Precedent of Environmental Design
16) *Rappoport Amos:* House Form and Culture
17) *Rappoport Amos:* Meaning of the built environment
18) *Geoffrey Broadbent*: Design in Architecture
19) *Geoffrey Baker*: Design strategies in architecture: An approach to analysis of form
20) *Lynch Kevin: City Sense*
21) *Lynch Kevin: Image of the City*

Reference Reading book

1) *MoughtinClif* ,Urban Design ,Method and Techniques. Architectural Press
2) Lawson B,(1980)How Designers Think, London Architectural Press
3) De Bono,E(1977) Lateral Thinking, Harmondsworth: Penguin
4) *Jane Jacob, The Death and Life of Great American Cities*(1961) New York, Random House.
5) *Rudi & Academy of Urbanism,* Place Making 2009
6) *Atkins,* Hinkley Town Center Renaissance Master Plan
7) *DETR/CABE,*By design(2000)
8) *DTLR/CABE*, Better places to live (2001)
9) *Bartlett School of Planning,*The value of design (CABE online, 2002)
10) *English Heritage/CABE*, Building in context (2001)
11) *Robert Cowan (ed.),*Urban design guidance (Urban Design Group, 2002)
Robert Cowan, Place check - a user's guide (Urban Design Alliance)
12) Bentley,I (etal) (1985) Responsive Environments ,Architectural Press
13) *Colquhoun, I* (1995) Urban Regeneration
14) *DETR and CABE (2000)* By Design: Urban Design in the Planning System: Towards Better Practice
15) *Urban Design Compendium*
16) *DETR* (2000) Planning Policy Guidance Note 3:Housing
17) The *New Urbanism:*Towards an Architecture of Community, McGraw-Hill,Inc.
18) *Krieger,A (Ed.)* (1991) Towns and Town Making Principles, New York, Rizzoli
19) *Rogers,R* (1997) Cities for a Small Planet,Faber and Faber
20) *Rudlin,D. and Falk,N.(*1999) Building the 21st Century Home:The Sustainable Urban Neighbourhood,
21) *Tibbalds ,F* (1992) Making People-Friendly Towns, Longman
22) *Urban Task Force* (1999) Towards an Urban Renaissance, E & FN Spon (Final Report of the Urban Task Force)
23) *Urban Villages Group (*1992 and 1998) Urban Villages
24) *English Partnerships* (1996) Time for Design

25) *English Partnerships* / Urban Villages Forum (1998) Making Places
26) *English Partnerships* (1998) Time for Design II
27) *English Partnerships* (1999) Space for Growth
28) *Housing Corporation* (1998) Scheme Development Standards
29) *Housing Corporation/DETR* (1999) Housing Quality Indicators
30) Bentley,I (etal) (1985) Responsive Environments ,Architectural Press
31) *Colquhoun, I* (1995) Urban Regeneration

Web Sites

Council on Architecture and the Built Environment: www.cabe.org.uk

UDPFI Guidelines

Student Assessment

Participation- Field studies, Pin -ups, critique, discussion, activity engagement, studio attendance and preparation, formulation of Vision, Objectives and Strategies	Weight age in marks 30
Studio assignments- sketchbooks, drawings, maps ,report, interpretations from archival studies, observation SWOT analysis	
Individual design project- process and product	20
Total	50

Successful accomplishment of learning outcomes will be assessed, primarily, based on two tools

1.Rubrics for the studio assignments

2. The community design project, organized around project process, product, and presentation; and verbal critique and written comments from guest reviewers for process and final project presentations spread across series of internal reviews, external reviews, community participation, discussions, exhibitions/Urban Design Charrette /pechakucha

Rationale	
Analysis	Physical Analysis(Lynch, Lost Space Analysis, Connectivity, Morhphology,SWOT, Factors Affecting the sites
Principles	Theory of Built environment, Genius Locii,Urban Design Principles, Historic Urban Landscape, Valletta Principles for Historic towns and villages
Strategy	Open Space, Built Environment, Heritage, Natural Setting, Connectivity,Urban Infrastructure, social infrastructure ,Urban Block, density, urban morphology etc
Master Plan	Area development,sustainable design parameters, design for resilience and inclusiveness
Design	Block plan, public realm design, area codes, Building codes, street features, street furniture ,lighting
Conclusion	

Program : Architecture		
Course Title: Building Constructions & Materials- VII		**Course Code: 15AATC402**
L-S-P: 0-4-0	**Credits: 4**	**Contact Hours: 6**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 96	**Examination Duration: NA**	

Course contents:

Unit-I: Large span Roofing systems,shell roof ,Folded Plates in R.c.c, advantages over conventional roofing systems and details there in space frame, Tensile &Pneumatic structures ,evolution ,advantages ,scope and construction details there in.

Unit-II :Envelop systemMethod of using various types of curtain wall method including structural glazing Advantages, provision and arrangements made during construction , working out details with various metals.

Unit-III Pre fab,Pre stress and post tension study of various buildings prefab elements ,advantages over in situ components study of pre tensioning and post tensioning of prefab and in situ components

Advantages &disadvantages over regular reinforcement, pre& post tensioning method.

Material-

Concrete admixture adhesive &sealants, pest control Identifying the pest which may attack the buildings precautionary measures taken during construction. Pre &post treatment methods

Sessional Work (Internal semester assessment)

The 'Sessional Work' shall comprise of the following.

Scheme for Semester End Assessment (ESA)

The students have to present the entire semester work for assessment along with Model.

Mode of assessment :

A1 size sheets related to above mentioned topics

Models to scale on each topic are expected

References :

Program : Architecture		
Course Title: Settlement Planning		**Course Code:** 15AATC403
L-S-P: 2-0-0	**Credits: 2**	**Contact Hours: 2**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 32	**Examination Duration: NA**	

Course contents:

Unit-I: 1 INTRODUCTION TO HUMAN SETTLEMENTS

Elements of Human Settlements – human beings and settlements – nature shells&Net work – their functions and Linkages – Anatomy & classification of Human settlements – Locational, Resource based, Population size & Occupational structure. Human settlements during ancient medieval and modern periods India, Europe and other parts of the world.

2 PLANNING CONCEPTS

Role and contribution of the following towards contemporary town planning thought – Geddesian Triad and outlook Tower by Patrick Geddes, City Beautiful by Daniel Burnham, Garden city by Ebenezer Howard, Neighbourhood by C.A.Perry, Radburn by Henry Wright and Clearance stein, Ekistics by CA Doxiadis, City for three million habitat, Radiant city and Chandigarh by Le Corbusier and F.L.Wright,Soria ,Soria Y Mata, Kevin Lynch.

Unit-II: 3 CONTEMPORARY ISSUES IN URBAN PLANNING

Contemporary problems of settlements, Environmental impact of unplanned growth. Socio-economic aspects of urban housing and problems of slums, rationale of urban regulatory controls. Urban redevelopment and renewal, urban traffic and transportation planning

4 URBAN AND REGIONAL PLANNING

Influence of socio-economic factors in the development of human settlements, growth and decay of human settlements. Classification of settlements: Classification based on population, functions, locations, Municipal status. Town and its land uses, graphical representation and colour coding of land use, character of a town, categories of a town, densities of a town, Principles, Advantages and types of Zoning. Scope and purpose of Perspective Plan, Regional Plan, Development Plan, Local Area Plan, Special Purpose Plan, Annual Plan, Project

Unit-III: 5 TOWN PLANNING TECHNIQUES.

Data Collection Techniques, Types of Surveys, Data and Map Analytical Techniques, Applying Carrying Capacity for Urban and Regional planning, Threshold Analysis – Factors taken into consideration to assess the most suitable land use & weighted overlay of Land suitability, Projection Techniques - Population Projection and Economic Projection, Plan formulation through Remote Sensing & Geographic Information System.

6 EMERGING TRENDS IN URBAN PLANNING.

New Urbanism, Smart growth, TOD, Form-Based Codes, Rural village, Transect Future of cities and cities of future - Sustainable cities, Intelligent cities, Liveable cities, Resilient cities, Smart Cities, Global city, Eco city, Compact city, Vertical urbanism, MediCity, Sports city.

Program : Architecture		
Course Title: Dissertation		**Course Code:** 15AATC404
L-S-P: 0-3-0	**Credits: 3**	**Contact Hours: 4**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 64	**Examination Duration: NA**	

Course contents: The objective of this course is to orient the students to gain a strong theoretical analytical base for a well structured research. The course shall enable students to conduct research, analyse and write a research paper on a topic of their interest.

Students may choose a topic related to Architecture and allied subjects. Emphasis must be on critical understanding, logical reasoning and structured writing.

Unit-I:

The nature and function of research, meaning of research in the field of architecture, pure and applied research, traditional and potential areas/types, the three stages of research

Research methodology, various techniques of data collection in general, specific techniques in architectural research, methods of analysis stage, communication of research reporting, the structure of a report, the necessity for the development of writing skills.

Unit-II

Technical data about formal writing, the use of visuals, the qualities of research, the use of primary and secondary references, bibliography, notation, cross reference etc. Issues of selective reference. Methods of writing draft reports before finalisation.
Research in the fields of environment, community structure, architectural history and theory, urban structure, building type studies, etc.

Unit-III

Behavioural studies and user evaluation.

Sessional Work (Internal semester assessment)

Students are expected to present the progress of the study at various stages of the semester.

Students will be asked to prepare research proposals, which will be discussed and modified.

Scheme for Semester End Assessment (ESA)

Final assessment of the students’ work may be based on written Paper as well as oral communication. However, greater weightage may be given for writing skills and research content of the study.

Mode of assessment :

By the end of the semester, students are expected to submit a written paper of approximately 3500 words.

Standard referencing conventions and technical writing norms must be adhered to.

Students are expected to present the progress of the study at various stages of the semester.

References :

1. Murray, R. Writing for academic journals. Berkshire: Maidenhead, Open University Press. (2005).
2. Borden, I. and Ray, K. R. The dissertation: an architecture student's handbook. (2006).
3. Anderson, J. and Poole, M. Thesis and assignment writing. Brisbane: John Wiley. (1998).
4. Architectural research methods; Linda Groat& David Wang, John Wiley and sons, New York
5. Visual research methods in Design; Henry Sanoff, Van Nostrnad Reinhold, New York
6. Architectural research; Snyder James C; Van Nostrnad Reinhold

Program : Architecture		
Course Title: Professional Practice II		Course Code: 15AATC405
L-S-P 3-0-0	Credits: 3	Contact Hours: 3
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hours: 48	Examination Duration: 3 HOURS	

Course contents:

Unit-I:

1. **Architect and his Practice:**
   Profession of architecture, duties and liabilities to the profession,
   Types of Architect's Office – proprietorship, partnership and combined concerns, advantages and Disadvantages of each, secure clientage, office administration and accounts of firms, Competitions
2. **Supervision by Architects:**
   Site Visits, Meaning and Purpose of Supervision, Remarks on Site Book, Site Meeting and Bill Checking**Unit-II**
3. **National Building Code:**
   Need and nature of building codes, standards and regulations, overview of basic terminologies, nature of building codes in special regions like heritage zones, environmentally sensitive zones, disaster prone regions, coastal zones, hilly areas, etc. Norms for Vehicular Areas, Norms For Fire Protection, Norms for Building Services.
4. **Building Regulations:**
   Building Bye laws and Regulations, Setbacks and margins, norms for building projections in open spaces, considerations in Floor Area Ratio (FAR) and Floor Space Index (FSI), building height regulations, Study of local administrative provisions for obtaining building permits.

Unit-III

5. **Council of Architecture (COA) and The Indian Institute of Architects (IIA)**
   Council of Architecture (COA) , Code of Professional Conduct, Architect's Act 1972, The Indian Institute of Architects (IIA), Conditions of engagement, Scale of Professional Charges, Mode of Payment, Taxation in the profession, Architect's responsibilities and liabilities towards client

Sessional Work (Internal semester assessment)

Scheme for Semester End Assessment (ESA)

Mode of assessment :

References :

1. Professional Practice – Dr. Roshan Namavati
2. Architectural Practice and Procedure – Ar. V S Apte
3. The Business of Architectural Practice – Derek Sharp
4. Architectural Practice in India – Ar. MadhavDeobhakta
5. Professional Practice – Dr. K G Krishna Murthy and Prof S V Ravindra

Program : Architecture		
Course Title: STRUCTURES - VII		**Course Code: 15AATC406**
L-S-P: 0-3-0	**Credits: 3**	**Contact Hours: 4**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 64	**Examination Duration: NA**	

UNIT I:

1. Case studies- Study of ongoing residential, public and commercial RC frame building structures by site visits.
2. Collecting data regarding the type of structural system, structural configuration, arrangement of columns, beams for the different floors.
3. Critical analysis and interpretation of data at the studio, for the possible alternative structural systems with column positions and beam layout.

UNIT II:

4. Preparing a RC structural system for an proposed architectural design of a residential, commercial and public building structures. Preparing column positions, beam layout as per requirements of all floors and parking arrangement.
5. Preparing various options of foundations can be provided for the proposed building structure. Design of typical isolated column foundation and pile foundation for the estimated axial loading Design of typical columns for the estimated gravity load subjected to axial load and uni axial moment. Design of typical beam and slab elements for the estimated loading.

UNIT III:

6. Structural detailing - Preparing the structural drawings of layout of columns, foundation and retaining walls.
Typical floor structural drawing with reinforcement details

Sessional Work (Internal semester assessment)

Scheme for Semester End Assessment (ESA)

Mode of assessment :

Text Books:

1. 1. S.R. Karve and V. L. Shah, Limit state theory and design of reinforced concrete structures publications Pune

Reference Books:

1. 1. IS : 875- 1987 (Part – I. II and III) Code of practice Design loads other than earthquake laod for building structures.
2. IS : 456- 2000 Code of practice for plane and reinforced concrete.

VIII SEMESTER

Program : Architecture		
Course Title:Architectural Design VIII (Campus Planning)		**Course Code: 15AATC407**
L-S-P: 0-7-0	**Credits: 7**	**Contact Hours: 10**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 160	**Examination Duration: NA**	

Course content: the following issues relating to institutional design will be addressed to:

• Nature of contemporary institution, correlation to urban structure.
• Development control and urban infrastructure affecting design.
• Various attitudes to building in urban context.
• Integration to function and movement, climate, and sound, structure and services into group of buildings
• Landscaping and site planning.
• Institutional character – from abstract to detail.
• User behavior and requirements pertaining to the physically handicapped.
Necessary theoretical inputs to be given highlighting the norms and design issues The topics not covered as studio faculty members through lecture/slide shows and site visits may cover design problems.
The topics to be covered as design problems may include:
• Institution of learning – colleges with it's various departments such as medical, engineering, law, business, music, and dance colleges, vocational training institutes etc.
• Institutions of life such as hospitals, reformatories and rehabilitation institutes for the disabled.
• Institutions of research in various disciplines.
• Local/legal institutions such as the high courts, secretariat, development authorities, directorates etc.
At least two major exercises and two minor design / time problems should be given .the final submission shall necessarily include a model for at least one of the two main problems.

The students have to present the entire semester work for assessment along with Model.

Sessional Work (Internal semester assessment)

The 'Sessional Work' shall comprise of the following.
(i) A hand written journal with notes and manual sketches of representative examples (10 marks)
(ii) A graphically presented or a written report with illustration of Any One of the topics to be individually elected and completed under the periodic supervision and guidance of the subject teacher. (20 marks)
(a) Scaled manual documentation of field studies of precincts, streets, building or parts thereof and artifacts bearing significance to the periodic history under study (not more than two half imperial sized sheets A2 – 420 x 594 mm each)
OR
(b) Graphically illustrated and annotated manual presentation on 'Style identification' of Building or parts thereof bearing significance to periodic history under study (Not more than two half imperial sized sheets (42 – 420 x 594 mm each).
OR
(c) A hand written illustrated report of not more than 1000 words on comparative

study of architectural features, motifs, design themes and typological planning
Evolutions in the periodic history under study. (20 marks)

Scheme for Semester End Assessment (ESA)

Mode of assessment :

References :

1 Campus design in India – Kanvinde& Miller

2. Compus Planning _ Richard Dober.

3. Urban Design. The Architecture of towns and cities. –Paul Sprereingen.

4. Exterior design in Architecture __ AshiharaToshinibu

5. Modern Language of Architecture __ Bruno Zevi.

6. Modern Movements in Architecture __ Charles Jencks

7. Language of Post – modern Architecture - Charles Jencks

8. Complexities and contradictions in Architecture – Robert Venturi

9. Architectural Composition. –Rob Krier.

10. Pattern Language Christopher Alexander.

11. Town Design –Fredrick Gibberd Alexander

12. Various monographs and periodicals

Program : Architecture		
Course Title: Pre-Thesis		**Course Code: 15AATC408**
L-S-P: 0-3-0	**Credits: 3**	**Contact Hours: 4**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 64	**Examination Duration: NA**	

Course contents:

Unit-I: The student shall submit a proposal towards a individual design dissertation project containing

- Skeletal foundation of the proposed thesis
- Relevance of the project to society and the place.
- Background information about the proposed thesis (archival study/ research)

Unit-II : The student shall submit a proposal towards a individual design dissertation project containing

- Case studies from literature and inter net
- Proposed live case studies
- Proposed schedule of visit to live case studies.
- Site selection criteria
- Norms and standards

Unit-III: The student shall submit a proposal towards a individual design dissertation project containing

- A report containing the all above mentioned information in paper presentation format
- The report should include Title and description of the topic
- Justification for Architectural intervention in context.
- Methodology of study and proposed architectural solution.
- Site analysis

Sessional Work (Internal semester assessment) Draft report containing all the above mentioned topics.

Scheme for Semester End Assessment (ESA) : Thesis Report/ Viva

Mode of assessment: Viva and thesis report/ Evaluation of Portfolio, assignments by internal and external examiners / Viva.

References:
1. Iain Borden, The Dissertation, 2005
2. Council of architecture, Archiving 14 Architecture thesis, NIASA,2014
3. Indian Institute of Architects, Architectural Footprints, IIA, 2014

4. IIA, COA, A+D, Previous thesis Reports, Architectural magazines, Time saver standards, etc.

Course Title: Digital Tool III (REVIT)		**Course Code: 15AATC409**
L-S-P: 0-0-3	**Credits: 3**	**Contact Hours: 4**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 64	**Examination Duration: NA**	

COURSE OVERVIEW:

Building Information Modelling is used by architects and other building professionals to help reduce risk obtain insight into how buildings will perform before construction begins, develop better quality designs, and improve project delivery.

Course contents:

UNIT I:

1. Building Information Modeling
2. Revit Architecture Basics
3. Starting a Design
4. The Basics of the Building Model
5. Loading Additional Building Components

UNIT II:

1. Viewing the Building Model
2. Using Dimensions and Constraints
3. Developing the Building Model
4. Detailing and Drafting
5. Construction Documentation.

UNIT III:

Presenting the Building Model.

Sessional Work (Internal semester assessment)

- Assessment will be done in three parts (Minor-I, Minor-II and Final Submission).
- There will submission for both the minors along with test in the lab where they will be marked.
- Term work submission will be in the format of portfolio containing the compilation of all the works done throughout the semester.

Scheme for Semester End Assessment (ESA)

- Portfolios will be marked on the basis of submission after ISA.

Mode of assessment :

- Portfolio Submission.

References : Online BIM tutorial

Program : Architecture		
Course Title: Online Portfolio		**Course Code: 15AATC410**
L-S-P: 0-2-0	**Credits: 2**	**Contact Hours: 03**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 48	**Examination Duration: NA**	

Course contents:

Unit-I:

Students will learn the industry-standard publishing application to design and publish high-quality Architectural presentations and portfolio across a full spectrum of digital and print media.

Portfolios and Presentations in Adobe InDesign, will take students through all of the steps needed to build a professional presentation and portfolio using textual description, photos of drawings, photos models, sketches etc.

Unit-II

Demonstrating how to set up Architectural online portfolio website using Word press (open source CMS).

Create profile and upload Architectural content like: Academic assignments, design sheets, participations, Award, hobbies etc. to share with professional architects and web audience.

Unit-III

Installing plugins, themes, and attracting web users with permalinks, social sharing etc. in wordpress.

Sessional Work (Internal semester assessment)

Regula Assignments, Architectural portfolio hardcopy (booklet) and online portfolio website

Scheme for Semester End Assessment (ESA)

Term work: Evaluation of Portfolio booklet and online portfolio website by external examiners

Mode of assessment: Printed portfolio booklet and online portfolio website

References :www.adobe.com, www.wordpress.com, video tutorials and web resources

Program : Architecture		
Course Title: Construction Management		Course Code: 15AATC411
L-S-P: 3-0-0	Credits: 3	Contact Hours: 3
CIE Marks: 50	SEE Marks: 50	Total Marks: 100
Teaching Hours: 48	Examination Duration: 3 HOURS	

UNIT I:

1) Construction Project Management –
Concept, 5M's, Administration, Organization, Organization structure for different project & firms.

Project Manager- Qualities

Construction Management Process – Planning, Scheduling, Monitoring, Central Phase, Scheduling techniques – Bar charts, CPM & PERT networks for different projects.

UNIT II:

2) Mechanization in construction industry Equipments – Selection, Types, Working. Economic life of Equipments, Depreciation, Obsolescence

Construction Economics – Basic concept, direct & Indirect corts, sources of Finance.

Text Books:

1. "Construction planning, equipment and methods by R L Peurifoy.
2. "project management for architects" by S P Mukopadhyay

Reference Books:

1. "Pert and CPM " by L S Srinath.

Program : Architecture		
Course Title: GREEN BUILDING STUDIO		**Course Code: 15AATC412**
L-S-P: 0-2-0	**Credits: 2**	**Contact Hours: 3**
CIE Marks: 50	**SEE Marks: 50**	**Total Marks: 100**
Teaching Hours: 48	**Examination Duration: NA**	

UNIT I:

1. Background on Green Design movement around the world and Introduction to Green Building Design.
2. Green Building Movement in India ; various organizations driving the movement and the current trends

UNIT II:

3. Introduction to LEED (US Green Building Council and LEED India) rating tools
4. Introduction to IGBC (Indian Green Building Council) rating tools
5. Introduction to GRIHA (The Energy and Resource Institute, New Delhi) rating tools
6. Brief introduction to BEE, EDGE Certification various other trends in green rating in India

UNIT III:

7. Guidance on Green Rating for a typical building with a detailed outline of the various parameters such as Site design, Energy, Water, Materials etc along with the necessary case studies
8. Exercise: Green Building Design of a Typical Housing/Office Building project

Text Books: Nil

Reference Books:

- USGBC LEED Reference manuals for various rating systems (www.usgbc.org)
- TERI : GRIHA Rating Manual Volume 1 to Volume 5 (www.grihaindia.org)
- IGBC Rating guidebooks for various types of buildings (www.igbc.in)

Electives

Program : ARCHITECTURE		
Course Title: ARCHITECTURAL LIGHTING		**Course Code: 15AATE410**
L-S-P: 0-2-0	**Credits: 2**	**Contact Hours: 2**
CIE Marks: 50	**SEE Marks: 50**	**Total Marks:**
Teaching Hours: 32	**Examination Duration:**	

UNIT I:

1. The history of architectural lighting
2. Basics of Lighting Design
3. Terminology and units
4. Types of Light and light sources
5. Control gear and control equipment

UNIT II:

6. Light – Qualities and features
7. Controlling light
8. Luminaries
9. Lighting design
10. Lighting design and analysis tools

UNIT III:

8. Exercise: Design of Lighting for a sample space.

Text Books: NIL

Reference Books:

- Handbook of Lighting Design by RudigerGanslandt and Harald Hofmann
- Lighting Design Basics by Mark Karlen
- Designing With Light: The Art, Science and Practice of Architectural Lighting Design by Jason Livingston.
- The Architecture of Light (2nd Edition): A textbook of procedures and practices for the Architect, Interior Designer and Lighting Designer.

Program : Architecture		
Course Title: Transit Oriented Development		**Course Code: 15AATE409**
L-S-P: 0-2-0	**Credits: 2**	**Contact Hours: 2 hrs.**
ISA Marks: 50 marks	**ESA Marks: 50 marks**	**Total Marks: 100**
Teaching Hours: 32	**Examination Duration: NA**	

Course contents:

Unit-I:

Introduction to Transit Oriented Development

Theories and Principals of TOD

Examples of TOD

Unit-II

Study, Analysis and Design of an identified area along a transit Corridor using Principles of TOD and Infrastructure

Unit-III

Research Paper on any one principal or component of Transit Oriented Development

Sessional Work (Internal semester assessment)

Scheme for Semester End Assessment (ESA)

Mode of assessment:

Checking of Portfolio of Term Work / Viva

References:

Nil

Program: Architecture		
Course Title: Elective – Architecture Film Making - I		**Course Code: 15AATE407**
L-T-P:0-0-1	**Credits: 1**	**Contact Hours: 2**
ISA Marks:50	**ESA Marks:50**	**Total Marks:100**
Teaching Hours:32	**Examination Duration: NA**	

Unit I

Film Pre-production

Introduction to Architectural film making concepts, story board, screenplay and planning.

Unit II

Film Production

Introduction to video shooting using various devices.

Unit III

Film Post-Production

Video post-production techniques like editing, titles, sub titles, narration and rendering.

Text Books

Reference Books: Online tutorials

Scheme for Semester End Examination (ESA)

Assignments, Checking of Portfolio of Term Work / Viva.

Program : Architecture		
Course Title: SUSTAINABLE DEVELOPMENT OF LIVING HERITAGE-II		**Course Code: 15AATE408**
L-S-P: 0-2-0	**Credits: 2**	**Contact Hours: 2 hrs.**
ISA Marks: 50 marks	**ESA Marks: 50 marks**	**Total Marks: 100**
Teaching Hours: 32	**Examination Duration: NA**	

UNIT I:

Definition of Cultural Heritage, Cultural Landscape, Monuments & site (UNESCO operational guidelines)
Documentation of the Heritage Site
Need for conservation of living cultural heritage sites.
Values & Ethics in heritage conservation
Charters

UNIT II:

Mapping
Analysis
Draft Proposals and report

UNIT III:

1. Final proposal and report

Text Books: Nil

References :

Nil

B.ARCHCURRICULUM SCHEME & STRUCTURE OF 2015-2020 BATCH

IX Semester - X Semester

School of Architecture,
KLE Technological University,
BVBCET Campus, Vidyanagar, Hubli.

(Year of introduction-2015, Faculty-A, Architecture-AT, Core course-C, Humanities-H, Lab-L, Elective-E, internship-I, Practice-P, W-Project)

B. Arch. Semester IX

No	Code	Course	Category	L-S-P	Credits	Contact Hours	ISA	ESA	Total	Exam Duration
1	15AATT501	Professional Training	Profession	0-22-0	22	50	50	50	100	NA
TOTAL				0-22-0	22	50	50	50	100	

ISA: Internal Semester Assessment,ESA: End Semester Assessment, P:Practical, S:Studio,L: Lecture

Date: 18-03-2016

Program Head

B. Arch. Semester X

No	Code	Course	Category	L-S-P	Credits	L-S-P	Contact Hours	ISA	ESA	Total	Exam Duration
1	15AATC501	Architectural Design - IX (Thesis Project)	Design	0-20-0	20	0-18-0	18	50	50	100	NA
3	15AATE502 15AATE505 15AATE506	Electives-V Architecture and Human Behavior Documentation and Technical Writing Adobe Illustrator	Design	0-2-0	2	0-3-0	3	50	50	100	NA
TOTAL				0-22-0	22	0-24-0	24	150	150	300	

ISA: Internal Semester Assessment ,ESA: End Semester Assessment, P: Practical, S : Studio , L : Lecture,

IX SEMESTER

Program : Architecture		
Course Title: Professional Training		**Course Code: 15AATT501**
L-S-P: 0-22-0	**Credits: 22**	**Contact Hours: 50**
CIE Marks: 50	**SEE Marks: 50**	**Total Marks: 100**
Teaching Hours: 800	**Examination Duration: NA**	

The Student is expected to be exposed to preparation of working drawing, detailing, preparation of architectural models, computer applications in design and drafting, filing system in respect of documents, drawing and preparation of tender, documents. Site experience may be given in respect of supervision of the construction activity, observing the layout on site, study of the stacking methods of various building materials, study of taking measurement and recording.

Students will have to maintain a day to day record of their engagement for the period of training. This will be recorded in an authorized diary to be counter signed by the architect at the end of each month and the same diary shall be sent to the department once in a month. At the end of the training period, a student will have tp produce a certificate of experience and satisfactory performance from the concerned office in the prescribed format.

The viva-voce marks shall be awarded based on the following works to be submitted by the student and presented during the viva.

Training Report: this shall contain copies of various drawing done by the student either drafted or designed. It shall also contain other works like photographs of site visited, models done, computer output produced etc.,

Building study – This shall be a detailed critical study of a building designed by the architect with whom the student has worked. It shall include the study of function, aesthetics, context, structure etc., This shall be presented through drawings, photographs, write ups etc.,

Building Materials Study – This shall be a detailed study of a new or relatively new building material available in the market. A study of its properties, uses, cost, maintenance etc., is expected to be done. Samples of materials shall also be obtained and presented.

Detailed Study – This shall be a study of any interesting detail done in the firm where the student has undertaken training. This shall include sketches and photographs of the detail.

A Candidate failing in the viva examination shall repeat the training afresh for 16 weeks, the starting date coinciding with the beginning of a subsequent semester.

Objectives of the course:

To provide exposure to the various dimensions of architectural practice.

Text Books:

NIL

Reference Books:

NIL

X SEMESTER

Program : Architecture		
Course Title: ARCHITECTURAL DEISGN-IX (Thesis Project)		**Course Code: 15AATC501**
L-S-P: 0-18-0	**Credits: 20**	**Contact Hours: 24**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 384	**Examination Duration: Nil**	

Course contents:Thesis project is the culmination of the Undergraduate program in architecture. In thesis a student is expected to undertake an in-depth investigation of an area of architecture that he/she is interested in. Students are required to develop the design as per the design objectives and design brief submitted in the report during Pre thesis. Afull-fledged large scale Architectural Design with holistic approach including site Investigation, Design programme formulation, Structural considerations, Interior space planning, Environmental planning, Building Services, Climate responsiveness shall be demonstrated.

Unit-I:

- Architectural Project shall consist of a graphically presented Design solution in from of sufficient number of architectural drawings with models, views.
- It is expected that students demonstrates an ability of holistic and comprehensive thinking in the areas of Site Planning, Interior space planning, Climate responsive design.

Unit-II:

- Architectural Project shall consist of a graphically presented Design solution in from of sufficient number of architectural drawings with models, views etc.
- It is expected that the students demonstrates an ability of holistic and comprehensive thinking in the areas of Environmental planning, Building Services, sustainable architecture and Architectural Detailing.
- Architectural thesis report addressing the above mentioned areas.

Unit-III:

- Design Portfolio of graphically presented Design solution in totality with the models and an Architectural thesis.

Sessional Work (Internal semester assessment)
The Internal assessment of Architectural Thesis Project shall be carried out Stage wise during the reviews as decided by the School.

Scheme for Semester End Assessment (ESA) The final assessment in the examination shall be done by Internal and External Examiner / s in which the students will display the work and explain their work and answer all the queries raised by the Examiners.
The Time allotted per student shall be minimum 20 minutes to maximum 30 minutes.
The Internal stage wise making shall be done out of 50 marks and External marking shall be done jointly by the External Examiner/s out of 50 marks. 5 marks shall be reserved for oral presentation to be assessed jointly by both Internal and External Examiners.

Mode of assessment : Stage wise reviews **(**internal and external) for ISA and External Jury for ESA

References :

1. Design Methods by Jones C. J. (1992) John Willey and Sons, Inc.
2. How Designers think: the design process demystified by Lawson B.2005 ,Architectural Press, Oxford

Program : Architecture		
Course Title: ELECTIVE-ArchitectureandHumanBehavior		**Course Code: 15AATE502**
L-S-P: 0-18-0	**Credits: 2**	**Contact Hours: 24**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 384	**Examination Duration: Nil**	

Course contents:

UNITI:

IntroductiontoBehavioralandEnvironmentalPsychology.
EvolutionofHumanBehavior.
InteractionofManandenvironment,Manandbuiltformsandstudyofpsychologyofspaces.
MethodsandprocessofstudyinghumanpsychologyinthecontextofArchitecture.

UNITII:

TheHuman–NatureinterfacethroughthemediumofBiophilicDesign.

NatureinSpace–StudyofVisualConnectionwithNature,Non-VisualConnectionwithNature,Non-Rhythmic SensualStimuli,Thermal/AirflowVariability,PresenceofWater,DynamicandDiffusedLight,ConnectiontoNatural Systems.

NaturalAnalogues–StudyofBiomorphicformsandPatterns,MaterialConnectiontoNature,ComplexityandOrder

NatureoftheSpace–StudyofProspect,Refuge,Mystery,Risk/Peril

UNITIII:

BuildingSystems

Roomuse,geometry&meaning,hiddenbehavioralassumptions,adjacencies,verticalbypass &horizontalbypass,variousstagesinthedesignofbuildingsubsystems.

Building–BehavioralInterface

Geometryofspaces,theirmeaning&connotations,Socialorganizationofbuildings, Behavioralassumptionsintheplanningofnewtownsandneighborhoods,borrowedspace.

BehavioralDesign

Processorganizationchart,affinitymatrices,pictograms:behavioraldesignprocessmodel, designcontext,activity/adjacencyrelationship,evaluationchart,Areausefrequency program,simultaneoususe,communityutilizationmap,occupancyloadprofile,defensible space,EDRAetc.,

UrbanEnvironment

Patternsofactivityintimeandspace,theecologyofaneighborhoodparkandplayground, cross-culturalissues,social&psychologicalissuesintheplanningofnewtowns, environmentalperceptionsandmigration,awarenessandsensitivitytoopenspaces, environmentalcognition.

Mode of assessment : Stage wise reviews **(**internal and external) for ISA and External Jury for ESA

TextBooks:

1.Burnette,C.(1971).Architectureforhumanbehaviour.PhiladelphiaChapter:AIA.
2.Canter,D.andLee,T.(1974).Psychologyandthebuiltenvironment.NewYork:HalsteadPress.
3.Christopher,A.etal.(1977).APatternLanguage.NewYork:OxfordUniversityPress.
4.Clovis,H.(1977).BehaviouralArchitecture.McGrawHill.
5.Lynch,K.(1973).Theimageofacity.Cambridge:MIT._
6.Sanoff,H.(1991).VisualResearchMethodsinDesign.NewYork:JohnWiley&Sons._
7.Zeisel,J.(1984).Enquirybydesign:ToolsforEnvironment-BehaviourResearch.Cambridge: CambridgeUniversityPress.
8.Zeisel,J.andEberhard,J.P.(2006).InquirybyDesign-Environment/Behaviour/Neurosciencein Architecture,Interiors,LandscapeandPlanning.NewYork:W.W.Norton&Company.
9:EvolutionandHumanBehaviour:DarwinianPerspectivesontheHumanConditionbyJohnCartwright

Reference:

1:BuiltEnvironmentPsychology:AcomplexaffairofbuildingsanduserbyMr.SafiullaKhan,IntegralUniversity,India.

2:ArchitecturalPsychology–STJanitius,St.John'sCollege,Bangalore

3:SpacesofSocialInfluencebyAnnaPGawlikowska

4:PsychologyofArchitecturebyW.BroVictorGPopow
5:BehavioralArchitecture–SPAVijaywada

Program : ARCHITECTURE		
Course Title: DOCUMENTATION AND TECHNICAL WRITING		**Course Code: 15AATE505**
L-S-P: 0-2-0	**Credits: 2**	**Contact Hours: 2**
CIE Marks: 50	**SEE Marks: 50**	**Total Marks: 100**
Teaching Hours: 32	**Examination Duration:**	

Course contents:

UNIT I:

Documentation and Technical Writing

Introduction to Documentation And Technical Writing

Various process of Documentation media or technique
Monographs and Magazine Formats

UNIT II:

Effective Writing Skills

Dissertation / Thesis Report Writing
Compiling of Ideas and Thoughts generated during Design Process

UNIT III:

Research Paper / Article
Research paper / Article on any architect showcasing his design philosophy and architectural works

Scheme for Internal semester assessment(ISA)
Assignments in the form of Portfolio.

Scheme for Semester End Assessment (ESA)
Term work Evaluation

Mode of Assessment: Field work attendance , Assignment

Text Books:NIL

Reference : NIL

Program: Architecture		
Course Title: Elective – Adobe Illustrator		**Course Code: 15AATE506**
L-T-P:0-0-1	**Credits: 1**	**Contact Hours: 2**
ISA Marks:50	**ESA Marks:50**	**Total Marks:100**
Teaching Hours:28	**Examination Duration: NA**	

Unit I

Graphic Designs

Create everything from gorgeous print, web and mobile graphics to logos, icons, brochures, flyers, posters etc.

Unit II

Typographic Designs

Design typographic designs and add effects, manage styles, and edit individual characters

Unit III

Publish artwork to various media

Publish illustrations anywhere, including printed pieces, presentations, websites, blogs, and social media.

Text Books

Reference Books: Online tutorials

Scheme for Semester End Examination (ESA)

Assignments, Checking of Portfolio of Term Work / Viva.

School of Architecture,
KLE Technological University,
BVBCET Campus, Vidyanagar, Hubli.

CURRICULUM SCHEME & SYLLABUS OF

I Semester - II Semester

(Year of introduction-2018, Faculty-A, Architecture-AT, Core course-C, Humanities-H, Lab-L, Elective-E, internship-I, Practice-p, W-Project)

Semester: I – (2020 - 21)

Sr.No	Course code	Course Title	Period			Evaluation scheme			Credit (L+T+P)	Hours
			L	T	P	ISA	ESA	Sub total		
1	18AATC101	Architectural Design – I	0	4	0	50	50	100	4	6
2	18AATC102	Building Const& Materials – I	0	4	0	50	50	100	4	6
3	18AATC103	Graphics – I	0	4	0	50	50	100	4	6
4	18AATC104	Skill development workshop-I	0	2	0	50	50	100	2	3
5	18AATC105	Prehistoric Architecture	2	0	0	50	50	100	2	2
6	18AATC106	Basic Design	0	3	0	50	50	100	3	4
7	18AATC107	Structures – I	3	0	0	50	50	100	3	3
TOTAL			5	17	0	350	350	700	22	30

ISA: In-semester Assessment **ESA**: End Semester Assessment **L**: Lecture **T**: Tutorials **P**: Practical

Credit	Lecture Hours	Studio Hours	Practical Hours
1	**1**	**1.5**	**2**

Program Head

Signature of Dean (Academic Affairs)

Semester:II (2020 - 21)

Sr.No	Course code	Course Title	Period			Evaluation scheme			Credit (L+T+P)	Hours
			L	T	P	ISA	ESA	Sub total		
1	18AATC108	Architectural Design – II	0	4	0	50	50	100	4	6
2	18AATC109	Building Const& Materials – II	0	4	0	50	50	100	4	6
3	18AATC110	Graphics – II	0	4	0	50	50	100	4	6
4	18AATC111	History of Architecture I	2	0	0	50	50	100	2	2
5	18AATC112	Skill Development Workshop II	0	2	0	50	50	100	2	3
6	18AATP101	Digital Tool-I	0	0	1	50	50	100	1	2
7	18AATC114	Structures – II	3	0	0	50	50	100	3	3
8	18AATC113	Surveying	2	0	0	50	50	100	2	2
TOTAL			7	14	1	400	400	800	22	30

ISA: In-semester Assessment **ESA**: End Semester Assessment **L**: Lecture **T**: Tutorials **P**: Practical

Credit	Lecture Hours	Studio Hours	Practical Hours
1	**1**	**1.5**	**2**

Program Head

Signature of Dean (Academic Affairs)

I- SEMESTER

Program : Architecture		
Course Title: ARCHITECTURAL DESIGN - I		Course Code: 18AATC101
L-S-P: 0-4-0	Credits: 4	Contact Hours: 6
ISA : 50	ESA: 50	Total Marks: 100
Teaching Hours: 96	Examination Duration: NA	

UNIT I:

Introduction to Human proportions, Anthropometry and space standards

Detailed study of spaces requirements with respect to single unit dwellings such as living, dining, bedrooms, kitchen, toilet etc. minimum standards for movements and vehicular data expression of design using the following.

Spatial perception of spaces

Study of anthropometrics

Circulation

Forms and integrity

Space planning

Architectural expression

UNIT II:

Introduction to Space making elements.

Defining the core space making elements like wall, openings, column, floors, roofs, stairs etc. its usage and importance in designing spaces of various needs. Measuring and plotting existing buildings to understand element and its role in space creation.

UNIT III:1 Designing a multi room space.

Designing and organizing spaces of various purposes with respect to movement, circulation, furniture layout, aesthetical relation of traditions, culture etc. expression of creativity in form making

The design issues to be addressed are

Various basic human functions and their spatial implications

Formulation of concepts

Anthropometry and furniture layout

Movement and circulation diagram

Interior volumes and space articulation through different materials.

Integration of form and function.

Study models.

The design projects could be, my dream house, guest house, farm house, tree house, cottage, etc.

Reference Books: Ching, Francis DK, Architecture: Form, Space and Order, 2nd ed.VanNostrand Reinhold, New York, 1999

Scheme for Internal semester assessment (ISA) The Portfolio covering the given topics and the study models shall be presented. The evaluation shall be through periodic internal reviews. The students have to present the entire semester work for assessment along with Models. Term work Evaluation of Portfolio, assignments by internal examiner
Scheme for End Semester Assessment (ESA) Term work: Evaluation of Portfolio and assignments by internal and external examiners/Viva
Mode of assessment: Portfolio, Models
Text Books: NIL

Program: Architecture		
Course Title: BUILDING CONSTRUCTION & MATERIALS - I		Course Code: 18AATC102
L-S-P: 0-6-0	Credits: 4	Contact Hours: 6
CIE Marks: 50	SEE Marks: 50	Total Marks: 100
Teaching Hours: 96	Examination Duration: NA	

UNIT I:
Basic building components, material convention, brick work & mortar building components - Introduction to and their functions in brief, like foundation, plinth, coping, DPC, floor, walls, lintels, D&W, weather shade, roof, parapet etc.
Material convention- Convention of construction materials, like brick & stone masonry, timber, ply wood, steel, glass, concrete, mortar, metal etc, used for representing, in plan, section and elevations
Tools- Introduction to various tools commonly used for excavation, masonry and carpentry works
Bricks and blocks- Introduction to burnt clay bricks, properties of good bricks, molding methods, and application. Blocks used as an alternative to bricks, such as i) adobe (stabilized mud), ii) hollow clay, iii) cementconcrete iv) fly ash v) autoclaved aerated concrete (AAC), etc.
Brick masonry- Types of bonds used in brick masonry, for walls & pilasters of varying thickness.
Mortar- Types, uses, & properties of bonding materials like clay, lime, cement, gypsum etc. Sources and qualities of good sand & alternatives in preparing mortars.

UNIT II:
Stone, stone masonry, foundation, plinth formation, lintels & arches
Stones – Geological classification, types, properties and uses of stones for building. By-products of stones such as ballast, aggregate, graded crushed stone & powder (M- sand).
Stone masonry- Types of bonds used in stone masonry.
Foundation: Introduction to excavation- types & behavior of soil. Types of shallow foundations in brick and stone & purpose, for load bearing structure.
Plinth formation- Construction and formation of plinth for building with masonry walls, using i) bricks ii) stones iii) CC blocks including refilling in and consolidation.
Lintel and arches- Introduction to, types and functions for spanning of openings in building. Method of construction using various materials like stone slab, timber, metal, brick and stone masonry, concrete etc.
UNIT III:
Coping, dpc, plastering, guniting& cladding
Coping &dpc- Introduction to and use of coping & DPC in building using various materials.
Plastering – Types, preparation and application in interior & exterior, like i) mud ii) lime iii) cement iv) gypsum with different finishes.
Guniting& grouting– To fill in cracks, voids in masonry, concrete and for repairs.
Cladding – Using tiles such as clay, stone, decorative cement, etc. for walls & roof
Note – The Portfolio covering the above topics shall be presented for Term work. Site visits shall be arranged by studio teacher. Study of material application shall be submitted in the form notes, sketches and photo brief as a part of portfolio

Scheme for Internal semester assessment (ISA)
Regular Assignments, models.
Term work: Evaluation of Portfolio, assignments by internal examiner

Scheme for End Semester Assessment (ESA)–
Term work: Evaluation of Portfolio, assignments by internal and external examiners

Mode of assessment : Portfolio .

Text Books - Nill

Reference Books:

McKay J.K Building Construction Metric Vol 1-4, 4th edi Orient Longman Pvt. Ltd, Mumbai,2002

"Construction Technology" volume-I by R Chudley, ELBS & Longman group Ltd.

Barry R, "The construction of buildings" , Vol-2, 5th Edi, East West Press, New Delhi 1999.

Bindra S.P and Arora S.P, Building Construction-Planning Techniques and Method of Construction, 19th edi, Dhanpat Rai Pub ,NewDelhi, 2000

"Building Construction" by JanardhanJha, Khanna New-Delhi.

RangawalS.C ,"Building Construction" 22nd Edi, charotar Publishing house, Anand, 2004

"Engineering Materials" by Surendra Singh, Vikas Delhi.

"Building Materials" by S K Duggal, IBH New Delhi.

Sushil Kumar T.B of Building Construction 19th edi, Standard Pub House, NewDelhi, 2003.

Chowdhary K.P. Engineering Materials used in India, 7th Edi, Oxford and IBH Pub ltd New Delhi, 1990.

Building Construction Hand book : By R Chudly& R Greeno, Bullerworth Heinemann, New-Delhi.

Program : Architecture		
Course Title: GRAPHICS - I		**Course Code: 18AATC103**
L-S-P: 0-4-0	**Credits: 4**	**Contact Hours: 6**
ISA: 50	**ESA: 50**	**Total Marks: 100**
Teaching Hours: 96	**Examination Duration: NA**	

UNIT I:

1: Introduction to the basic principles of drawing

Introduction to the basic principles of drawing, introduction to drawing equipments and their uses, sign conventions, Lettering and Dimensioning, Architectural Scale

2: Plane geometry – Lines, Angles, Curves and regular Polygons

Construction of triangles, quadrilaterals, curves and regular polygons

3: Solid Geometry – Points and Lines

Introduction to solid geometry, Orthographic projections of points and lines

4: Solid Geometry – Planes and Solids

Problems on Orthographic projections of planes and solids

UNIT II:

5: Three Dimensional Representation – Oblique, Axonometric & Isometric

Problems on Oblique, axonometric & Isometric projection of solids

6: Technical drawing

Simple floor plans, elevation, sections, of simple building.

UNIT III:

7: Architectural Detailing

Reading and representing building components details such as door frames fixing,chejja, plinth formation, steel joinery etc

Scheme for Internal semester assessment (ISA)

Regular Assignments, models.

Term work: Evaluation of Portfolio, assignments by internal examiner

Scheme for End Semester Assessment (ESA) –

Term work: Evaluation of Portfolio, assignments by internal and external examiners

Mode of assessment : Portfolio.

Text Books:

Bhat N.D. and Panchal V.M, Engineering Drawing, Plane and solid geometry, Charotar Publishing house, Anand 2002.

Francis D.K. Ching, Architectural Graphics, 4th Edition, John Wiley & Son, New York

Program : Architecture		
Course Title: Skill Development Workshop- I		**Course Code: 18AATC104**
L-S-P: 0-2-0	**Credits: 2**	**Contact Hours: 3**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 48	**Examination Duration: NA**	

Course contents:

Unit-I:

Free hand and objects drawing: Observation and recording through free hand drawing by using various drawing and sketching tools like pencil, pen, charcoal crayons etc.

Architectural Model Making :Introduction to Basics of the Model making skills like cutting, pasting etc.

Unit-II

Architectural sketching: Drawing of human figures, vehicles, small buildings, furniture, simple and complex geometrical objects with an emphasis on the perception of details and expressing them in lines, colour texture etc.

Architectural ModelMaking: Introduction to Basics of the following associated skills to enhance and understand spatial, scale, material, and aesthetical requirements of design, construction and presentation.

Unit-III

PAINTING: Understanding of colour wheel, components , types of colour, colour schemes, value and intensity by using painting tools and materials like brushes, paper, water color, poster colouretc.

Sessional Work (Internal semester assessment)

Regular Assignments, Architectural sketches, drawings and models

Scheme for Semester End Assessment (ESA)

Term work: Evaluation of Portfolio, assignments by internal and external examiners

Mode of assessment: Portfolio/ Models.

References: Book: Robert Gill: Rendering with pen &ink, Thames & Hudson New York 1984. Robert Gill: Basic Rendering, Thames& Hudson New York 1991. John Chen: Architecture in pen & ink, McGraw-Hill Inc- USA 1995. Colin Saxton: Art School, Chart well Books IncNewJersey.

Program : Architecture		
Course Title: Prehistoric Architecture		**Course Code: 18AATC105**
L-S-P: 2-0-0	**Credits: 2**	**Contact Hours: 2**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours:32	**Examination Duration: 3Hours**	

Course contents:
Focuses on study of evolution of various styles of architecture, methods of construction and influ**ence of art and culture** on architecture.
Evolution of mankind-its impact – on primitive arts and crafts in various countries.
Evolution of shelter forms in different regions.
Growth of Human settlements and cultural influences.
Influence of religion and culture on domestic and civil architecture.

Unit-1
Pre-Historic world
Primitive man – Shelters, Settlements, religious and burial systems
Ex: Oval Hut, Nive, Dolmen Tomb, Gallery Grave, Passage Grave, Houses at CatalHuyuk, Lepe**nsikiVir settlements,** stone Henge.

Unit-II
River valley cultures-
Study of political systems, concept of settlement, impact of climate, socio culture and their relate**d shelter types,** planning types, method of building structures and detailing. Study of building materials used.
Indus valley civilization-
Layout of Mohenjo-Daro, House Plans, Community well, Great Bath, Granary.
Egyptian-
Tombs, Pyramids, & Temples- Mastaba Tombs, Pyramid of Cheops, Temple of Khons, Karnak.

Unit-III
River Valley Cultures-
Tigris and Euphrates
Ziggurats at Warka, Ur and TchogaZanbil, Palace of Sargon, Mastaba Tombs.

Sessional Work (Internal semester assessment)
Students will be assessed by 2 theory minor exams of 20 marks each and 10 marks for sketch b**ook submission.**

Scheme for Internal semester assessment (ISA)
Regular Assignments, models.
Term work: Evaluation of Portfolio, assignments by internal examiner

Scheme for End Semester Assessment (ESA)
External examination-3 hrs

Mode of assessment :
Portfolio& Theory Exam

Text Books:NIL

References :

“History of Architecture in India “byTadgell Christopher.
Sir Banister Fletcher’s “History of Architecture

Scheme for End Semester Assessment (ESA)

Sl.No	8 Questions to be set of 20 Marks Each	Chapter Number	Instructions
I	Q.No.-1, Q.No.-2, Q.No.-3	1, 2,3	Solve Any 2 out of 3
II	Q.No.-4, Q.NO – 5 Q.No.-6,	4, 5,6	Solve Any 2 out of 3
III	Q.No.-7, Q.No.-8	7,8	Solve Any 1 out of 2

Program : Architecture		
Course Title: Basic Design		**Course Code: 18AATC106**
L-S-P: 0-3-0	**Credits: 3**	**Contact Hours: 4**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 64	**Examination Duration: NA**	

Course contents:
To understand and interpret elements of design in Visual composition.
To develop creative skills to address design principles in Architecture.
To explore art forms and understand importance of art in architecture.

Unit-I:

Elements of Visual Composition: Understanding role of the following basic elements of visual design existing in paintings, compositions, murals, sculptures, building and in a nature – Dots, Lines, Planes, Patterns, Shapes, Forms, Spaces, Colour, Texture, Levels, Light, Fenestration's. Study of Textures and Textures Schemes.

Unit-II

Principles of Visual Compositions : To address design principles in architecture. Understanding and using principles like Repetition, Rhythm, Radiation, Focal point, Symmetry, Asymmetry, Background, Foreground, Sense of Direction, Harmony, Balance and Proportion.

Unit-III

EXPLORATION OF ART FORMS- study of traditional and contemporary art forms, relation between art and architecture from earliest times to present.

Sessional Work (Internal semester assessment)
Regular Assignments, Architectural models, rendered sheets and photos

Scheme for Semester End Assessment (ESA)
Term work: Evaluation of Portfolio, assignments by internal and external examiners

Mode of assessment: Portfolio, Model .

References :

Robert Gill : Rendering with pen & ink , Thames & Hudson New York 1984
Robert Gill : Basic Rendering ,Thames & Hudson New York 1991
John Chen : Architecture in pen & ink, McGraw-Hill Inc- USA 1995
Colin Saxton : Art School, Chartwell Books Inc New Jersy.

Program : Architecture		
Course Title: Structures-I		**Course Code: 18AATC107**
L-S-P: 3-0-0	**Credits: 3**	**Contact Hours: 3**
ISA: 50	**ESA: 50**	**Total Marks: 100**
Teaching Hours: 48	**Examination Duration: 3 Hours.**	

UNIT I:

Evolution of Structures: Historical perspective and definition of structure as a device for channeling loads that result from the use or presence of the building in relation to ground.

Structural systems and its elements overview: Vertical/lateral systems: wall, cantilever, moment frame, braced frame, horizontal one-way and two-way systems: truss, arch, vault, dome, shell, cable stayed, suspended, membrane.

Experiment with Structures: Example-1: Build a structure using drawing sheet paper having three and four supports to carry a weight of 2 to 3 kg on it. Example-2: Make a column of height 30mm to carry a weight of 3kg. Example-3: Build a beam of span 450mm simply supported to carry a weight of 1kg at mid span.

Basic structural Materials: Qualities of building materials Mechanical properties of Structural materials: wood, masonry, steel, concrete, fabric; energy use and rupture length. Advantages and disadvantages of Structural Materials and choice of Structural Material for domestic buildings, Industrial buildings, Tall buildings and Long Span buildings.

Loads on Structures: Dead load (DL), live load (LL), static, dynamic, impact, and thermal loads. Principle of transmissibility of forces. Understanding load flow by tributary load and load path (slab, beam, and girder) and vertical members (post, wall, and footing); load path.

Sectional properties: Centroid, difference between centroid and centre of gravity, role of symmetry in locating centroid, moment of inertia, obtaining moment of inertia of unsymmetrical by applying parallel and perpendicular axis theorems.

UNIT II

Equilibrium of Forces: Force, characteristics of a force, Reaction, Moment of a force and Principle of Support conditions and their significance in resistance to forces and to maintain equilibrium.

Basic principles of mechanics: Tension, compression, shear, bending, torsion; symbols and notations; force and stress.

Stress/strain relations (Hooke's Law): Material response to applied loads, intensity of stress, strain and types. Stress strain diagrams for major building materials, Modulus of Elasticity, linear and non-linear materials, elastic, plastic, and elastic-plastic materials; Poisson's Ratio; Thermal stress and strain.

Graphic vector analysis: Resultant and equilibrant of coplanar, concurrent and non-concurrent force systems. Parallelogram, force polygon, resultant, equilibrant, components; numeric method.

UNIT III

Truss: Truss concept of triangulation, common truss configurations, innovative forms for truss of given span.

Truss loads and reactions: For a given configuration of the trusses and center to center spacing, calculations of the dead weight of the truss and the dead weight of the roof cover and support reaction loads analysis of simple trusses by method of joints..

Scheme for Internal semester assessment (ISA)

Regular Assignments

Scheme for End Semester Assessment (ESA) - External examination-3 hrs

Mode of assessment : Portfolio& Theory Exam.

Text Books: Engg Mechanics by S.S.Bhavikatti III-edition .Vikas publications New Delhi.

Reference Books

STRUCTURES - Martin Bechthold, Daniel L Schodek, and PHI Learning Private limited, Sixth Edition 2) Structure in Architecture, the building of buildings, by Mario Salvadori 3) Structure and Design, by G. G. Schierle 4) Engg Mechanics – R K Bansal & Sanjay Bansal, Laxmi publications, New Delhi, 3rd ed 5) Engg Mechanics, Ferdinand L Singer, Harper Collins publications, 3rd ed.

Scheme for Semester End Examination (ESA)

Sl.No	8 Questions to be set of 20 Marks Each	Chapter Number	Instructions
I	Q.No.-1, Q.No.-2, Q.No.-3	1,2,3,4,5	Solve Any **2** out of **3**
II	Q.No.-4, Q.NO – 5 Q.No.-6,	6,7,8,9	Solve Any **2** out of **3**
III	Q.No.-7, Q.No.-8	10,11	Solve Any **1** out of **2**

II SEMESTER

Program : Architecture		
Course Title: ARCHITECTURAL DESIGN – II		**Course Code: 18AATC108**
L-S-P: 0-4-0	**Credits: 4**	**Contact Hours: 6**
ISA: 50	**ESA: 50**	**Total Marks: 100**
Teaching Hours: 96	**Examination Duration: NA**	

UNIT I:

Introduction to Design theory

Principles of architectural composition:

General principles like unity, Balance, Proportion, Scale, Contrast, Harmony, Accentuation, and Restraint. Repose, Vitality, Strength in the built environment

Underlying Ordering Principles Symmetry, hierarchy, datum, axis, scale and proportion rhythm in the built environment.

UNIT II

Introduction Multiuser/ public spaces

Defining and understanding various design aspects needed for multi /semipublic/public user spaces.

UNIT III:

Designing a multi user multi level room space.

To develop skills for comprehensive understanding and dealing with Architecture Provide skills for designing multi-user and multi level spaces.

The design issues to be addressed are

Multi user and multi level space formation

Integration of material and form.

Integrate the horizontal and vertical circulation.

Develop skills to correlate the materials and the resulting form.

Details pertaining to the disabled, aged people and children.

The tentative list of suggested projects to be covered as design problems: Architectural Exhibition / display spaces Multi level museum, academic spaces, kindergarten school, Recreational spaces fast food/ restaurant

Scheme for Internal semester assessment (ISA)

The Portfolio covering the given topics and the study models shall be presented.

The evaluation shall be through periodic internal reviews.

The students have to present the entire semester work for assessment along with Models.

Term work Evaluation of Portfolio, assignments by internal examiner

Scheme for End Semester Assessment (ESA)

Term work: Evaluation of Portfolio and assignments by internal and external examiners/Viva

Mode of assessment: Portfolio, Models,Reviws.

Text Books: NIL

Program: Architecture		
Course Title: BUILDING CONSTRUCTION & MATERIALS - II		**Course Code: 18AATC109**
L-S-P: 0-4-0	**Credits: 4**	**Contact Hours: 6**
CIE Marks: 50	**SEE Marks: 50**	**Total Marks: 100**
Teaching Hours: 96	**Examination Duration: NA**	

UNIT I

Timber, bamboo & its products.

TIMBER- Introduction to, qualities of good timber used in building. Timber based products like i) veneer, ii) plywood iii) block board iv) chip / particle board v) fiber board (MDF) vi) Engineered timber, finger-joint boards. Introduction of bamboo and its products used in building.

TIMBER DOORS – Study of timber doors in building. Components of a door. Various types & joinery details of doors i.e. i) battened &ledged ii) battened, ledged & braced iii) framed & battened iv) framed & paneled v) framed & glazed. Flush doors using timber products & detailing there on. Study of fixtures used for doors.

UNIT II:

Timber windows

Study, types & construction details of glazed timber windows, i.e. i) casement ii) corner iii) bay iv) dormer v) clerestory vi) lantern vii) skylight viii) louvered etc. Components of window. Construction, joinery details, & study of fixtures, for i) casement ii) bay & iii) louvered windows.

TIMBER ROOFS- Introduction to, evolution, classification & study of conventional timber roofs for small to moderate spans like i) flat (*madagi*) ii) Lean to iii) couple iv) collar beam v) king post vi) queen Post. Construction & joinery details for King post roof truss.

UNIT III:

Roofing materials, paints

Identifying & working out fixing details of various common roofing materials like i) clay tiles ii) asbestos cement, aluminium, galvanized iron, SS, profiled, PVC, polycarbonate sheets etc.

PAINTS- Study & use of paints, polishes and protective coatings, including preparation of for new and old, surfaces, of interior and exterior like: wood work, steel work, plastered work, exposed masonry & cladding work etc

Scheme for Internal semester assessment (ISA)
Regular Assignments, models.
Term work: Evaluation of Portfolio, assignments by internal examiner

Scheme for End Semester Assessment (ESA) –
Term work: Evaluation of Portfolio, assignments by internal and external examiners

Mode of assessment : Portfolio .

Text Books - Nill

Reference Books:

12. McKay J.K Building Construction Metric Vol 1-4, 4th edi Orient Longman Pvt. Ltd, Mumbai,2002
13. “Construction Technology” volume-I by R Chudley, ELBS & Longman group Ltd.
14. Barry R, “The construction of buildings” , Vol-2, 5th Edi, East West Press, New Delhi 1999.
15. Bindra S.P and Arora S.P, Building Construction-Planning Techniques and Method of Construction, 19th edi, Dhanpat Rai Pub ,NewDelhi, 2000
16. “Building Construction” by JanardhanJha, Khanna New-Delhi.
17. RangawalS.C ,“Building Construction” 22nd Edi, charotar Publishing house, Anand, 2004
18. “Engineering Materials” by Surendra Singh, Vikas Delhi.
19. “Building Materials” by S K Duggal, IBH New Delhi.
20. Sushil Kumar T.B of Building Construction 19th edi, Standard Pub House, NewDelhi, 2003.
21. Chowdhary K.P. Engineering Materials used in India, 7th Edi, Oxford and IBH Pub ltd New Delhi, 1990.
22. Building Construction Hand book : By R Chudly& R Greeno, Bullerworth Heinemann, New-Delhi.

Program : Architecture		
Course Title: GRAPHICS - II		**Course Code: 18AATC110**
L-S-P: 0-4-0	**Credits: 4**	**Contact Hours: 6**
ISA: 50	**ESA: 50**	**Total Marks: 100**
Teaching Hours: 96	**Examination Duration: NA**	

UNIT I:

Section of Solids - section of simple and composite objects.

Perspective View**-** Parallel and Angular perspective projection.

Principles and visual effects of three dimensional objects.

Study of picture plane, station point, vanishing point, eye level, ground level etc., their variation **and their resultant** effects.

UNIT II:

Perspective view drawings of simple geometrical forms by office method and by measuring poin**t method**

Sciography **-** Introduction of basic principles of sciography and its application to the field of archi**tecture. Sciography of** line and plane in plan and elevation.

Sciography of three dimensional objects in perspectiveviews.

UNIT II

Perspective drawing including (one point & two point) of building exteriors including rendering.

Perspective drawing including (one point & two point) of building interiors including rendering.

Scheme for Internal semester assessment (ISA)

Regular Assignments, models.

Term work: Evaluation of Portfolio, assignments by internal examiner

Scheme for End Semester Assessment (ESA) –

Term work: Evaluation of Portfolio, assignments by internal and external examiners

Mode of assessment : Portfolio .

Text Books: NIL

Reference Books:

Perspective Drawing, Shah Patki Kale
Geometrical Drawing for Art students, I H Morris,
Engineering Drawing, Prof, VeeEss, MSRIT, V.K.Publishers, BNG-10,1990
Basic Perspective” by Robert Gill, Rendering with Pen & Ink by Robert Gill.
“Perspective and Sciography” by S.H.Mullik.
Perspective for Interior Desingners by John Pile.
Applied perspective by John Holmes.
Building Drawing by M.G.Shah, C.M.Kale&S.Y.Patki

Program : Architecture		
Course Title: HISTORY OF ARCHITECTURE - I		Course Code: 18AATC111
L-S-P: 2-0-0	Credits: 2	Contact Hours: 2
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hours: 32	Examination Duration: 3 Hours	

Course contents:

Unit-I:

Pre-Classical Architecture – Persian, Mycenaean, Etruscan

Characteristics, The Palace of Persepolis, The Palace Tiryns, The Temple of Juno Sospita, Lanuvium.

Greek Architecture

Characteristics, Orders of Greek, The Acropolis: Athens, Parthenon, Theatres and Temples

Unit-II

Roman Architecture

Characteristics, Orders , Colosseum, Pantheon, Forums, Temples, Theatres, Amphitheaters, andAqueducts

Early Christian Architecture & Byzantine Architecture

Characteristics, Basilicachurches , St Peter's Church Rome, Evolution of Byzantine Churches, Hagia Sophia

Unit-III

Romanesque Architecture

New Construction Methods, Pisa Cathedral, The Abbey Church, Cluny

Gothic Architecture

Cathedrals, Gothic Churches with construction of pointed arch, Rose windows, etc.

Scheme for Internal semester assessment (ISA)

Regular Assignments, models.

Term work: Evaluation of Portfolio, assignments by internal examiner

Scheme for End Semester Assessment (ESA)

External examination-3 hrs

Mode of assessment :

Portfolio& Theory Exam

Text Books:NIL

References :

Sir Banister Fletcher - History of Architecture

F.D K Ching, Mark Jarzombek and Vikramaditya Prakash – A Global History of Architecture

Scheme for End Semester Assessment (ESA)

Sl.No	8 Questions to be set of 20 Marks Each	Chapter Number	Instructions
I	Q.No.-1, Q.No.-2, Q.No.-3	1, 2,3	Solve Any 2 out of 3
II	Q.No.-4, Q.NO – 5 Q.No.-6,	4, 5,6	Solve Any 2 out of 3
III	Q.No.-7, Q.No.-8	7,8	Solve Any 1 out of 2

Program : Architecture		
Course Title: Skill Development Workshop- II		**Course Code: 18AATC112**
L-S-P: 0-2-0	**Credits: 2**	**Contact Hours: 3**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 48	**Examination Duration: NA**	

Course contents:
Unit-I:
Allied skills for Architecture

Tools and materials

Hands-on working of advance model making and working tools. Various types of materials used **for making scaled** models, sculpting etc. (Paper, card sheet, mount board, Art card, foam, metal, plaster, clay, wax **glass**, **vegetables** etc.) Methods of cutting, joining, texture development, glue welding and joinery.

Unit-II
Introduction to Architectural rendering skill and mobile photography, Soft skills

1. Hands on rendering of Architectural plan, elevation and sections.
2. Hands on mobile photography of models, buildings, furniture, vehicles etc.
3. Soft skills like communication, speaking, reading & writing.

Unit-III

1. Introduction to scanning of rendered sheets
2. Introduction to Adobe Photoshop software for photo processing and composition
3. Using above skills create own imaginative forms or objects

Sessional Work (Internal semester assessment)
Regular Assignments, Architectural models, rendered sheets and photos

Scheme for Semester End Assessment (ESA)
Term work: Evaluation of Portfolio, assignments by internal and external examiner

Mode of assessment: Portfolio / Model

References :

Robert Gill : Rendering with pen & ink , Thames & Hudson New York 1984
Robert Gill : Basic Rendering ,Thames & Hudson New York 1991
John Chen : Architecture in pen & ink, McGraw-Hill Inc- USA 1995
Colin Saxton : Art School, Chartwell Books Inc New Jersy.

Program : Architecture		
Course Title: Digital Tool –I (CAD)		Course Code: 18AATP101
L-S-P: 0-0-1	Credits: 1	Contact Hours: 2
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hours:32	Examination Duration: NA	

UNIT I:

Introduction to CAD Environment: Introduction to The world space, user co-ordinate system (ucs). Command line and menus, to learn basic commands like, units, limits, line, circle, arc. Etc. Use editing commands like trim, extend, erase, and offset to create basic shapes.

Unit-II

2D Drafting: Use basic drawing and editing commands to create 2d architectural plans, elevations, and sections, adding text and dimensions creating layers using advance editing commands.

Unit-III

Composing and printing: Creating detail sanction drawings, using plot for output, saving drawings in different file formats. Creating 2d drawings from Google earth and importing images in cad.

Sessional Work (Internal semester assessment)

Students will be assessed by 2 theory minor exams of 15 marks each and 20 marks for portfolio submission.

Scheme for Semester End Assessment (ESA)

Evaluation of Assignments in form of soft copy & hard copy worked during the course by internal and external examiners.

Mode of assessment : Portfolio .

References :

AutoCAD 2007 for Dummies. By David Byrnes, Mark Middle brook.
Publisher: For Dummies; Revised edition (May 8, 2006)
ISBN-10: 0471786497, ISBN-13: 978-0471786498

2.)Enhancing CAD Drawings with Photoshop by Scott On Stott
Publisher: Sybex (January 21, 2005) Language: English
ISBN-10: 0782143865 ISBN-13: 978-0782143867

Program : Architecture		
Course Title: Structures - II		**Course Code: 18AATC114**
L-S-P: 3-0-0	**Credits: 3**	**Contact Hours: 3**
ISA: 50	**ESA: 50**	**Total Marks: 100**
Teaching Hours: 48	**ExaminationDuration:3 Hours**	

Unit I

1. **Determinate and indeterminate structures:** Difference between determinate and indeterminate structures, implication of indeterminacy, obtaining the redundancy of beams and frames.
2. **Bending moment and shear force:** Concept of shear force and bending moment, types of beams, concept of concentrated load, uniformly distributed load, uniformly varying load and couple. Construction of SFD and BMD for simple cases of cantilever and simply supported beams. Bending moment and shear force diagrams for two and three span continuous beams.
3. **Stresses in beams:** Concept of pure or simple bending, bending equation, section modulus and moment of resistance, obtaining bending stress distribution for simple cases of beams. Shear stress distribution across the symmetrical and unsymmetrical beam cross sections.

Unit II

4. **Deflection of beams:** Relation between deflection, bending moment, shear force and rate of loading, deflection equation, obtaining slope and deflections for cantilever and simply supported beams using standard formulae.
5. **Torsion in structures:** Concept of torsion, torsion equation, elements subjected to torsion in structural system.

Unit III

6. **Columns and struts:** short and long columns, buckling of column, boundary conditions for columns, effective length, slenderness ratio and critical load. Euler's and Rankine's theories.

REFERENCES:

1) Structures - Martin Bechthold, Daniel L Schodek, and PHI Learning Private limited, Sixth Edition 2) Structure in Architecture, the building of buildings, by Mario Salvadori 3) Structure and Design, by G. G. Schierle 4) Engg Mechanics – R K Bansal & Sanjay Bansal, Laxmi publications, New Delhi.

Scheme for Internal semester assessment (ISA)

Regular Assignments

Scheme for End Semester Assessment (ESA)

External examination-3 hrs

Mode of assessment : Portfolio& Theory Exam.

Scheme for Semester End Examination (ESA)

Sl.No	8 Questions to be set of 20 Marks Each	Chapter Number	Instructions
I	Q.No.-1, Q.No.-2, Q.No.-3	1,2,3,4,5	Solve Any **2** out of **3**
II	Q.No.-4, Q.NO – 5 Q.No.-6,	6,7,8,9	Solve Any **2** out of **3**
III	Q.No.-7, Q.No.-8	10,11	Solve Any **1** out of **2**

Program : Architecture		
Course Title: Surveying		**Course Code: 18AATC113**
L-S-P: 2-0-0	**Credits: 02**	**Contact Hours: 02**
CIE Marks: 50	**SEE Marks: 50**	**Total Marks: 100**
Teaching Hours: 32	**Examination Duration: 3 Hours**	

UNIT I:

Surveying- definition, scope of surveying, applications of surveying in architecture **projects, principles,** classification and character of work. Shrunken scale. Direct and reciprocal ranging**, offsets types. Basic** problems in chaining, well-conditioned triangle and chain triangulation. Errors in chain **surveying.**

Principles of plane table surveying, accessories and methods of plain tabling. Merits **and demerits of plane** table survey as compared to chain survey.

UNIT II:

Leveling, terms used, instruments, classification of leveling, Temporary adjustments of **dumpy level. Plane** of collimation and rise and fall methods. Booking and reduction of levels related numer**ical on the topics. and** errors in leveling. .

Introduction to contouring, definitions contour interval, factors affecting contour inter**val. Characteristics of** contours, location of contours, direct and indirect methods of contouring, interp**olation of contours.** Application of contour maps in architecture field.

UNIT III:

Introduction to Theodolite temporary adjustments and field work.

Introduction to Geographical Information systems and Total station.

Scheme for Internal semester assessment (ISA)

Regular Assignments

Scheme for End Semester Assessment (ESA)

External examination-3 hrs

Mode of assessment: Portfolio& Theory Exam.

Text Books:

B.C. Punmia, Surveying and Levelling, Vol-IChirator Publications.

Kanetkar T. P. and Kulkarni S.V, Surveying and Levelling Part-

Reference Books: Duggal, Surveying and Levelling. Vol-I

15ECAP706	Rich Internet Application Lab.

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Program: MASTER OF COMPUTER APPLICATIONS		
Course Title: Rich Internet Applications Lab.		Course Code: 15ECAP706
L-T-P : 0-1-1	Credits: 2	Contact Hours: 4 hrs
CIE Marks: 80	SEE Marks: 20	Total Marks: 100
Teaching Hours: 48hrs	Examination Duration: 3Hrs.	

1)a) Write the program which describes Boolean data type.
b) Write the program which describes integer, float and string data type.
c) Write the program for type casting of different data type

2) Find the biggest of 2 numbers.
Find the biggest of 3 numbers.
Check whether a number is positive or negative.
Find the biggest of two numbers using ternary operator.
Check whether the given number is odd or even.
Find the factorial of a number (while loop)
Reverse the digit (Use do while)
Find the sum of the digits (Use for loop)
Display the Fibonacci series for a particular limit.(Use for loop)
Check the given letter is vowel or not.
3) Create an associative array with book details and display it in a table.
Write a program to create an array and try with all array functions.
4) Find the length of a string
Create a form with one text field and submit buttons for string length, string, reverse, uppercase, lowercase, string replace . Display the result according to it.
5) Write a program of function passing a two values and add the two values in the function.
Write a program of function showing with return value.
Create a registration form which contains fields name, Roll No, Gender and a submit button. All the details should be displayed in the server page when the user clicks the submit button.
Write a program to check whether the given number is prime or not.
6) Create Cookie, store a value "Ram" in the cookie.
Write a program of Cookie showing expire of cookie
7) Write a program to display the contents of a file(use fread, fgets, fgetc)
Write a program to create a file and write contents to it
Write a program to append data to an existing file.
Write a program to upload a file and display the contents in server.
8) Write a program for cinema ticketing. All the age should be over 12 years, if less than,dont allow to get ticket.(apply the exception handling

9) Write a PHP code to connect MySql Database.
Write a PHP code to select data,delete data and update data with MySqli.
Working with MVC framework(joomla) using PHP and MySql.

15ECAP708	Web Services Lab

Program: MASTER OF COMPUTER APPLICATIONS		
Course Code: **15ECAP708**	Course Title: **Web Services Lab.**	
L-T-P: **0-1-1**	Credits: 2	Contact Hrs: **4**
ISA Marks: **80**	ESA Marks: **20**	Total Marks: **100**
Teaching Hrs: **48**		Exam Duration: **3 Hours**

1) PHP

2) AJAX

1. XMLHttpRequest Object
2. Creating a request object
3. Sending a request to server
4. Receiving a response from the server
5. Ready State and Status of a request

3) JQUERY

6. Introduction and Installation
7. Syntax
8. jQuery Selectors
9. jQuery Events
10. jQuery Effects
    - i. jQuery Hide and Show Effect
    - ii. jQuery Fade Effect
    - iii. jQuery Slide Effect
    - iv. jQuery Animate

1. jQuery Callbacks
2. jQuery and HTML
    - i. jQuery Get
    - ii. jQuery Set
    - iii. jQuery Add
    - iv. jQuery Remove
    - v. jQuery css
    - vi. jQuery Width

vii. jQuery Height

3. jQuery and AJAX (Pre-Requisite: ServerEnd Technology)
    i. AJAX Function
4. JQuery UI
    i. Implementing Accordion
    ii. Implementing Date picker
    iii. Implementing Slider
    iv. Implementing Progessbar
    v. Implementing Tabs

4) HTML 5

1. Introduction
2. HTML5 New Elements
3. HTML5 Video
4. HTML5 Video/DOM
5. HTML5 Audio
6. HTML5 Drag and Drop
7. HTML5 Canvas
8. HTML5 SVG
9. HTML5 Canvas vs. SVG
10. HTML5 Geolocation

5) BOOTSTRAP

6) GOOGLE MAPS API

Evaluation Scheme

1. **In Semester Assessment (ISA) : Continuous Internal Assessment for 80 Marks.**
2. **End Semester Assessment (ESA) for 20 Marks.**

Program: MASTER OF COMPUTER APPLICATIONS		
Course Code: **15ECAE802**	Course Title: **Information Storage and Management**	
L-T-P: **3-0-0**	Credits: **3**	Contact Hrs: **3**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **42**		Exam Duration: **3 Hours**

No	Content	Hrs
	Unit I	
1	**Chapter 1: Introduction to Information Storage:** Information Storage, Evolution of storage architecture, Data Center Infrastructure, Virtualization and Cloud Computing. Data center environment: Application, DBMS, Host, Connectivity, Storage, Disk Drive Components, Disk Drive Performance, Host Access To Data, Direct Attached Storage, Storage Design Based on Application, disk native Command Queuing	6 Hrs
2	**Chapter 2 : Data protection: RAID** RAID Implementation Methods, RAID Array Components, RAID Techniques, Raid Levels, RAID Impact on Disk performance, RAID Comparison, HOT Spares	6 Hrs
3	**Chapter 3. Intelligent Storage Systems:** Components of an Intelligent storage system, LUN Masking, Types of Intelligent storage Systems	5 Hrs
	Unit II	
4	**Chapter 4: Fibre Channel Storage Area Networks:** Fiber channel :Overview, Components of SAN, FC Connectivity, Switched Fabric ports, Fibre Channel Architecture, Zoning, FC SAN Topologies, Virtualization in SAN. IP SAN: iSCSI, FCIP.	7 Hrs
5	**Chapter 5: Network Attached Storage (NAS):** Components of NAS, NAS Implementations, NAS File sharing Protocols, Factors Affecting NAS Performance, File Level Virtualization.	5 Hrs
6	**Chapter 6: Content Addressed Storage(CAS) and Unified Storage** Object Based Storage Devices, Content Addressed Storage, Unified Storage	5 Hrs
	Unit – III	
7	**Chapter 7: Local Replication and Remote Replication** : Local Replication Technologies, Remote Replication Technologies .	4 Hrs
8	**Chapter 8: Securing & Managing the Storage Infrastructure** Information security Framework, Risk Traid, Storage Security Domains ,Monitoring the Storage Infrastructure, Storage Infrastructure Management activities, Storage Infrastructure Management Challenges.	4 Hrs

Text Book:

1. G.Somasundaram, Aloka Shrivastava, “ EMC Education Services, Information Storage and Management”, Wiley, 2009.

References:

1. Foundations ULF Troppens, Rainer Erkens and Wolfgang Muller, “ Storage Networks Explained”, John Wiley & Sons, 2003.
2. Robert Spalding, “ Storage Networks: The complete Reference”, Tata Mc Graw Hill, 2003.

3. Richard barker and Paul Massiglia, “ Storage Area Networks Essentials: Acomplete Guide to understanding and Implementing SANS”, John Wiley India, 2002.
4. Marc Farely, “ Building Storage Networking Fundamentals”, Cisco press, 2005

Evaluation Scheme

1. In Semester Assessment (ISA)

Assessment	Weightage in Marks
ISA- 1	20
ISA- 2	20
Assignments	10
Total	**50**

2. End Semester Assessment (ESA)

UNIT	8 Questions to be set of 20 Marks Each	Chapter Nos.	Instructions
I	3 Questions to be set of 20 Marks Each	1,2,3	Any 2 questions are to be answered
II	3 Questions to be set of 20 Marks Each	4,5,6	Any 2 questions are to be answered
III	2 Questions to be set of 20 Marks Each	7,8	Any 1 question is to be answered

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15ECAP804	Advance DBMS Lab.

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Program: MASTER OF COMPUTER APPLICATIONS		
Course Code: **15ECAP804**	Course Title: **Advance DBMS Lab.**	
L-T-P: **0-0-1.5**	Credits: **1.5**	Contact Hrs: **3**
ISA Marks: **80**	ESA Marks: **20**	Total Marks: **100**
Teaching Hrs: **36**		Exam Duration: **3 Hours**

PL/SQL programs on :Strings, Arrays, Cursors, Records, Exceptions, Triggers, Packages, Collections, Transactions& Stored Procedures.

EXERCISE 1

Write a PL/SQL code to retrieve the employee name, join_date, and designation from employee database of an employee whose number is input by the user.

Employee database with the tables and fields specified as below.

a) Employee:

Emp_no	Employee_ name	Street	City

b) Works :

Emp_no	Company_ name	Joining_date	Designation	Salary

c) Company :

Emp_no	City

d) Manages :

Emp_no	Maanager_ name	Mang_no

Note: Primary keys are underlined.

EXERCISE 2

Write a PL/SQL code to calculate total and percentage of marks of the students in four subjects.

EXERCISE 3

Write a PL/SQL code to calculate the total and the percentage of marks of the students in four subjects from the table- Student with the schema given below.

STUDENT (RNO , S1 , S2, S3, S4, total, percentage)

EXERCISE 4

Write a PL/SQL code to display employee number, name and basic of 5 highest paid employees. (Usage of cursors)

EXERCISE 5

Write a PL/SQL code to calculate the total salary of first n records of emp table. The value of n is passed to cursor as parameter.

EXERCISE 6

Write a trigger on the employee table which shows the old values and new values of Ename after any updations on ename on Employee table

EXERCISE 7

Write a row trigger to insert the existing values of the salary table in to a new table when the salary table is updated.

EXERCISE 8

Write a PL/SQL procedure to find the number of students ranging from 70-100%, 60-69%, 50-59% & below 49% in each course from the student_course table .

Student database with the tables and fields specified as below.

a) Student :

Roll_no	Student_ name	Course	Gender

b) Student Personal:

Roll_no	DOB	Father_name	Address	Place

c) Student enrollment :

Roll_no	Course	Course_code	Sem	TotalMarks	Percentage

EXERCISE 9

Create a store function that accepts 2 numbers and returns the addition of passed values. Also write the code to call your function.

EXERCISE 10

Write a PL/SQL function that accepts department number and returns the total salary of the department. Also write a function to call the function.

EXERCISE 11

Write a PL/SQL code to create:
a) Package specification
b) Package body.
For the insert, retrieve, update and delete operations on a student table.

EXERCISE 12

Extending the power of PL/SQL:

This experiment shows how to call a PL/SQL subprogram from a Java program. It's aimed at those PL/SQL programmers who have no previous experience of Java, and those Java programmers who have no previous experience of PL/SQL (to call Java from PL/SQL).

Evaluation Scheme

1. **In Semester Assessment (ISA) : Continuous Internal Assessment for 80 Marks.**
2. **End Semester Assessment (ESA) for 20 Marks.**

17ECAP702	Web Programming Lab.

Program: MASTER OF COMPUTER APPLICATIONS

Course Code: **17ECAP702** Course Title: **Web Programming Lab.**

L-T-P:**0-0-1.5** Credits: **1.5** Contact Hrs: **3**

ISA Marks**: 100** ESA Marks: **--** Total Marks: **100**

Teaching Hrs: **36** Exam Duration: **3 Hours**

No **Content** **Hrs**

Unit I

Laboratory Section

Expt./ Job No.	*Lab assignments/experiment*	*No. of Lab. Slots per batch (estimate)*
	Demonstration	
1-2	Web designing using all elements of HTML and HTML5.	*02*
3	Applying CSS and CSS3 to HTML pages	*01*
4-5	Client side scripting using JavaScript	*02*
	Exercises	
6-7	Exercise programs on Web designing using all elements of HTML and HTML5.	*02*
8	Exercise programs on Applying CSS and CSS3 to HTML pages	*01*
9-10	Exercise programs on Client side scripting using JavaScript	*02*
	Structured enquiry	
11	Develop a customized web based application.	*02*

17ECAC703	PHP Programming

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Program: MASTER OF COMPUTER APPLICATIONS

Course Code**: 17ECAC703** Course Title: **PHP Programming**

L-T-P:**3-0-1** Credits: **4** Contact Hrs: **5**

ISA Marks Theory: **50 +** Practice: **100** ESA Marks: **50** Total Marks: **200**

Teaching Hrs: **42 + 24** Exam Duration: **3 Hours**

No	Content	Hrs
	Unit I	
1	**Chapter No. 1- Introducing PHP** History, Unique features, Basic development concepts , Creating your first PHP script, Writing & running the script, Understanding the scripts , Handling script errors	**3 Hrs**
2	**Chapter No. 2- Using variables & operators** Storing data in variables, Understanding PHP's data types, Setting & checking variable data types, Using constants, Manipulating variables with operators, Handling form input	**3Hrs**
3	**Chapter No. 3- Controlling Program Flow** Writing Simple Conditional Statements, Writing More Complex Conditional Statements , Combining Conditional Statements, Repeating actions with loops, Working with string & numeric functions	**4Hrs**
4	**Chapter No. 4- Working with Arrays** Storing data in Arrays, Processing arrays with loops & iterators, Using arrays with forms, Using arrays with forms, Working with array functions, Working with dates & times.	**3Hrs**
5	**Chapter No. 5- Using functions & Classes** Creating user defined function, Creating classes ,Using Advanced OOP concepts	**4Hrs**
	Unit II	
6	**Chapter No. 6. Working with Files & Directories** Reading files, Writing files , Processing directories , Performing Other files & directory operations	**6 Hrs**
7	**Chapter No. 7. Working with databases & SQL** Introducing databases & SQL, Using PHP MySQLi extension, Adding or modifying data, Handling errors , Using PHP's PDO extension, Building a Login form	**6 Hrs**
8	**Chapter No. 8. Working with XML** Introducing XML, Using PHP's Simple XML extension, Converting XML to SQL, Reading RSS feeds ,Using PHP's DOM extension, Recursively processing an XML document tree	**5Hrs**
	Unit – III	
9	**Chapter No. 9. Working with Cookies, Sessions & Headers** Working with Cookies ,Cookie Basics , Cookie Attributes , Cookie Headers , Setting Cookies ,Reading Cookies , Removing Cookies, Working with Sessions , Session Basics , Creating Sessions and Session Variables , Removing Sessions and Session Variables, Using HTTP headers	**4Hrs**

10 Chapter No. 10. Securing PHP **4Hrs**

Sanitizing Input and Output , Securing Data , Securing Configuration Files, Securing Database Access , Securing Sessions , Validating User Input, Working with Required Fields , Working with Numbers , Working with Strings , Working with Dates

Text Books :

1. VikramVaswani, A Beginner's Guide PHP, Mc Graw Hill, 2009.

References:

1. Online tutorials websites - w3schools and tutorialspoint

Laboratory Section

Expt./ Job No.	*Lab assignments/experiment*	*No. of Lab. Slots per batch (estimate)*
Demonstration		
1	Scripts that helps to understand the syntax and grammar of PHP language.	01
2	Scripts to develop dynamic web pages that read and process the user input submitted via online form.	01
3	Scripts to Develop dynamic web pages that store and retrieve data from a file on a disk and database from the server	01
4	Scripts to Develop dynamic web pages that authenticate and track users with sessions and cookies	01
5	Scripts to Perform efficient exception handling and error processing on the developed web pages	01
6	Scripts to demonstrate Database Communication through PHP	01
	Exercises	
7	Practice Scripts on developing dynamic web pages that read and process the user input submitted via online form	01
8	Practice Scripts on Developing dynamic web pages that store and retrieve data from a file on a disk and database from the server	01
9	Practice Scripts on Develop dynamic web pages that authenticate and track users with sessions and cookies	01

10	Practice Scripts on Performing efficient exception handling and error processing on the developed web pages	01
11	Practice Scripts on demonstrating Database Communication through PHP	01
	Structured enquiry	
12	Develop dynamic, interactive and customized web portals	01

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Evaluation Scheme

1. Assessment

Assessment	Theory	Lab.
ISA- 1	25	100
ISA- 2	25	
ESA	50	00
Total	**100**	**100**

2. End Semester Assessment (ESA) Pattern:

UNIT	8 Questions to be set of 20 Marks each	Chapter Nos.	Instructions
I	3 Questions to be set of 20 Marks Each	1,2,3,4,5	Any 2 questions are to be answered
II	3 Questions to be set of 20 Marks Each	6,7,8	Any 2 questions are to be answered
III	2 Questions to be set of 20 Marks Each	9,10	Any 1 question is to be answered

16ECAP804	Programming in C# with .NET Lab.

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Program: MASTER OF COMPUTER APPLICATIONS

Course Code: **16ECAP804** Course Title: **Programming in C# with .NET Lab.**

L-T-P:**0-0-1.5** Credits: **1.5** Contact Hrs: **3**

ISA Marks:**100** ESA Marks: **00** Total Marks: **100**

Teaching Hrs: **36** Exam Duration: **3 Hours**

No **Content** **Hrs**

Unit I

Expt/Job No.	Brief description about the experiment / job	No. of Lab. Slots per batch (estimate)
	Demonstration	
1.	C# programming constructs Arrays, Strings, Enumerations, Structures, Methods and Namespaces.	1
2.	Pillars of OOP - Encapsulation, Inheritance, Polymorphism.	1
3.	Interfaces & members of Systems.Collections namespace.	1
4.	Delegates, Events & Operator Overloading.	1
	Exercises	
5.	Implementation of boxing & unboxing techniques, methods and Parameter Modifiers.	1
6.	Application of basic OOP concepts and ArrayList class.	1
7.	Building Structures in C#.	1
8.	Implementation of encapsulation, inheritance and polymorphism in C#.	1
9.	Implementation of interfaces.	1
10.	Operator Overloading and Exception handling.	1
11.	Building Delegates in C#.	1
	Structured Enquiry	
12.	Designing a C# GUI application with database connection.	1

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16ECAP805	PL - SQL Lab.

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Program: MASTER OF COMPUTER APPLICATIONS

Course Code: **16ECAP805** Course Title: **PL / SQL Lab.**

L-T-P: **0-0-1.5** Credits: **1.5** Contact Hrs: **3**

ISA Marks: **100** ESA Marks: 0**0** Total Marks: **100**

Teaching Hrs: **36** Exam Duration: **3 Hours**

Expt No.	*Brief description about the experiment*	*Remarks*
	Demonstration	
1	Introduction to basic PL/SQL control structures.	No-Evaluation
2	Introduction to Functions	No-Evaluation
3	Introduction to Procedures	No-Evaluation
4	Introduction to cursers and curser variables.	No-Evaluation
5	Introduction to Triggers and records.	No-Evaluation
	Exercise	
6	Implementation of basic PL/SQL control structures on a given database	Evaluation
7	Implementation of PL/ SQL Functions on a given database	Evaluation
8	Implementation of Procedures on a given database.	Evaluation
9	Implementation of Cursers and curser variables on a given database.	Evaluation
10	Implementation of Triggers on a given database.	Evaluation
11	Implementation of Records on a given database.	
	Structured Enquiry	
12	Implementing a PL/SQL operations on a real time data base	Evaluation

Evaluation Scheme

1. In Semester Assessment (ISA): Continuous Internal Assessment for 100 Marks.

16ECAE802	NO SQL

Program: MASTER OF COMPUTER APPLICATIONS

Course Code: **16ECAE802**	Course Title: **NoSQL**	
L-T-P: **3-0-1**	Credits: **4**	Contact Hrs: **5**
ISA Marks-Theory: **50** +Practice: **100**	ESA Marks: **50**	Total Marks: **200**
Teaching Hrs: **50**		Exam Duration: **3 Hours**

No	**Content**	**Hrs**
	Unit I	

1	**Chapter 1 – Introduction to NoSQL** What it is & Why you need it, Hello NoSQL : Getting Initial hands-on Experience, Interfacing and Interacting with NoSQL	**8 Hrs**
2	**Chapter 2 – NoSQL Basics** Understanding the Storage Architecture, Performing CRUD operations, Querying NoSQL Stores, Modifying Data Stores & Managing Evolution, Indexing and ordering datasets.	**12Hrs**
	Unit II	
3	**Chapter 3 – Advanced NoSQL** Using NoSQL in the CLOUD, Scalable Parallel Processing with MapReduce, Analyzing BigData with Hive.	**8 Hrs**
4	**Chapter 4 – Working with NoSQL** Surveying Database Internals, Using MySQL as a NoSQL solution, WebFrameworks and NoSQL, Migrating from RDBMS to NoSQL.	**12 Hrs**
	Unit – III	
5	**Chapter 5 – Developing Web Application with NoSQL** Php and MongoDB – Comparing documents in MongoDB & PHP, MongoDB classes, Connecting & Disconnecting, Inserting Data, listing your data, Modifying data with PHP, Deleting data, DBRef, GridFS & PHP Driver, Creating a Blog Application with PHP driver - Designing the Application, Listing the Posts, Looking at a Single Post, Searching the Psots, Adding, Deleting & modifying Posts, Creating the Index Pages, Recapping the blog application.	**6 Hrs**
6	**Chapter 6 – NoSQL Database Administration** Using Administrative tools, Backing up the MongoDB Server, Digging Deeper into Backups, Restoring Individual Databases or Collections, Automating Backups, Backing up Large Databases, Importing Data into MongoDB, Exporting data into MongoDB, Securing.	**4 Hrs**

Text Book:

1. "Professional NoSQL" by Shashank Tiwari, 2011, WROX Press (Chapter 1,2,3,4,5,6,7.8.9,10.11.12.13.15)
2. The Definitive guide to MongoDB, The NoSQL Database for Cloud and Desktop Computing, Apress 2010. (Chapter 6,7,8,9).

NOSQL PRACTICES

COURSE DESCRIPTION:

The widespread emergence of big data storage needs has driven the development and adoption of a new class of non - relational databases commonly referred to as NoSQL databases. The NoSQL (or Not-Only SQL) databases are basically developed to meet the requirements of the modern cloud-based decentralized apps and are a good solution as compared to the relational databases in many ways. These unstructured databases are widely known for their non-relational and schema less data model, improved performance and scalability factors which are always an issue with relational database systems. This course will explore the origins of NoSQL databases and the characteristics that distinguish them from traditional relational database management systems. Core concepts of NoSQL databases will be presented followed by an exploration of how different database technologies implement these core concepts.

OBJECTIVES

- Demonstrate competency in designing NoSQL database management systems.
- Demonstrate competency in describing how NoSQL databases differ from relational databases from a theoretical perspective.
- Demonstrate competency in selecting a particular NoSQL database for specific use cases.

LAB REQUIREMENTS:

- Computer with latest configuration having Windows and Unix OS Versions.
- Java software installed.

LIST OF EXERCISES

Expt./ Job No.	Lab assignments/experiment	Implementation	Number of Hours
1.	Set up MongoDB environment.	i. Installation of MongoDB on Windows and Unix platform. ii. Operations on Start, Stop and Restart MongoDB. iii. Using MongoDB Help. iv. Getting MongoDB Statistics.	02
2.	Create/Drop, NoSQL Datatypes	i. Differentiate between database, document and collection. ii. Create Database, Drop Database. iii. Create Collection, Drop Collection. iv. MongoDB Datatypes.	02
3.	Working with MongoDB Documents	Insert Document, Update Document, Delete Document,	02
4.	Data Retrieval	i. Projection ii. Limit Records iii. Sort Records iv. Indexing v. Aggregation	02
5.	Creating Backup	i. Replication ii. Sharding iii. Create Backup	02

		iv. Deployment	
6.	MongoDB in Java	Set up MongoDB JDBC driver, Connect to database, Create a Collection, Retrieve a Collection, Insert a Document, Retrieve a Documents, Update Document.	04

References:

1. https://www.tutorialspoint.com/mongodb/mongodb_tutorial.pdf
2. https://blog.codecentric.de/files/2012/12/MongoDB-CheatSheet-v1_0.pdf
3. http://www.guru99.com/mongodb-tutorials.html

Evaluation Scheme

1. Assessment

Assessment	Theory	Lab.
ISA- 1	25	100
ISA- 2	25	
ESA	50	00
Total	**100**	**100**

2. End Semester Assessment (ESA) Pattern:

UNIT	8 Questions to be set of 20 Marks Each	Chapter Nos.	Instructions
I	3 Questions to be set of 20 Marks Each	1,2	Any 2 questions are to be answered
II	3 Questions to be set of 20 Marks Each	3,4	Any 2 questions are to be answered
III	2 Questions to be set of 20 Marks Each	5,6	Any 1 question is to be answered

16ECAE803	Database Administration

Program: MASTER OF COMPUTER APPLICATIONS

Course Code: **16ECAE803** Course Title: **Database Administration**

L-T-P:**3-0-1** Credits: **4** Contact Hrs: **5**

ISA Marks-Theory: **50** +Lab: **100** ESA Marks: **50** Total Marks: **200**

Teaching Hrs: **50** Exam Duration: **3 Hours**

No	Content	Hrs
	Unit I	
1	**Chapter No. 1 : Introduction** Why Learn Database Administration?, A Unique Vantage Point, The Management Discipline of Database Administration, Evaluating a DBA Job Offer, Database, Data and System Administration, DBA Tasks, DBMS Release Migration, Types of DBAs.	**7 Hrs**
2	**Chapter No. 2: Creating the Database Environment** Defining the Organization’s DBMS Strategy, Installing the DBMS, Upgrading DBMS Versions and Releases, Database Standards and Procedures.	**7 Hrs**
3	**Chapter No. 3: Database Change Management**	**6 Hrs**

Change management Requirements, Types of changes, Impact of Change on Database Structures,

Unit II

4 **Chapter No. 4 Performance Management** **7 Hrs**
Defining Performance, Monitoring versus Management, Service-Level Management, Types of performance tuning, Performance Tuning tools, DBMA performance Basics.

5 **Chapter No. 5 System and Database Performance** **7 Hrs**
The Larger Environment, DBMS Installation and Configuration Issues, System Monitoring, Techniques for optimizing Databases, Database reorganization.

6 **Chapter No. 6 Application Performance** **6 Hrs**
Designing Applications for Relational Access, Relational Optimization, Additional Optimization Considerations, Reviewing Access Paths, SQL Coding and Tuning for Efficiency.

Unit – III

7 **Chapter No. 7 Database Security** **5 Hrs**
Data Breaches, Database Security Basics, Granting and Revoking Authority, Authorization Roles and Groups, Other Database Security Mechanisms, Encryption.

8 **Chapter No. 8 Database Backup and Recovery** **5 Hrs**
The Importance of Backup and Recovery, Preparing for Problems, Backup, Recovery, Alternatives to Backup and Recovery

Text Book:

1. Craig S. Mullins "Database Administration: The complete guide to DBA Practices and Procedures"2nd Edition, Addison Wesley.

Evaluation Scheme

1. Assessment

Assessment	Theory	Lab.
ISA- 1	25	100
ISA- 2	25	
ESA	50	00
Total	**100**	**100**

2. End Semester Assessment (ESA) Pattern:

UNIT	8 Questions to be set of 20 Marks Each	Chapter Nos.	Instructions
I	3 Questions to be set of 20 Marks Each	1,2,3	Any 2 questions are to be answered
II	3 Questions to be set of 20 Marks Each	4,5,6	Any 2 questions are to be answered
III	2 Questions to be set of 20 Marks Each	7,8	Any 1 question is to be answered

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16ECAE804	Web Content Management

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Program: MASTER OF COMPUTER APPLICATIONS

Course Code: **16ECAE804** Course Title: **Web Content Management**

L-T-P:**3-0-1** Credits: **4** Contact Hrs: **5**

ISA Marks-Theory: **50** +Lab: **100** ESA Marks: **50** Total Marks: **200**

Teaching Hrs: **50 + 24** Exam Duration: **3 Hours**

No	Content	Hrs
	Unit I	
1	**Chapter 1: What Content Management Is (and Isn't)**	**6 Hrs**
	What Is Content?, What Is a Content Management System?, Types of Content Management Systems, What a CMS Does, What a CMS Doesn't Do	
2	**Chapter 2 :Points of Comparison**	**7 Hrs**
	Target Site Type, Systems Versus Implementations, Platform Versus Product, Open Source Versus Commercial, Technology Stack, Management Versus Delivery, Coupled Versus Decoupled, Installed Versus Software-as-a-Service (SaaS), Code Versus Content, Code Versus Configuration, Uni- Versus Bidirectional Publishing, Practicality Versus Elegance, and the Problem of Technical Debt	
3	**Chapter 3 :Acquiring a CMS**	**7 Hrs**
	Open Source CMSs, Commercial CMSs, Software-as-a-Service, Build Your Own, Questions to Ask	
	Unit II	
4	**Chapter 4: The Content Management Team**	**7 Hrs**
	Editors, Site Planners, Developers, Administrators, Stakeholders	
5	**Chapter 5: CMS Feature Analysis**	**6 Hrs**
	The Difficulties of Feature Analysis, An Overview of CMS Features	
6	**Chapter 6 Content Modeling**	**7 Hrs**
	Data Modeling 101, Data Modeling and Content Management, Separating Content and Presentation, Defining a Content Model, Relationships, Content Composition, Content Model Manageability, A Summary of Content Modeling Features	
	Unit – III	
7	**Chapter 7 :Content Aggregation**	**5 Hrs**
	The Shape of Content, Content Geography, Aggregation Models: Implicit and Explicit, Aggregation Functionality, By Configuration or by Code, A Summary of Content Aggregation Features	
8	**Chapter 8 :Editorial Tools and Workflow**	**5 Hrs**
	The Content Lifecycle, The Editing Interface, Versioning, Version Control, and Version Labels, Dependency Management, Content Scheduling and Expiration, Workflow and	

Approvals, Collaboration, Content File Management, Permissions, A Summary of Editorial Tools

Text Book:

1. "Web Content Management", Systems, Features, and Best Practices, Publisher: O'Reilly Media, March 2016.

WEB CONTENT MANAGEMENT SYSTEM – COURSE PROJECT

COURSE DESCRIPTION:

Today, many web publishers use content management systems (CMS) to allow them to instantly and dynamically update web pages and properties as new content becomes available so that every visit to a site is engaging, informative, and meaningful. The course project shall explore any one of the three most popular open source web-based content management systems—**WordPress, Joomla, and Drupal**—to create dynamic and flexible websites and landing pages. Students shall explore the fundamentals of planning dynamic websites, CMS database management, developing CSS-controlled site templates, and creating database-driven websites through the planning and creation of their own topic-based sites.

OBJECTIVES

- Introduce learners to any one of the three most popular open source content management systems (CMS) such as WordPress, Drupal, or Joomla.
- Create, deploy and Maintain websites using CMS, including creating and editing content, adding functionality, and creating custom templates and themes.

COURSE PROJECT TITLE: BUILDING WEBSITE USING CMS (JOOMLA / WORDPRESS OR DRUPAL)

To build website for any real world examples such as Corporate web sites or portals, Online magazines, newspapers, and publications, E-commerce and online reservations, Government applications, Small business web sites, Community-based portals, School, religious web sites or Personal or family homepages using popular Web Content Management System. The website shall facilitate to create, manage, store and deploy content on the Web, including text, graphics, video or audio as a part of Enterprise Content Management.

EXECUTION PLAN:

Sl.No	Demonstration	Implementation	Number of Slots
1.	**Introducing Content Management Systems** o An overview of some of the different tools and methods that today's web publishers are using to create highly-tailored dynamic web content. o Purchasing and configuring a domain name and web hosting.	1. Introduction to Joomla & Installation 2. Domain Name Registration & Configuration and Hosting 3. Create a Database 4. Content Preparation and Planning	02

	2.	**Introduction to Joomla** ○ Explore the CAM model (Categories, Articles, and Menus) approach to creating content for Joomla environments. ○ Administration and management of users and media. ○ Installing Joomla ○ Exploring the Admin Interface ○ Content creation using the CAM model ○ Content customization: images, video, audio, tags, formats, etc.	1. Write an article & put your articles in order with categories. 2. Customize Administrator's Panel 3. Change your website's look with Templates. 4. Expand your website's functionality with different extensions. 5. Content creation & Customization using the CAM model	02	
	3.	**Joomla Menus** ○ Creating and controlling menus for Joomla site. ○ To link to articles and create special menu items. ○ Adding and displaying menus ○ Linking menus to articles and other features	1. Categorize the articles which allow grouping your content better. 2. Create menu items for website.	02	
	4.	**Extending Joomla –Plug-ins, Modules** ○ Use of Joomla, Plug-ins, Modules, Components and other extensions. ○ Installation of extensions, Finding and adding Joomla extensions ○ Adding and setting up 2 "big" extensions (choose blog, calendar, image gallery, Paypal-based shopping cart, or portfolio. Other extensions on approval)	Select Create Joomla Modules for the website such as Feed Display Module, Footer Module, Latest News Module, Search Module, Random Image Module, Who's Online Module etc.	02	
	5.	**Custom Templates** ○ Explore the addition of creation and uses of customized Joomla templates ○ Modifying templates using CSS and HTML tricks.	Select and Customize template for website.	02	
	6.	**User management and permissions** ○ Explore how to manage users in Joomla site, including managing who sees what based on login, as well as who can do what based on permissions assigned.	Control the use of Captcha, registration allowed and type of registration, default user group new users, reset password, and new user registration email notice to administration.	02	

Evaluation Scheme

1. Assessment

Assessment	Theory	Lab.
ISA- 1	25	100
ISA- 2	25	
ESA	50	00
Total	**100**	**100**

2. End Semester Assessment (ESA) Pattern:

UNIT	8 Questions to be set of 20 Marks Each	Chapter Nos.	Instructions
I	3 Questions to be set of 20 Marks Each	1,2,3	Any 2 questions are to be answered
II	3 Questions to be set of 20 Marks Each	4,5,6	Any 2 questions are to be answered
III	2 Questions to be set of 20 Marks Each	7,8	Any 1 question is to be answered

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16ECAE807	IT Infrastructure & Management

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Program: MASTER OF COMPUTER APPLICATIONS

Course Code: **16ECAE807** Course Title: **IT Infrastructure Management**

L-T-P:**3-0-1** Credits: **4** Contact Hrs: **5**

ISA Marks-Theory: **50** +Lab: **100** ESA Marks: **50** Total Marks: **200**

Teaching Hrs: **50** Exam Duration: **3 Hours**

No	Content	Hrs
	Unit I	
1	**Chapter 1. Introduction** Basic Conceptual Overview of Router, Routing Protocols and Routed Protocols & Conceptual Overview of the concept of Zoning, Internet, Extranet, Intranet (Militarized Zone), De-Militarized Zones.	**5 Hrs**
2	**Chapter 2. IT Infrastructure Components and their associated Zones** Firewall , IPS (Intrusion Prevention System) , VPN (Virtual Private Network), NATing, Servers-Domain Name System Server, Proxy Server,Web Application Server, DHCP Server, FTP Server, Mail Server	**5 Hrs**
3	**Chapter 3. Firewall** :	**5 Hrs**

	Basic Operation of Firewall, Types of Firewall-Stateless-Static Packet Filtering Firewall, Stateful-Dynamic Filtering Firewall, Firewall Rule Set-Conceptual Overview, Standard Firewall Rules, How to Create a Firewall Rule ;Windows Firewall -Configuration of a Windows Based Firewall on PC, Host Based Firewall, Security Products ;Modern Firewall Architecture- Deep Packet Inspection; Essence of a Firewall in the Corporate IT Infrastructure- How it protects the Servers in the Corporate Infrastructure; Protection to Corporate IT Infrastructure in absence of a Firewall.	
4	**Chapter 4. IPS (Intrusion Prevention System)**	**5 Hrs**
	What is an IPS Device, Uses of IPS Device, Modes of Operation of IPS Device, IPS Device Update Mechanism, Advantages of IPS Device, Disadvantages of IPS Device	
	Unit II	
5	**Chapter 5. VPN (Virtual Private Network)**	**10Hrs**
	Leased Line Network and the Advnet of VPN, What is VPN (Virtual Private Network? How VPN can be Helpful? How does VPN Work? Types of VPN - Remote Access, VPN Tunneling, Equipments to set up VPN Connectivity, VPN Case let – Challenge, VPN Technology - SSL VPN and IPSec VPN, Encryption and Security Protocols in VPN, Advantages of VPN, VPN Related Threats- End Point Security Posture , Split Tunneling- Concept, Advantages, Configuration, ICS Split Tunneling Problem, Web Application Attacks, Unauthorized Access to Host, Insecure Storage of Authentication Credentials by VPN Clients, Misconfiguration, RSA - VPN Implementation, Setting Client Based VPN Connection	
	NATing- Conceptual Overview, NATing Operation - How it works? Applications of NATing	
6	**Chapter 6. Domain Name System Server-**	**10Hrs**
	Conceptual Overview, DNS Hierarchical Structure, Distributed Database- Top Level Domains Classification - Geographical and organizational, Fully Qualified Domain Name; DNS Server Classification - Zone Information/ Function, DNS Operation Modes - Recursive and Iterative, DNS Caching-a. Conceptual Overview, How DNS Resolves Queries; DNS Records - A, AAAA, MX, NS, PTR, CNAME-Registering DNS Records in Corporate/ ISP DNS Servers; DNS Zone Files, DEMO:nslookup utility -Command Line tool for forward DNS query, Reverse DNS Queryand Extracting Domain Related Information; DNS Threats and Mitigation- Split Zone Architecture, Zone Information Leakage -Unauthorized Zone Zone Transfer, Reverse DNS Lookup, Zone Transfers Applications to keep DNS updated, Security Zone Transfers using DNS/ TSIG, Security Zone Transfers using DNSSEC (DNS Security) Protocol- How DNSSEC Works? Difference between DNS TSIG and DNSSEC; Cache Poisoning Attack, Conceptual Overview - How it happens, Implications- Mail Redirection, Web Redirection, URL Redirection; Deletion Attack, DoS Attack-Demo:DoS Attack on a DNS Server, Dynamic Updates using DHCP Client/ Server, Integrated with ADS, Wrong Configuration - Non-Authoritative, Recursive Mode, Integrity Compromise of ROOT Hints File, DNS Amplification Attacks, Other Security Parameters- Restrict DNS servers to listen on specific addresses, Configure Global Query Block List.	
	Unit – III	
7	**Chapter 7. Proxy Server**- Conceptual Overview, Operation - How Proxy Server Works , Applications of Proxy Server; **Antivirus -** Types of Malwares - Virus, Worms, Trojans, Spyware,	**5 Hrs**

	Ghostware, RansomWare etc., What is an Antivirus- How does an Antivirus Work? **Web Application Server-** Conceptual Overview, Web Application Attacks	
8	**Chapter 8. DHCP Serve**r -Conceptual Overview, Overview of DHCP Operation, Uses of DHCP Server; **FTP Server**- Conceptual Overview, FTP Operations - Active and Passive FTP, Uses of FTP Server; **Mail Server**- Conceptual Overview, Overview of Email Filter Devices.	**5 Hrs**

References:

1. Kemp, Juliet, Spinger, "Linux System Administration"
2. Anita Sengar "IT Infrastructure Management" 2012 Edition, publisher: S K Kataria and Sons
3. Sjaak Laan "Infrastructure Architecture - Infrastructure Building Blocks and Concepts Second Edition, Kindle Edition, Lulu Press Inc; Second Edition

IT Infrastructure Management Practices

COURSE DESCRIPTION:

IT infrastructure consists of a set of physical devices and software applications that are required to operate the entire enterprise. IT infrastructure is also consists both human and technical capabilities. These services include the following- Computing platforms used to provide computing services, that connect employees, customers, and suppliers into a coherent digital environment, including servers ,Data management services that store and manage corporate data and provide capabilities for analyzing the data and Application software services that provide enterprise-wide capabilities such as enterprise resource planning, customer relationship management, supply chain management, and knowledge management systems that are shared by all business units. It allows an organization to deliver IT solutions and services to its employees, partners and/or customers and is usually internal to an organization and deployed within owned facilities.

OBJECTIVES

- Acquire comprehensive knowledge, technical expertise and hands-on experience in IT Infrastructure Management
- To learn all aspects of IMS such as Networking, Operating Systems, Virtualizations and Data Center technologies.

LAB REQUIREMENTS:

- A modern web-browser with HTML5 and JavaScript enabled.
- Remote Desktop Client connection software.
- Internet connectivity Microsoft Account (LiveID).

LIST OF EXERCISES

Expt./ Job No.	Lab assignments/experiment	Implementation	Number of Slots

1.	Web Server	Apache Web Server, IIS Server: Install and Configure the Apache Web Server on Linux and IIS server on windows.	01
2.	Samba Server	Implementation of Windows files and print services for Linux allowing the sharing of files and printers between Windows and Linux.	01
3.	LDAP Server	LDAP Server: Lightweight Directory Access Protocol- Server Installation to access a directory service.	01
4.	Mail Server	Mail Server configuration- POP3 Server, IMAP Server	01
5.	Proxy Server	Develop a small web proxy server, which is able to cache web pages. It is a very simple proxy server which only understands simple GET-requests, but is able to handle all kinds of objects - not just HTML pages, but also images.	01
6.	Firewalls and NAT (Network Address Translation)	Use of iptables to build a permissive firewall by selectively filtering packets based on protocol type. To demonstrate how addresses may be translated from private addresses to public and vice versa as they pass in and out of the firewall.	01
7.	Cloud Infrastructure: Azure Hands-on Lab (HOL) Build your Infrastructure in the Cloud using Windows Azure Infrastructure Services -	1. Login to the Windows Azure Management Portal, Define a new Windows Azure Affinity Group and Create a new Windows Azure Storage Account. 2. Register a DNS Server in Windows Azure. 3. Define a Virtual Network in Windows Azure. 4. Configure Windows Server Active Directory in a Windows Azure VM. 5. Configure New Machine for File Services in a Windows Azure VM.	01

References:

1. https://amizone.net/AdminAmizone/WebForms/Academics/NewSyllabus/194201472058683.pdf
2. http://itproguru.com/azurehol/#sthash.HMydlzVA.dpuf
3. https://simms-teach.com/docs/cis192/cis192lab08.pdf
4. https://simms-teach.com/resources.php
5. http://www.cs.rpi.edu/~kotfid/security1/PDF2/NS1_lab_6_1_4_en.pdf
6. http://www.cse.unsw.edu.au/~cs3331/12s1/Labs/
7. https://www.6diss.org/workshops/ca/dns-practical.pdf
8. http://www.dwaynewhitten.com/info306/pages/lab.html
9. http://www.bo.ingv.it/~scacciag/home_files/teach/netadminguide.pdf
10. https://techpolymath.com/2015/02/16/how-to-setup-a-dns-server-for-a-home-lab-on-ubuntu-14-04/
11. http://www.dwaynewhitten.com/info306/lab2.pdf

Evaluation Scheme

1. Assessment

Assessment	Theory	Lab.

ISA- 1	25	100
ISA- 2	25	
ESA	50	00
Total	**100**	**100**

2. End Semester Assessment (ESA) Pattern:

UNIT	8 Questions to be set of 20 Marks Each	Chapter Nos.	Instructions
I	3 Questions to be set of 20 Marks Each	1, 2, 3, 4	Any 2 questions are to be answered
II	3 Questions to be set of 20 Marks Each	5, 6	Any 2 questions are to be answered
III	2 Questions to be set of 20 Marks Each	7, 8	Any 1 question is to be answered

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15ECAP901	Big Data Analytics Lab.

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Program: MASTER OF COMPUTER APPLICATIONS		
Course Code: **15ECAP901**	Course Title: **Big Data Analytics Lab.**	
L-T-P:**0-0-1**	Credits: **1**	Contact Hrs: **2**
ISA Marks-: **100**	ESA Marks: **--**	Total Marks: **100**
Teaching Hrs: **24**		Exam Duration: **3 Hours**

No	**Content**	**Hrs**

1. Installation of R and RStudio
2. Demonstration of R programing.
3. Demonstration of data handling in R

Write R programs for following:

4. Compute measures of central tendency and dispersion for a given data.
5. Demonstrate data visualization using histogram, bar/line chart, boxplot and scatter plot for given data.
6. Demonstrate predictive analysis using regression
7. Demonstrate clustering using k-means.

8. Demonstrate classification using KNN, decision tree, Bayesian classifier and random forest.
9. Demonstrate time series analysis using moving average, ARMA and ARIMA techniques.

Note:

Test the R programs using publicly available data sets in the websites. The data can be numeric or text.

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15ECAP902	Advance Java Programming Lab.

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Program: MASTER OF COMPUTER APPLICATIONS

Course Code: **15ECAP902**	Course Title: **Advance Java Programming Lab.**	
L-T-P:**0-0-1**	Credits: **1**	Contact Hrs: **2**
ISA Marks-: **100**	ESA Marks: **00**	Total Marks: **100**
Teaching Hrs: **24**		Exam Duration: **3 Hours**

No	**Content**	**Hrs**
	Unit I	

Expt No.	***Brief description about the experiment***	***Slots***
	DEMONSTRATION	
1	Introduction to Session management in JSP.	1
2	Introduction to Java Beans.	
3	Introduction to RMI.	1
4	Introduction to Struts Action class and Action Form class	1
5	Introduction to Springs.	1
6	Introduction to ORM	1
	EXERCISE	

7	Implementation of session management in JSP application.	1
8	Implementation of Java Bean application	1
9	Implementation of RMI application.	1
10	Implementation of Springs application.	1
11	Implementation of ORM using Hibernate.	1
	STRUCTURED ENQUIRY	
12	Design and Develop Java Web application using Spring and Hibernate framework.	2

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15ECAE901	Internet of Things

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Program: MASTER OF COMPUTER APPLICATIONS		
Course Code: **15ECAE901**	Course Title: **Internet of Things**	
L-T-P:**3-0-1**	Credits: **4**	Contact Hrs: **5**
ISA Marks-Theory: **50** +Lab: **100**	ESA Marks: **50**	Total Marks: **200**
Teaching Hrs: **50+ 24**		Exam Duration: **3 Hours**

No	Content	Hrs
	Unit I	
1	**Chapter No. 1.Introduction to Internet of Things (IoT)** Definition & Characteristics of IoT, Physical Design of IoT: IoT protocols, Logical Design of IoT: IoT functional blocks, communication models and APIs.	**6 Hrs**
2	**Chapter No. 2. IoT Enabling Technologies** Wireless Sensor Networks, Cloud Computing, Big Data Analytics, Communication Protocols, Embedded Systems, IoT Levels and Deployment Templates.	**7 Hrs**
3	**Chapter No. 3. Domain specific IoTs** Home Automation ,Cities, Environment ,Energy, Retail, Logistics, Agriculture, Industry ,Health and Lifestyle	**7 Hrs**
	Unit II	
4	**Chapter No. 4. IoT Platforms Design Methodology** IoT Design Methodology, Case Study on IoT System for Weather Monitoring.	**5 Hrs**
5	**Chapter No. 5. IoT systems – Logical design using Python**	**8 Hrs**

	Introduction to Python, Data types, data structures, Control of flow, functions modules, packages, file handling, data/time operations, classes, Python packages - JSON, XML, HTTPLib, URLLib, SMTPLib.	
6	**Chapter No. 6. IoT Physical Devices and Endpoints** Basic building blocks of an IoT device, Exemplary device: Rasyberry Pi, interface (serial, SPI, I2C), Programming Rasyberry Pi with Python.	**7 Hrs**
	Unit – III	
7	**Chapter No. 7. IoT Physical Servers & Cloud Offerings** Introduction to Cloud Storage models and communication APIs ,Webserver – Web server for IoT, Cloud for IoT, Python web application framework, Designing a RESTful web API	**5 Hrs**
8	**Chapter No. 8. Case Studies Illustrating IoT Design** Home Automation-smart lighting, home intrusion detection, Cities-smart parking.	**5 Hrs**

Text Book:

1. Arshdeep Bahga and Vijay Madisetti, “Internet of Things - A Hands-on Approach”, Universities Press, 2015

References:

1. Matt Richardson & Shawn Wallace, “Getting Started with Raspberry Pi”, O'Reilly (SPD), 2014

IoT Practices

Expt No.	*Brief description about the experiment*	*Slots*
	DEMONSTRATION	
1	Introduction to preparing the OS for Raspberry Pi	1
2	Introduction to Shell basic for Raspberry Pi	
3	Introduction to GPIO Input/output	1
4	Introduction GPIO using Python	1
5	Introduction to Python and SPI	1
	EXERCISE	
6	Creating a Shell scripts for Hook up circuit.	1
7	Implementing PHP and AJAX Calls.	1

8	Working with SPI Protocol.	1
9	Creating Web interface for ADC	1
10	Creating GPIO using Python	1
11	Working with SPI using Python	1
STRUCTURED ENQUIRY		
12	Design and Develop flow control using Raspberry pi kit	2

Evaluation Scheme

1. Assessment

Assessment	Theory	Lab.
ISA- 1	25	100
ISA- 2	25	
ESA	50	00
Total	**100**	**100**

2. End Semester Assessment (ESA) Pattern:

UNIT	8 Questions to be set of 20 Marks each	Chapter Nos.	Instructions
I	3 Questions to be set of 20 Marks Each	1,2	Any 2 questions are to be answered
II	3 Questions to be set of 20 Marks Each	3,4	Any 2 questions are to be answered
III	2 Questions to be set of 20 Marks Each	5	Any 1 question is to be answered

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15ECAE908	E-Commerce

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Program: MASTER OF COMPUTER APPLICATIONS		
Course Code: **15ECAE908**	Course Title: **E-Commerce**	
L-T-P:**3-0-1**	Credits: **4**	Contact Hrs: **5**
ISA Marks-Theory: **50** +Lab: **100**	ESA Marks: **50**	Total Marks: **200**
Teaching Hrs: **50+ 24**		Exam Duration: **3 Hours**

No	Content	Hrs
	Unit I	
1	**Chapter 1:** Electronic Commerce-Frame work, anatomy of E-Commerce applications, E-Commerce Consumer applications, E-Commerce organization applications.	7 Hrs
2	**Chapter 2:** Consumer Oriented Electronic commerce - Mercantile Process models.	6 Hrs
3	**Chapter 3:** Electronic payment systems - Digital Token-Based, Smart Cards, Credit Cards, Risks in Electronic Payment systems. (	7 Hrs
	Unit II	
4	**Chapter 4:** Inter Organizational Commerce - EDI, EDI Implementation, Value added networks.	6 Hrs
5	**Chapter 5:** Intra Organizational Commerce - work Flow, Automation Customization and internal Commerce, Supply chain Management.	7 Hrs
6	**Chapter 6:** Corporate Digital Library - Document Library, digital Document types, corporate Data Warehouses. Advertising and Marketing - Information based marketing, Advertising on Internet, on-line marketing process, market research.	7 Hrs
	Unit – III	
7	**Chapter 7:** Consumer Search and Resource Discovery - Information search and Retrieval,Commerce Catalogues, Information Filtering.	5 Hrs
8	**Chapter 8:** Multimedia - key multimedia concepts, Digital Video and electronic Commerce, Desktop video processings, Desktop video conferencing.	5 Hrs

Text Book:

1. Frontiers of electronic commerce – Kalakota, Whinston, Pearson

References:

1. E-Commerce fundamentals and applications Hendry Chan, Raymond Lee, Tharam Dillon, Ellizabeth Chang, John Wiley.
2. E-Commerce, S.Jaiswal – Galgotia.
3. E-Commerce, Efrain Turbon, Jae Lee, David King, H.Michael Chang.
4. Electronic Commerce – Gary P.Schneider – Thomson.
5. E-Commerce – Business, Technology, Society, Kenneth C.Taudon, Carol Guyerico Traver

E-Commerce and Security Practices

Expt./ Job No.	*Lab assignments/experiment*	*Slots*
Demonstration		
1	Introduction to Secure Web Transaction.	*1*
2	Introduction to Web Server Security.	*1*
3	Introduction to SQL Injection.	*1*
4	Introduction to Cross site Scripting	*1*
5	Introduction to SSL/TLS Configuration in Apache Web Server.	*1*
6	Introduction to Payment Gateway Transaction.	*1*
Exercises		
1	Implementation of Secure Web Transaction.	*1*
2	Implementation of Web Server Security.	*1*
3	Implementation of SQL Injection	*1*
4	Implementation of Cross Site Scripting	*1*
5	Implementation of SSL/TLS Configuration in Apache Web Sever.	*1*
6	Implementation of Payment Gateway for given application	*1*
Structures enquiry		
12	Design and Develop a customized E-Commerce Web Application.	*02*

Evaluation Scheme

1. Assessment

Assessment	Theory	Lab.
ISA- 1	25	100
ISA- 2	25	

ESA	50	00
Total	**100**	**100**

2. End Semester Assessment (ESA) Pattern:

UNIT	8 Questions to be set of 20 Marks Each	Chapter Nos.	Instructions
I	3 Questions to be set of 20 Marks Each	1,2,3	Any 2 questions are to be answered
II	3 Questions to be set of 20 Marks Each	4,5,6	Any 2 questions are to be answered
III	2 Questions to be set of 20 Marks Each	7,8	Any 1 question is to be answered

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18ECAC702	Web Programming

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Program: MASTER OF COMPUTER APPLICATIONS

Course Code:**18ECAC702** Course Title: **Web Programming**

L-T-P:**2-1-0** Credits: **3** Contact Hrs: **4**

ISA Marks:**: 50** ESA Marks: **50** Total Marks: **100**

Teaching Hrs: **42** Exam Duration: **3 Hours**

No	**Content**	**Hrs**
	Unit I	
1	**Chapter 1: Introduction to HTML** HTML Attributes, Styles in Tags, Current and Evolving Standard: HTML5, Headings, Paragraphs, Comments	**4 Hrs**
2	**Chapter 2: Organizing Information with List & Link** Numbered Lists, Customizing Ordered Lists & Unordered Lists, Nesting Lists, Creating Links, Linking Local Pages Using Relative and Absolute Pathnames, Anatomy of a URL, Kinds of URLs, HTTP and Anonymous FTP.	**8 Hrs**
3	**Chapter 3: Formatting Text with HTML** Character-Level Elements, Semantic HTML Tags, Font Properties, Quotations, Special Characters, Character Encoding	**4 Hrs**
	Unit II	
5	**Chapter 4: Structuring a Page with HTML5 Tables & Forms** Cell Padding, Cell and Caption Alignment, Spanning Multiple Rows or Columns, Dynamic Overlays, Controlling Stacking, Creating Drop-Down Menus, Creating Form Controls, Access Keys, Displaying Updates with progress and meter	**6 Hrs**
6	**Chapter 5: Creating CSS with Images**	**10 Hrs**

Creating Page-Level Styles, Contextual Selectors, Classes and IDs, Editing Styles with Developer Tools, The Box Model, Borders, Margins and Padding, Controlling Size and Element Display, Inline Images in HTML, Image Dimensions and Scaling, usemap Attribute, Image Etiquette, Integrating Multimedia: Video and Sound

Unit – III

7 Chapter 6: Using JavaScript and jQuery **5 Hrs**

Overview of JavaScript, Syntactic characteristics, Primitives, operations and expressions, Control statements, Object creation and modification, Arrays, Functions, Constructor, Pattern matching using regular expressions, Errors in scripts, Getting Started with jQuery, Selecting Elements from the Document, Binding Events, Retrieving and Changing Style Sheet Properties, Special Effects.

8 Chapter 7: XML **5 Hrs**

Document structure; Document Type definitions; Namespaces; XML schemas; Displaying raw XML documents; Displaying XML documents with CSS; XSLT style sheets; XML processors; Web services.

Text Book:

1. Laura Lemay, Rafe colburn, jennifer Kyrnin, MASTERING HTML, CSS & Java Script Web Publishing, BPB publications, 2016.
2. Sebesta, R.W., Programming the World Wide Web, 3rd, Pearson education, 2013.

Evaluation Scheme

1. Assessment

Assessment	Theory
ISA- 1	25
ISA- 2	25
ESA	50
Total	**100**

2. End Semester Assessment (ESA) Pattern:

UNIT	8 Questions to be set of 20 Marks each	Chapter Nos.	Instructions
I	3 Questions to be set of 20 Marks Each	1, 2, 3, 4	Any 2 questions are to be answered
II	3 Questions to be set of 20 Marks Each	5,6	Any 2 questions are to be answered
III	2 Questions to be set of 20 Marks Each	7,8	Any 1 question is to be answered

17ECAC804	Python Programming

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Course Code: **17ECAC804** Course Title: **Python Programming**

L-T-P:**3-0-1** Credits: **4** Contact Hrs: **5**

ISA Marks: **50** ESA Marks: **50** Total Marks: **100**

Teaching Hrs: **42 + 24** Exam Duration: **3 Hours**

No	Content	Hrs
	Unit I	
1	**Chapter No. 1: Introduction to python**	**4 Hrs**
	How Programming is Different from Using a Computer, The First Steps; Installing Python 3.1 on Non-Windows Systems 6,Using the Python Shell, Beginning to Use Python — Strings, Putting Strings Together in Different Ways; Joining Strings with the Print() Function. Numbers in Python, Program Files; Using the Different Types ,Basic Math, Some Surprises; Order of Evaluation, Number Formats, Using Numbers, Referring to Data — Using Names for Data; Changing Data Through Names, Copying Data, Built in types ; Tuples — Unchanging Sequences of Data, Lists — Changeable Sequences of Data, Treating a String Like a List, Common Sequence Properties; Referencing the Last Elements, Ranges of Sequences, Growing Lists by Appending Sequences, Using Lists to Temporarily Store Data.	
2	**Chapter No. 2: Making Decisions & Functions**	**6 Hrs**
	Comparing Values, Reversing True and False, Looking for the Results of More Than One Comparison, Handling Errors, Grouping Code under a Name; Choosing a Name, The Same Name in Two Different Places, Checking Your Parameters, Calling Functions from within Other Functions, Flagging an Error on Your Own Terms, Layers of Functions.	
3	**Chapter No. 3: Classes and Objects, Organizing Programs**	**6 Hrs**
	Thinking About Programming; What is an Object?, Defining a Class; How Code Can Be Made into an Object, Objects and Their Scope, Modules and Packages; Importing a Module, Making a Module from Pre-existing Code, Using Modules — Starting with the Command Line, Basics of Testing Your Modules and Packages; Re-importing Modules and Packages..	
	Unit II	
4	**Chapter 4: Files and Directories, Modules , Text Processing**	**10Hrs**
	File Objects; Writing Text Files, Appending Text to a File, Reading Text Files, File Exceptions, Paths and Directories, Exceptions in os; Paths, Directory Contents, Obtaining Information about Files, Renaming, Moving, Copying, and Removing Files, Rotating Files, Creating and Removing Directories, Globbing; Exploring Modules; Importing Modules, Finding Modules, Digging through Modules, Creating Modules and Packages; Finishing Your Modules; Defining Module-Specific Errors, Choosing What to	

Export , Documenting Your Modules, Testing Your Module, Running a Module as a Program; Why Text Processing Is So Useful; Searching for Files, Clipping Logs, Navigating the File System with the os Module, Working with Regular Expressions.

5 **Chapter 5: Accessing Databases** **6 Hrs**

Working with DBM Persistent Dictionaries; Choosing a DBM Module ,Creating Persistent Dictionaries, Accessing Persistent Dictionaries, Working with Relational Databases; Writing SQL Statements, Defining Tables , Setting Up a Database, Using the Python Database APIs; Downloading Modules, Creating Connections, Working with Cursors , Working with Transactions and Committing the Results, Examining Module, Capabilities and Metadata, Handling Errors.

Unit – III

6 **Chapter 6: Testing, GUI with Python** **5 Hrs**

Creating GUI Widgets with Tkinter; Resizing the Widget , Configuring Widget Options, Putting the Widgets to Work , Creating Layouts, Packing Order, Controlling Widget, Appearances, Radio Buttons and Checkboxes , Dialog Boxes, Other Widget Types.

7 **Chapter 7: Network Programming** **5 Hrs**

Understanding Protocols; Comparing Protocols and Programming Languages, The Internet Protocol Stack, A Little Bit About the Internet Protocol, Sending Internet E-mail; The E-mail File Format, MIME Messages, Sending Mail with SMTP and smtplib, Retrieving Internet E-mail; Parsing a Local Mail Spool with mailbox, Fetching Mail from a POP3 Server with poplib, Fetching Mail from an IMAP Server with imaplib, Secure POP3 and IMAP , Webmail Applications Are Not E-mail Applications, Socket Programming; Introduction to Sockets, Binding to an External Hostname, The Mirror Server, The Mirror Client, SocketServer, Multithreaded Servers, The Python Chat Server, Design of the Python Chat Server , The Python Chat Server Protocol, The Python Chat Client, Single-Threaded Multitasking with select.

Textbooks:

1. James Payne, Beginning Python using python 2.6 and Python 3.1,Wiley Publishing Inc, 2010

References:

1. Kent D Lee, Python Programming Fundamentals,2nd Edition, 2014
2. Jennifer Camphell, Paul Gries, Greg Wilson, Practical Programming-An Introduction to Computer science using python, 2011

1. Assessment

Assessment	Theory	Lab.
ISA- 1	25	100
ISA- 2	25	
ESA	50	00
Total	**100**	**100**

2. End Semester Assessment (ESA) Pattern:

UNIT	8 Questions to be set of 20 Marks Each	Chapter Nos.	Instructions
I	3 Questions to be set of 20 Marks Each	1,2,3	Any 2 questions are to be answered
II	3 Questions to be set of 20 Marks Each	4,5	Any 2 questions are to be answered
III	2 Questions to be set of 20 Marks Each	6,7	Any 1 question is to be answered

*** *Course project:*** In this course, group of 2 students will carry out project using Python.

Python Programming

Expt No.	*Brief description about the experiment*	*Number Of Slots*
DEMONSTRATION		
1	To write, test, and debug simple Python programs using Spyder IDE 3.x	1
2	To implement Python programs with conditionals and loops.	1
3	To demonstrate functions for structuring Python programs.	1
4	Represent compound data using Python lists, tuples, and dictionaries.	2
EXERCISE		
5	Write a code to read and write the data to the text files.	*1*
6	Write a code to find the most frequent words in a text read from a file.	*1*

7	Demonstrate the pandas library to perform the different mathematical functions by reading data from excel file.	1
8	Explore the sci-kit learn libraries to implement different algorithms.	1
9	Explore the matplotlib library for the visualization of data.	2
10	Write a code to Simulate bouncing ball using Pygame.	1
	STRUCTURED ENQUIRY	
11	Develop an application to plot the visualization using 3d graph of real time data from excel file and plot it online in cloud using plotly .	2

17ECAC805	Data Mining

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Course Code: **17ECAC805** Course Title: **Data Mining**

L-T-P: **3-0-1** Credits: **4** Contact Hrs: **5**

ISA Marks: **50 + 100** ESA Marks: **50** Total Marks: **200**

Teaching Hrs: **42 + 24** Exam Duration: **3 Hours**

No	Content	Hrs
	Unit I	
1	**Chapter No. 1. Introduction** Fundamentals of data mining, Kinds of pattern, technologies used, and technologies used, applications, issues, data objects and attribute types, Basic Statistical Descriptions of Data, Data Visualization,.	**8 Hrs**

2 Chapter No. 2. Data Preprocessing **5 Hrs**
Need of preprocessing the Data, Data Cleaning, Data Integration and Transformation, Data Reduction, Discretization.

3 Chapter No. 3. . Data Warehousing and Online Analytical Processing **7 Hrs**
Data Warehouse: Basic Concepts, Data Warehouse Modeling: Data Cube and OLAP, Data Warehouse Design and Usage, Data Warehouse Implementation, Data Generalization by Attribute-Oriented Induction.

Unit II

4 Chapter No. 4. Mining Frequent Patterns, Associations, and Correlations **6 Hrs**
Basic Concepts, Frequent Itemset Mining Methods, Which Patterns Are Interesting?: Pattern Evaluation Methods, Pattern Mining in Multilevel, Multidimensional Space, Constraint-Based Frequent Pattern Mining.

5 Chapter No. 5. . Classification **7 Hrs**
Basic Concepts, Decision Tree Induction, Bayes Classification Methods, Rule-Based Classification, Model Evaluation and Selection, Techniques to Improve Classification Accuracy, Bayesian Belief Networks, Classification by Backpropagation.

6 Chapter No. 6. Graph Mining, Social Network Analysis, and Multi-relational Data Mining **7 Hrs**
Methods for Mining Frequent Sub graphs, Mining Variant and Constrained Substructure Patterns, Characteristics of Social Networks, Mining on Social Networks, Multirelational mining, Multirelational Classification, Multirelational Clustering with User Guidance..

Unit – III

7 Chapter No. 7. . Cluster Analysis **5 Hrs**

Cluster Analysis, Partitioning Methods, Hierarchical Methods, Density-Based Methods, Grid-Based Methods, Evaluation of Clustering..

8 Chapter No. 8. Mining Complex Types of Data **5 Hrs**
Multidimensional Analysis and Descriptive Mining of Complex, Data Objects, Mining Spatial Databases, Mining Multimedia Databases, Mining Time Series and Sequence Data, Mining Text Databases, Mining the World Wide Web.

Text Book:

1. J. Han, M. Kamber., Data Mining Concepts and Techniques, 3rd edition, Kaufamann publishers, 2011.

References

1. Pujari, A.K, Datamining Techniques, 1, Universities Press, 2010

Evaluation Scheme

In Semester Assessment (ISA)

Assessment	Marks

ISA 1	20
ISA 2	20
Seminar by individual student*	05
Course Project Activity**	05
Total	**50**

* **Seminar** topic should be on application of DM in various domains such as health, insurance, sports, social networks, education, politics, business and so on.

****Course Project Activity:*** Group of 2 students need to demonstrate the DM tool/s for the extraction of various knowledge from real life data.

End Semester Assessment (ESA)

UNIT	8 Questions to be set of 20 Marks Each	Chapter Nos.	Instructions
I	3 Questions to be set of 20 Marks Each	1, 2, 3	Any 2 questions are to be answered
II	3 Questions to be set of 20 Marks Each	4, 5, 6	Any 2 questions are to be answered
III	2 Questions to be set of 20 Marks Each	7, 8	Any 1 question is to be answered

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Data Mining		
List of Practices		
S. No	Assignment	
1	Demonstration of preprocessing on given dataset	Using DM tools such as Weka Rapid Miner Orange KNIME Tableau Excel Google Analytics
2	Demonstration of mining Discrimination between different Classes in given dataset	
3	Demonstration of Association rule process on given dataset using Apriori algorithm	
4	Demonstration of classification rule process on given dataset using Decision tree algorithm	
5	Demonstration of classification rule process on dataset using naïve Bayes algorithm	
6	Demonstration of prediction on given dataset using regression techniques	
7	Demonstration of data visualization on given dataset	
8	Demonstration of quartiles using FIVE number summary on given dataset	
9	Demonstration of Graph displays of statistical class description on given dataset using: 1. Histogram 2. A quantile plot 3. A quantile-quantile plot 4. A scatter plot	

	5. A loess curv	
10	Demonstration of web mining for given portal.	

17ECAC806	Programming in C# with .NET

Course Code: **17ECAC806** Course Title: **Programming in C# with .NET**

L-T-P:**2-1-0** Credits: **3** Contact Hrs: **4**

ISA Marks Theory: **50** ESA Marks: **50** Total Marks: **100**

Teaching Hrs: **42** Exam Duration: **3 Hours**

No	Content	Hrs
	Unit I	
1	**Chapter No. 1.The Philosophy of .NET** Understanding the Previous State of Affairs, The .NET Solution, Introducing the Building Blocks of the .NET Platform (CLR,CTS, and CLS), The Role of the .NET Base Class Libraries, What C# Brings to the Table, An Overview of .NET Assemblies, The Role of the Common Intermediate Language , The Role of .NET Type Metadata, The Role of the Assembly Manifest, Compiling CIL to Platform –Specific Instructions, Understanding the Common Type System, Intrinsic CTS Data Types, Understanding the Common Languages Specification, Understanding the Common Language Runtime, The Assembly/Namespace/Type Distinction, Using ildasm.exe, Deploying the .NET Runtime, The Platform independent nature of .NET, Installing the .NET Framework, C# Command-Line Compiler, Building C# Applications using csc.exe, Working with csc.exe Response Files.	**6 Hrs**
2	**Chapter No. 2.C# Language Fundamentals.** The Anatomy of a Simple C# Class, An Interesting Aside : The System.Environment Class, Defining Classes and Creating objects, The System.Console Class, Establishing Member Visibility, Default Values of Class Member Variables, Member Variable Initialization Syntax, Defining Constant Data, Defining Read-only fields, Understanding the static keyword, Method Parameter Modifiers, Iteration Constructs, Decision Constructs and the Relational/Equality Operators, Understanding Value Types and Reference Types, Understanding Boxing and Unboxing Operations, Working with .NET Enumerations, The Master Class: System.Object, Overridding some default behaviours of System.Object, The System Data types(and C# Shorthand notation), The System.String data types, The role of System.Text.StringBuilder, .NET Array Types, Understanding C# Nullable Types, Defining Custom Namespaces	**5 Hrs**
3	**Chapter No. 3. Object-Oriented Programming with C#** Understanding the C# Class Type, Reviewing the Pillars of OOP, The First Pillar: C#'s Encapsulation Services, The Second Pillar: C#'s Inheritance Support, Programming for Containment/Delegation, The Third Pillar: C #'s Polymorphic Support, C# Casting rules, Understanding C# Partial types, Documenting C# Source Code via XML	**5 Hrs**
	Unit II	

4	**Chapter No. 4.Object Lifetime and Exceptions Handling.** Classes, Objects and References, the basics of Object Lifetime, The role of Application Roots, Understanding Object Generations, System.GC type, Building Finalizable Objects, Building Disposable Objects, Building Finalizable and Disposable types. Ode to Errors, Bugs, and Exceptions, The Role of .NET Exception Handing, The Simplest possible example, Configuring the state of an exception, System – Level Exception (System. System Exception), Application-Level Exception (System.ApplicationException), Processing Multiple Exception, The Finally Block, The result of unhandled exceptions, Debugging Unhandled exceptions using VS. NET .	**6 hrs**
5	**Chapter No. 5.Interfaces and Collections** Defining Interfaces in C#, Implementing an Interface in C#, Contrasting Interfaces to Abstract Base Classes, Invoking Interface Members at the Object Level, Interfaces As Parameters, Interfaces As Return Values, Arrays of Interfaces Types, Understanding Explicit Interface Implementation, Building Interface Hierarchies, Implementing Interfaces Using Visual Studio 2005, Building Enumerable Types(IEnumerable and IEnumerator), Building Cloneable Objects(IConeable), Building Comparable Objects(IComparable), The Interfaces of the System.Collections Namespace, The Class Types of System.Collections.	**5 Hrs**
6	**Chapter No. 6.Callback Interfaces, Delegates, and Events, Advanced C# Techniques** Understanding Callback Interfaces, Understanding the .NET Delegate type, Defining a Delegate in C#, The System.multicastDelegate and System.Delegate Base Classes, Investigating a Delegate Object, Delegates as Parameters, Understanding C# Events Building a Custom Indexer, Internal Representations of Type Indexers: Final Details, Understanding Operator Overloading Binary Operators, Unary Operators, Equality Operators, Comparison Operators, Understanding Custom Type Conversions, The Advanced Key words of C#, C# Preprocessor Directives.	**5 Hrs**
	Unit – III	
7	**Chapter No. 7.Programming with Windows Forms.** Controls - Labels, Text boxes, Masked Text boxes, Buttons, Check boxes, Radio Buttons, Group Boxes, Checked List Boxes, List Boxes, Combo Boxes, Configuring the Tab Order, Setting the Form's Default Input Button, Working with more Exotic Controls – Month Calendars, Tool Tips, Tab Controls, Track Bars, Panels, Up Down Controls, Error Providers, Tree Views, Web Browsers, Building Custom Windows Forms Controls – Creating Images, Building Design-Time UI, Defining Custom Events, Defining Custom Properties.	**5 hrs**
8	**Chapter No. 8.Database Access with MSSQL Server** Overview of Data Access, Creating database connections, connecting to MSSQL Server, Dataset and Data table features, using inline SQL Statements, using stored procedures , Executing select commands, SQL transaction	**5 hrs**

Text Book:

1. Andrew Troelsen: Pro C# with .NET 3.0, Special Edition, Dream tech Press, India, 2007.Chapters: 1 to 11 (up to pp.389, except Chapter 10)

Evaluation Scheme

Assessment

Assessment	Theory
ISA- 1	25
ISA- 2	25
ESA	50
Total	**100**

End Semester Assessment (ESA) Pattern:

UNIT	8 Questions to be set of 20 Marks each	Chapter Nos.	Instructions
I	3 Questions to be set of 20 Marks Each	1, 2, 3	Any 2 questions are to be answered
II	3 Questions to be set of 20 Marks Each	4,5,6	Any 2 questions are to be answered
III	2 Questions to be set of 20 Marks Each	7,8	Any 1 question is to be answered

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17ECAP803	Mini Project-3

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Course Code: **17ECAP803** Course Title: **Mini Project-3**
L-T-P: **0-0-2** Credits: **2** Contact Hrs: **4**
ISA Marks: **100** ESA Marks: **100** Total Marks: **200**
Teaching Hrs: **72 approx.** Exam Duration: **3 Hours**

Theme: “Mini project Using Java”

Java is one of the fundamental programming languages that can be used in many applications as well as product developments. The simple reason for this is because Java can be put to use in various platforms due to its multi-platform nature. Java is one of the favorite choices for developers for many reasons like security, object oriented(reusability), cross platform computing, multithreaded capability, Rich API, Powerful development tools ,availability of various frameworks, Great collection of open source libraries, wonderful community support, Excellent documentation support. Support for various databases and many more.

Students can use the following tools in web and mobile applications as well as product developments:

- Struts, Spring, Hibernate and JPA
- JAXB and Apache Axis 2/Java
- JSP, Servlets, JDBC, EJB, JMS, JTA and JUnit
- Apache Tomcat, JBoss and GlassFish
- JavaScript, JSF, GWT and jQuery
- Eclipse, Netbeans and JBoss tools
- TestNG

 jBPM and Drools
 JCR

Objectives:
Help students to utilize and strengthen the knowledge of java which they have learnt in previous semester.

Methodology:

Students are asked to make a team of 3-4 members and can choose the different categories of projects like desktop applications, web applications, mobile application and distributed application and work once it is approved by the coordinator.

Assessment:
Students Assessment through CIE (80%) + SEE (20%)

Continuous Internal Evaluation	**Assessment**	**Marks**
	Problem Definition, Literature Review	10
	Synopsis and SRS Deliverables	10
	Design (Module wise algorithmic design)	20
	Coding	10
	Integration and testing	10
	Report	10
	Presentation skills and Viva-voce	10
	Total	**80**
Semester End Examination	Presentation	10
	Viva-voce	10
	Total	100

1.1 Course Objectives:

The Mini Project being part of the course work is not only a mechanism to demonstrate the abilities and specialization but also provides the opportunity to demonstrate originality, teamwork, inspiration, planning and organization in a software project. One can put into practice the techniques that have been taught throughout the previous courses. Mini-projects develop practical skills in students. The idea is to propose a problem that one might encounter in future career (be it in academia, industry, or government). Then propose a solution and implement it.

Theme: Java Based E-Commerce Applications with Multilingual Support

E-commerce Objectives:

Most business houses are shifting their operations to the online world. Right from buying apparels to computers to booking tickets and renting out apartments, everything can be done through the Internet now. It is a win-win formula for both the customers and the business houses. Digital India aims to boost E-business and the E-commerce industry with the vision that it would in turn boost the economy is a whole.

Multilingual Objectives:

Language is an essential driver of enterprise growth. The user interface is the key component of any application that needs to support various language speaking audiences. Making an app that appeals to and is available for more users broadens the market and brings more revenue in the app sales and there will be more exposure to the business.

***Evaluation*:**

- The project assessment is done by an evaluation team as per the schedule.

Guidelines for In Semester Assessment (ISA) Scheme

Phase wise distribution of marks	Marks
Identification and defining the problem	15
Software Requirement Specification	20
Software Design	15
Mid–way Implementation	10
Final Demo and Report Submission	20
Total	80

End Semester Assessment (ESA):

There will be a final presentation /demonstration//viva-voce at the end of the semester for 20 Marks

17ECAE802	Linux Administration

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Course Code: **17ECAE802** Course Title: **Linux Administration**

L-T-P:**3-0-1** Credits: **4** Contact Hrs: **5**

ISA Marks-Theory: **50** +Lab: **100** ESA Marks: **50** Total Marks: **200**

Teaching Hrs: **42+24** Exam Duration: **3 Hours**

No	Content	Hrs
	Unit I	

1	**Chapter 1. Basic System Configuration** Opening Graphical Applications, System Locale and Keyboard Configuration: Setting the System Locale, Changing the Keyboard Layout**,** Managing Users and Groups; Introduction to Users and Groups, Managing Users in a Graphical Environment..	**6 Hrs**
2	**Chapter 2. Package Management, Services and Daemons** Yum: Checking For and Updating Packages, Packages and Package Groups, Configuring Yum and Yum Repositories. Configuring Services, Running Services OpenSSH: The SSH Protocol, An Open SSH Configuration, Open SSH Clients	**6 Hrs**
3	**Chapter 3. Web & Mail Servers :** **Web Servers: The Apache HTTP Server** Updating the Configuration, Running the httpd Service, Editing the Configuration Files, Working with Modules , Setting Up Virtual Hosts, Setting Up an SSL Server. **Mail Servers**- Email Protocols, Email Program Classifications, Mail Transport Agents, Mail Delivery Agents, Mail User Agents	**8 Hrs**
	Unit II	
4	**Chapter 4. File & Directory Servers :** **FTP Servers :** The File Transfer Protocol, FTP Servers, Files Installed with **vsftpd,** Starting and Stopping **vsftpd,vsftpd** Configuration Options.Runing FTP Server **Samba Server :** Introduction to Samba, Samba Daemons and Related Services, Connecting to a Samba Share, Configuring a Samba Server ,Starting and Stopping Samba, Samba Server Types and the smbconf File, Samba Security Modes, Samba Account Information Databases, Samba Network Browsing , Samba with CUPS Printing Support, Samba Distribution Programs **Directory Servers -**OpenLDAP, Introduction to LDAP, Installing the OpenLDAP Suite , Configuring an OpenLDAP Server , SELinux Policy for Applications Using LDAP, Running an OpenLDAP Server, Configuring a System to Authenticate Using OpenLDAP	**10 Hrs**
5	**Chapter 5 Viewing and Managing Log Files -** Locating Log Files, Basic Configuration of Rsyslog, Working with Queues in Rsyslog , Using Rsyslog Modules , Interaction of Rsyslog and Journal, Structured Logging with Rsyslog , Debugging Rsyslog, Using the Journal, Managing Log Files in a Graphical Environment.	**5 Hrs**
	Unit – III	
6	**Chapter. 6. Working with the GRUB 2 Boot Loader** Configuring the GRUB 2 Boot Loader, Customizing GRUB Menu, GRUB 2 Password Protection, Reinstalling GRUB , GRUB 2 over Serial Console, Terminal Menu Editing During Boot, UEFI Secure Boot	**5 Hrs**

8	**Chapter 7. Automating System Tasks** -Cron and Anacron- Installing Cron and Anacron, Running the Crond Services, Configuring Anacron Jobs, Configuring Cron Jobs, Controlling Access to Cron,Black and White Listing of Cron Jobs At and Batch-Installing At and Batch,Running the At Service, Configuring an At Job, Configuring a Batch Job, Viewing Pending Jobs, Additional Command Line Options, Controlling Access to At and Batch.	**5 Hrs**

Textbook:

4. Fedora 21 System Administrator's Guide Deployment, Configuration, and Administration of Fedora 21 Edition 1.0, Author Jaromír Hradílek jhradilek@redhat.com, Douglas Silas silas@redhat.com , Martin Prpič mprpic@redhat.com etc.

References:

1. Kemp, Juliet, Spinger, “Linux System Administration”
2. Anita Sengar “IT Infrastructure Management” 2012 Edition, publisher: S K Kataria and Sons
3. Sjaak Laan “Infrastructure Architecture - Infrastructure Building Blocks and Concepts Second Edition, Kindle Edition, Lulu Press Inc; Second Edition

Linux Administration Practices

COURSE DESCRIPTION:

IT infrastructure consists of a set of physical devices and software applications that are required to operate the entire enterprise. IT infrastructure is also consists both human and technical capabilities. These services include the following- Computing platforms used to provide computing services, that connect employees, customers, and suppliers into a coherent digital environment, including servers ,Data management services that store and manage corporate data and provide capabilities for analyzing the data and Application software services that provide enterprise-wide capabilities such as enterprise resource planning, customer relationship management, supply chain management, and knowledge management systems that are shared by all business units. It allows an organization to deliver IT solutions and services to its employees, partners and/or customers and is usually internal to an organization and deployed within owned facilities.

OBJECTIVES

- Acquire comprehensive knowledge, technical expertise and hands-on experience in IT Infrastructure Management
- To learn all aspects of IMS such as Networking, Operating Systems, Virtualizations and Data Center technologies.

LAB REQUIREMENTS:

- A modern web-browser with HTML5 and JavaScript enabled.
- Remote Desktop Client connection software.
- Internet connectivity Microsoft Account (LiveID).

LIST OF EXERCISES

Expt./ Job No.	Lab assignments/experiment	Implementation	Number of Slots
8.	Web Server	Apache Web Server, IIS Server: Install and Configure the Apache Web Server on Linux and IIS server on windows.	01
9.	Samba Server	Implementation of Windows files and print services for Linux allowing the sharing of files and printers between Windows and Linux.	01
10.	LDAP Server	LDAP Server: Lightweight Directory Access Protocol- Server Installation to access a directory service.	01
11.	Mail Server	Mail Server configuration- POP3 Server, IMAP Server	01
12.	Proxy Server	Develop a small web proxy server, which is able to cache web pages. It is a very simple proxy server which only understands simple GET-requests, but is able to handle all kinds of objects - not just HTML pages, but also images.	01
13.	Firewalls and NAT (Network Address Translation)	Use of iptables to build a permissive firewall by selectively filtering packets based on protocol type. To demonstrate how addresses may be translated from private addresses to public and vice versa as they pass in and out of the firewall.	01
14.	Cloud Infrastructure: Azure Hands-on Lab (HOL) Build your Infrastructure in the Cloud using Windows Azure Infrastructure Services -	6. Login to the Windows Azure Management Portal, Define a new Windows Azure Affinity Group and Create a new Windows Azure Storage Account. 7. Register a DNS Server in Windows Azure. 8. Define a Virtual Network in Windows Azure. 9. Configure Windows Server Active Directory in a Windows Azure VM. 10. Configure New Machine for File Services in a Windows Azure VM.	01

References:

12. https://amizone.net/AdminAmizone/WebForms/Academics/NewSyllabus/194201472058683.pdf
13. http://itproguru.com/azurehol/#sthash.HMydlzVA.dpuf

14. https://simms-teach.com/docs/cis192/cis192lab08.pdf
15. https://simms-teach.com/resources.php
16. http://www.cs.rpi.edu/~kotfid/security1/PDF2/NS1_lab_6_1_4_en.pdf
17. http://www.cse.unsw.edu.au/~cs3331/12s1/Labs/
18. https://www.6diss.org/workshops/ca/dns-practical.pdf
19. http://www.dwaynewhitten.com/info306/pages/lab.html
20. http://www.bo.ingv.it/~scacciag/home_files/teach/netadminguide.pdf
21. https://techpolymath.com/2015/02/16/how-to-setup-a-dns-server-for-a-home-lab-on-ubuntu-14-04/
22. http://www.dwaynewhitten.com/info306/lab2.pdf

Evaluation Scheme

Assessment

Assessment	Theory	Lab.
ISA- 1	25	100
ISA- 2	25	
ESA	50	00
Total	**100**	**100**

End Semester Assessment (ESA) Pattern:

UNIT	8 Questions to be set of 20 Marks Each	Chapter Nos.	Instructions
I	3 Questions to be set of 20 Marks Each	1, 2, 3, 4	Any 2 questions are to be answered
II	3 Questions to be set of 20 Marks Each	5, 6	Any 2 questions are to be answered
III	2 Questions to be set of 20 Marks Each	7, 8	Any 1 question is to be answered

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(01FM16MCAXXX)	
16ECAC901	Big Data Analytics

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Program: MASTER OF COMPUTER APPLICATIONS

Course Code: 16ECAC901 Course Title: **Big Data Analytics**

L-T-P:**2-1-0** Credits: **3** Contact Hrs: **4**

ISA Marks-Theory: **50** ESA Marks: **50** Total Marks: **100**

Teaching Hrs: **42** Exam Duration: **3 Hours**

No **Content** **Hrs**

Unit I

1 **Chapter 1: Types of digital data and concept of big data** **4 Hrs**

Classification of digital data: Unstructured, Semi-structured, and Structured; Characteristics of data, Evolution of big data, and definition of big data: 5 Vs, challenges with big data, typical data warehouse environment: Hadoop Environment.

2 **Chapter 2: Big Data Analytics** **8 Hrs**

What is big data analytics? What big data analytics is not? Classification of analytics, Top challenges facing big data, Importance of big data analytics, Need of technology to meet big data challenges, Data science: business acumen skills, technology expertise, mathematics expertise, Data scientist, terminologies used in big data environments, BASE, top analytics tools.

3 **Chapter 3: Big data technology landscape** **4 Hrs**

Not Only SQL (NOSQL): Types of NoSQL, Advantages of NoSQL, Use of NoSQL in industry, NewSQL, Hadoop: features, key advantages, versions, overview of Hadoop ecosystem, Hadoop distributions, Hadoop versus SQL, Cloud-based Hadoop solutions.

Unit II

4 **Chapter 4: Hadoop distributed file system** **8 Hrs**

Introduction, Why Hadoop, RDBMS versus Hadoop, distributed computing challenges: hardware failure, how to process gigantic store of data, history of Hadoop, Hadoop overview, use case of Hadoop, Hadoop distributors, Hadoop Distributed File System (HDFS): Name node, Data node, secondary Name node, anatomy of file read, anatomy of file write; replica placement, processing of data with Hadoop, Managing resources an applications with Hadoop, Interacting with Hadoop ecosystem.

5 **Chapter 5: MongoDB and query language** **4 Hrs**

Introduction, Why MongoDB, Terms used in RDBMS and MongoDB, data types in MongoDB, MongoDB query language: basic functions, Arrays, aggregate functions, MapReduce function, Java script programming, Cursors in MongoDB, MongoImport and MongoExport..

6 **Chapter 6: Cassandra and MapReduce programming** **4 Hrs**

Introduction, Apache Cassandra, features of Cassandra, data types, CQLSH, Keyspaces, CRUD operations, Introduction to MapReduce, Mapper, Reducer, Combiner, partitioner, searching, Sorting, and compression..

Unit – III

7 **Chapter 7: Hive and query language** **5 Hrs**

Introduction, What is Hive, History of Hive and recent releases of Hive, Hive integration and work flow, Hive data units; Hive architecture, Hive data types, Hive file format, Hive Query Language (HQL): DDL, DML, Hive shell, database, tables, Partitions, Bucketing, Views, Sub-query: RCFile implementation, SERDE, User defined function.

8 Chapter 8: PIG **5 Hrs**

Introduction, What is PIG, Key features of PIG; The anatomy of PIG, PIG philosophy, use case for PIG: ETL processing, PIG Latin overview, Data types in PIG, Running PIG, execution modes of PIG, HDFS commands, relational operators, eval function, complex data types, piggy bank, user defined function.

Text Book

1. Seema Acharya, Subhashini Chellapan, Big Data and Analytics, First edition, 2015, Wiley publications.

References

1. EMC Education Services, Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data, Wiley Publications.
2. Frank J Ohlhorst, Big Data Analytics: Turning Big Data into Big Money‖, Wiley and SAS Business Series, 2012.
3. Colleen Mccue, Data Mining and Predictive Analysis: Intelligence Gathering and Crime Analysis‖, Elsevier, 2007.
4. Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer, 2007.
5. Bill Franks, Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics‖, Wiley and SAS Business Series, 2012.
6. Paul Zikopoulos, Chris Eaton, Paul Zikopoulos, Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data‖, McGraw Hill, 2011.
7. Jiawei Han, Micheline Kamber, Data Mining Concepts and Techniques‖, Second Edition, Elsevier, Reprinted 2008.

Evaluation Scheme

1. Assessment

Assessment	Theory	Lab.
ISA- 1	25	100
ISA- 2	25	
ESA	50	00
Total	**100**	**100**

2. End Semester Assessment (ESA) Pattern:

UNIT	8 Questions to be set of 20 Marks Each	Chapter Nos.	Instructions
I	3 Questions to be set of 20 Marks Each	1,2	Any 2 questions are to be answered
II	3 Questions to be set of 20 Marks Each	3,4	Any 2 questions are to be answered
III	2 Questions to be set of 20 Marks Each	5,6	Any 1 question is to be answered

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16ECAC902	Advanced Java Programming

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Program: MASTER OF COMPUTER APPLICATIONS

Course Code: 16ECAC902 Course Title: **Advanced Java Programming**

L-T-P: **2-1-0** Credits: **3** Contact Hrs: **4**

ISA Marks-Theory: **50** ESA Marks: **50** Total Marks: **100**

Teaching Hrs: **42** Exam Duration: **3 Hours**

No	Content	Hrs
	Unit I	
1	**Chapter 1: Java Server Pages** JSP Technologies, Understanding the Client-Server Model, Understanding Web server software, Configuring the JSP Server, Handling JSP Errors, JSP Translation Time Errors, JSP Request Time Errors o Creating a JSP Error Page.	9 Hrs
2	**Chapter 2: Session Management** HTTP as a stateless protocol, Hidden form fields, Cookies, session tracking Http Session, Exception handling and error pages, Directives	3 Hrs
3	**Chapter 3: Java Beans** Concepts of Java Beans, Developing Java Beans, Controls and Properties of a Bean, Types of Properties.	5 Hrs
	Unit II	
4	**Chapter 4: Struts** Introduction to the Apache Struts o MVC Architecture o Struts Architecture, How Struts Works? ,Introduction to the Struts Controller o Introduction to the Struts Action Class ,Using Struts Action From Class Using Struts HTML Tags Introduction to Struts Validator Framework ,Client Side Address Validation in Struts o Custom Validators Example, Developing Application with Struts Tiles	7 Hrs
5	**Chapter 5: Spring Framework** Introduction to spring 3.0, steps to use spring framework in applications, understanding IOC and Dependency Injection, Understanding the bean life-cycle, annotation based dependency injection.	7 Hrs
6	**Chapter 6: Hibernate** Introduction to Hibernate 3.0 ,Hibernate Architecture ,First Hibernate Application	3 Hrs
	Unit – III	
7	**Chapter 7: RMI** RMI Architecture, Designing RMI application, Executing RMI application.	4 Hrs
8	**Chapter 8: Maven (Project Management Tool)**	4 Hrs

What is Maven, Ant Vs Maven, Install Maven ,Maven Repository(Local, Central ,Remote) , Maven pom.xml, Maven web App, Maven plugin

Text Book:

1. Java Server Programming Java EE7 (J2EE 1.7), Black Book Kindle Edition 2014
2. Spring in action 4th edition by Carig walls

References:

1. www.Javatpoint.com
2. www.tutorialspoint.com

Evaluation Scheme

1. Assessment

Assessment	Theory
ISA- 1	25
ISA- 2	25
ESA	50
Total	**100**

2. End Semester Assessment (ESA) Pattern:

UNIT	8 Questions to be set of 20 Marks each	Chapter Nos.	Instructions
I	3 Questions to be set of 20 Marks Each	1,2,3	Any 2 questions are to be answered
II	3 Questions to be set of 20 Marks Each	4,5,6	Any 2 questions are to be answered
III	2 Questions to be set of 20 Marks Each	7.8	Any 1 question is to be answered

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16ECAC903	Mobile Application Development

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Program: MASTER OF COMPUTER APPLICATIONS

Course Code: 16ECAC903 Course Title: **Mobile Application Development**

L-T-P:**3-0-1** Credits: **4** Contact Hrs: **5**

ISA Marks-Theory: **50** +Lab: **100** ESA Marks: **50** Total Marks: **200**

Teaching Hrs: **42 + 24** Exam Duration: **3 Hours**

No	Content	Hrs
	Unit I	

1	**Chapter No. 1- Mobility and Android** Introduction, Mobility Panorama, Mobile Platforms, App Development Approaches, Android Overview.	**2 Hrs**
2	**Chapter No. 2- Getting Started with Android** Introduction, Setting up Development Environment, Saying Hello to Android, Traversing an Android App, Project Structure, Logical Components of an Android App, Android Tool Repository, Installing and Running App Devices.	**2 Hrs**
3	**Chapter No. 3- Learning with an Application** Introduction, 3CheersCable App, Mobile App Development, Challenges, Tenets of a Winning App.	**3 Hrs**
4	**Chapter No. 4- App User Interface** Introduction, Activity, UI Resources, UI Elements and Events, Interaction among Activities, Fragments, Action Bar and Applications.	**5 Hrs**
5	**Chapter No. 5- App Functionality - Beyond UI** Introduction, Threads, AsyncTask, Service, Notifications, Intents and Intent Resolution, Broadcast Receivers, Telephony and SMS- Their Application.	**4 Hrs**
	Unit II	
6	**Chapter No. 6. App Data - Persistence and Access** Introduction, Flat Files, Shared Preferences, Relational Data, Data Sharing Across Apps, Enterprise Data.	**4 Hrs**
7	**Chapter No. 7. Graphics and Animation** Introduction, Android Graphics, Android Animation.	**4 Hrs**
8	**Chapter No. 8. Multimedia** Introduction, Audio, Video and Images, Playback, Capture and Storage.	**4 Hrs**
9	**Chapter No. 9. Location Services and Maps** Introduction, Google Play Services, Location Services, Maps	**4 Hrs**
	Unit – III	
10	**Chapter No. 10. Sensors** Introduction, Sensors in Android, Android Sensor Framework, Motion Sensors, Position Sensors, Environment Sensors.	**4 Hrs**
11	**Chapter No. 11. Testing Android Apps** Introduction, Testing Android App Components, App Testing Landscape Overview Publishing Apps: Introduction, Groundwork, Configuring, Packaging, Distributing.	**4 Hrs**
12	**Chapter No. 12. Publishing Apps** Introduction, Groundwork, Configuring, Packaging, Distributing.	**2 Hrs**

Text Book:

1. AnubhavPradhan, Anil V Deshpande, Composing Mobile Apps using Android, 2010, Wiley, 2010

References:

1. Barry Burd, Android Application Development All in one for Dummies.
2. Ian F Darwin, Android Cookbook.
3. Frank Ableson, RobiSen, Chris King, C. Enrique Ortiz, Android in Action, Manning

Publications.

Mobile Application Development Course Project

Objective:

This is the course Project for the Mobile App Development. The students will be divided into project teams, and each team will develop a marketable mobile app. ideally, each project team will have 2 or 3 students with a maximum of 4. The goals are to expose students to the process of developing a new mobile app from start to finish and to provide an experience very similar to what a developer would have at any company where they work to produce an app that not only works but is also something that meets the needs of their clients.

Concepts:

Mobile app development, project management, and quality assurance.

Required Textbooks

AnubhavPradhan, Anil V Deshpande, Composing Mobile Apps using Android, 2010 wiley, 2010.

Chapters	Topic	Course Project	Slots
Ch-01: Mobility and Android. Ch-02: Getting Started with Android. Ch-03: Learning with an Application.	Mobility Panorama, App Development Approaches, Setting Development Environment, Installing and Running App Devices, Mobile App Development Challenges.	Development of logical Architecture for given Mobile Application.	2
Ch-04: App User Interface. Ch-05: App Functionality.	Activity, UI Resources, UI Elements and Events, Threads, AsyncTask, Notification, Broadcast Receivers	Building User Interface for given Application.	2

Ch-06: App Data – Persistence and Access.	Flat Files, Shared Preferences, Relational Data, Data Sharing Across Apps.	Exchanging a Data with in Enterprise Application.	2
Ch-07: Graphics and Animation.	Android Graphics, Android Animation.	Adding Animation and Graphics into Application.	2
Ch-11: Testing Android Apps.	Testing Android App Components, App testing Landscape Overview.	Testing an App.	2
Ch-12: Publishing Apps.	Groundwork, Configuring, Packaging, Distribution.	Deploying an App.	2

Evaluation Scheme

1. Assessment

Assessment	Theory	Lab.
ISA- 1	25	100
ISA- 2	25	
ESA	50	00
Total	**100**	**100**

2. End Semester Assessment (ESA) Pattern:

UNIT	8 Questions to be set of 20 Marks Each	Chapter Nos.	Instructions
I	3 Questions to be set of 20 Marks Each	1,2,3,4,5	Any 2 questions are to be answered
II	3 Questions to be set of 20 Marks Each	6,7,8,9	Any 2 questions are to be answered
III	2 Questions to be set of 20 Marks Each	10,11,12	Any 1 question is to be answered

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16ECAE906	Machine Learning

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Program: MASTER OF COMPUTER APPLICATIONS

Course Code: **16ECAE906** Course Title: **Machine Learning**

L-T-P:**3-0-1** Credits: **4** Contact Hrs: **5**

ISA Marks-Theory: **50** +Lab: **100** ESA Marks: **50** Total Marks: **200**

Teaching Hrs: **42 + 24** Exam Duration: **3 Hours**

No	Content	Hrs

Unit I

1 **Chapter 1. Introduction** **4 Hrs**

Introduction: Statistical Decision Theory - Regression, Classification, Bias Variance:

2 **Chapter 2. Linear Regression and Linear Classification** **6 Hrs**

Linear Classification, Logistic Regression, Linear Discriminant Analysis; Perceptron; Linear Regression, Multivariate Regression, Subset Selection, Shrinkage Methods, Principal Component Regression, Partial Least squares.

3 **Chapter 3. Support Vector Machines and Artificial Neural Networks** **6 Hrs**

Support Vector Machines, Neural Networks - Introduction, Early Models, Perceptron Learning, Backpropagation, Initialization, Training & Validation.

Unit II

4 **Chapter 4. Bayesian Learning and Decision Trees** **6 Hrs**

Parameter Estimation - MLE, MAP, Bayesian Estimation
Decision Trees, Regression Trees, Stopping Criterion & Pruning
Loss functions, Categorical Attributes, Multiway Splits, Missing Values
Decision Trees - Instability.

5 **Chapter 5. Evaluation Measures and Hypothesis Testing** **4 Hrs**

Evaluation Measures, Bootstrapping & Cross Validation, Class Evaluation Measures, ROC curve, MDL

6 **Chapter 6. Ensemble Methods and Clustering** **6 Hrs**

Ensemble Methods - Bagging, Committee Machines and Stacking, Boosting, Gradient Boosting, Random Forests, Multi-class Classification, Naive Bayes, Bayesian Networks; Partitional Clustering, Hierarchical Clustering, Birch Algorithm, CURE Algorithm, Density-based Clustering.

Unit – III

7 **Chapter 7. Graphical Models and Expectation Maximization** **5 Hrs**

Undirected Graphical Models, HMM, Variable Elimination, Belief Propagation; Gaussian Mixture Models, Expectation Maximization.

8 **Chapter8. Learning Theory and Reinforcement Learning** **5 Hrs**

Learning Theory, Introduction to Reinforcement Learning, RL framework, TD learning, Solution Methods, Applications.

Text Book:

1. T. Hastie, R. Tibshirani, J. Friedman. The Elements of Statistical Learning, 2e,
2. Christopher Bishop.Pattern Recognition and Machine Learning. 2e.

References:

1. Introduction to machine learning with python by Andreas C.Miiller and Sarah Guide

Machine Learning Practices Using Python

1) Implement linear regression with one variable to predict profits for a food truck. Suppose you are the CEO of a restaurant franchise and are considering different cities for opening a new outlet. The chain already has trucks in various cities and you have data for profits and populations from the cities.
2) Build a logistic regression model to predict whether a student gets admitted to a university. Suppose that you are the administrator of a university department and you want to determine each applicant's chance of admission based on their results on two exams.
3) Implement one-vs-all logistic regression and neural networks to automate handwritten digit recognition (0 to 9)
4) Implement the backpropagation algorithm for neural networks and apply it to task of hand –written digit recognition.
5) Build a Spam Classifier using Support Vector Machines.
6) Implement the K-means clustering algorithm and apply it to compress an image.
7) Build Principle Component analysis to find a low dimensional representation of face images.
8) Implement the anomaly detection algorithm and apply it to detect failing servers on a network.
9) Build a recommender system for movies by using collaborative filtering.

Evaluation Scheme

1. Assessment

Assessment	Theory	Lab.
ISA- 1	25	100
ISA- 2	25	
ESA	50	00
Total	**100**	**100**

2. End Semester Assessment (ESA) Pattern:

UNIT	8 Questions to be set of 20 Marks Each	Chapter Nos.	Instructions

I	3 Questions to be set of 20 Marks Each	1,2,3,4	Any 2 questions are to be answered
II	3 Questions to be set of 20 Marks Each	5,6,7	Any 2 questions are to be answered
III	2 Questions to be set of 20 Marks Each	8,9	Any 1 question is to be answered

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16ECAP901	Mini Project-3

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Program: MASTER OF COMPUTER APPLICATIONS

Course Code: 16ECAP901 Course Title: **Mini Project-3**

L-T-P: **0-0-2** Credits: **2** Contact Hrs: **4**

ISA Marks: **100** ESA Marks: **100** Total Marks: **200**

Teaching Hrs: **36** Exam Duration: **3 Hours**

Theme:“Development of Applications using .NET/ JavaTechnology”

.NET Technology

The Microsoft .NET framework has major advantages over previous programming languages and environments. Applications written in .NET may be in any of several different programming languages (languageinteroperability). .NET consists of a re-useable library of classes (smallcomponents that help developers create applications). It also consists of a development environment to help developers rapidly and graphically build applications. All operating system functions can be encapsulated within .NET.The framework manages the execution of applications and Web services, and provides many functionalities including security enforcement and memory management. Because of these advantages, corporations and industry are beginning to embrace .NET. They will need graduates whoknow how to use it.Hence, a project done using this technology would give an insight of the powerful features of .NET and help the students to find a job in this field. Below is a list of some of the types of applications that can be created using the .NET platform.

- Customer relationship management
- Accounting applications
- Product/inventory applications
- Warehousing applications using hand-held devices
- Web sites
- Value chain/supply management
- Integration with partners through the Internet
- XML Web services
- PDA (hand-held) applications

Objectives of using .NET Technology-

Student doing a project in .NET technology should be able to:

1. Develop an application that is pure OOP, platform independent, language independent and interoperable.
2. Use the features of .NET to make the application scalable, maintainable, easily deployable, reliable and secure.
3. Work with databases using ADO.NET.
4. Develop background processes windows services.
5. Create animations using .NET's WPF.
6. Create and use Web Services through SOA.

Java Technology

Java is one of the fundamental programming languages that can be used in many applications as well as product developments. The simple reason for this is because Java can be put to use in various platforms due to its multi-platform nature. Java is one of the favorite choices for developers for many reasons like security, object oriented(reusability), cross platform computing, multithreaded capability, Rich API, Powerful development tools ,availability of various frameworks, Great collection of open source libraries, wonderful community support, Excellent documentation support. Support for various databases and many more.

Students can use the following tools in web and mobile applications as well as product developments:

 Struts, Spring, Hibernate and JPA
 JAXB and Apache Axis 2/Java
 JSP, Servlets, JDBC, EJB, JMS, JTA and JUnit
 Apache Tomcat, JBoss and GlassFish
 JavaScript, JSF, GWT and jQuery
 Eclipse, Netbeans and JBoss tools
TestNG
jBPM and Drools
 JCR

Objectives:

Help students to utilize and strengthen the knowledge of Java which they have learnt in previous semester.

Methodology:

Students are asked to make a team of 3-4 members and can choose the different categories of projects like desktop applications, web applications, mobile application and distributed application and work once it is approved by the coordinator.

Evaluation:

Students Assessment through CIE (80%) + SEE (20%)

Continuous Internal Evaluation	Assessment	Marks
	Problem Definition, Literature Review	10
	Synopsis and SRS Deliverables	10
	Design (Module wise algorithmic design)	20
	Coding	10

	Integration and testing	10
	Report	10
	Presentation skills and Viva-voce	10
	Total	**80**
Semester End Examination	Presentation	10
	Viva-voce	10
	Total	100

16ECAE903	Information Security

Program: MASTER OF COMPUTER APPLICATIONS

Course Code: 16ECAE903 | Course Title: **Information Security**

L-T-P:**3-0-1** | Credits: **4** | Contact Hrs: **5**

ISA Marks: **50 + 100** | ESA Marks: **50** | Total Marks: **200**

Teaching Hrs: **42 + 24** | Exam Duration: **3 Hours**

No	Content	Hrs
	Unit I	
1	**Chapter 1: Cryptography Basics**	**4 Hrs**
	Introduction, Classic Crypto: Modern Crypto, Taxonomy of Cryptography & Cryptanalysis	
2	**Chapter 2: Symmetric Key Crypto**	**6 Hrs**
	Introduction, Stream Ciphers, Block Ciphers, Block cipher modes	
3	**Chapter 3:Public Key Crypto and Hash Functions**	**6 Hrs**
	Introduction, Knapsack, RSA, Diffie-Hellman, Elliptic Curve Cryptography, Public Key Notation, Uses for Public Key Crypto, Public Key Infrastructure Hash Functions: Introduction, The Birthday Problem, Non-Cryptographic Hashes, Tiger Hash, HMAC	
	Unit II	
4	**Chapter 4: Authentication and Authorization**	**4 Hrs**
	Authentication: Introduction, Authentication Methods, Passwords, Biometrics, Two-Factor Authentication, Single Sign-On and Web Cookies, Authorization: Introduction, Access Control Matrix, Multilevel Security Models	
5	**Chapter 5: Authorization and Authentication Protocols**	**6 Hrs**
	Authorization: Multilateral Security, Firewalls, Intrusion Detection, Simple Authentication Protocols: Introduction, Simple Security Protocols, Authentication Protocols	

6 Chapter 6: Security Protocols **6 Hrs**

Service-orientation and contemporary SOA; Service layer abstraction; Application service layer; Business service layer, Orchestration service layer; Agnostic services; Service layer configuration scenarios.

Unit – III

7 Chapter 6: Software Flaws and Malware **5 Hrs**

Introduction, Software Flaws, Malware, Miscellaneous Software Based Attacks, software tamper resistance, Digital Rights Management.

8 Chapter 6: Cyber Crimes and Laws **5 Hrs**

Introduction, Computer Forensics, Online Investigative tool, tracing and recovering electronic evidence, Internet fraud, Identity Theft, Industrial Espionage, Cyber Terrorism. Indian IT laws: Introduction and briefs of Law clauses.

Text Book:

1. Mark Stamp, "Information Security: Principles and Practices", 2nd Edition, John Wiley and Sons, 2011.

References:

1. Michael E. Whitman and Herbert J. Mattord, "Principles of Information Security", 2nd Edition, Thompson, 2005.
2. William Stallings, "Network Security Essentials Applications and Standards", Person Education, 2000.
3. Behrouz A. Forouzan, "Cryptography and Network Security", Tata McGraw-Hill, 2007.

Evaluation Scheme

1. In Semester Assessment (ISA)

Assessment	Marks
ISA- 1	20
ISA- 2	20
Assignment	10
Total	**50**

2. End Semester Assessment (ESA)

UNIT	8 Questions to be set of 20 Marks Each	Chapter Nos.	Instructions
I	3 Questions to be set of 20 Marks Each	1,2,3	Any 2 questions are to be answered
II	3 Questions to be set of 20 Marks Each	4,5,6	Any 2 questions are to be answered
III	2 Questions to be set of 20 Marks Each	7,8	Any 1 question is to be answered

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16ECAE905	Wireless & Mobile Computing

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Program: MASTER OF COMPUTER APPLICATIONS

Course Code: 16ECAE905 Course Title: **Wireless & Mobile Computing**

L-T-P:**3-0-1** Credits: **4** Contact Hrs: **5**

ISA Marks: **50 + 100** ESA Marks: **50** Total Marks: **200**

Teaching Hrs: **42 + 24** Exam Duration: **3 Hours**

No	Content	Hrs
	Unit I	
1	**Chapter1:Introduction**	**4 Hrs**
	Mobility Of Bits & Bytes, Wireless-The Beginning, Mobile Computing, Dialog Control, Networks, Middle Gear & Gateways, Applications & Services, Developing Mobile Computing Applications, Security In Mobile Computing, Standard And Standard Bodies And Players In The Wireless Space.	
2	**Chapter 2 : Wireless LAN**	**4 Hrs**
	Introduction, Wireless LAN advantages, IEEE 802.11 standards, Wireless LAN architectures, Mobility in Wireless LAN, Deploying Wireless LAN, Mobile adhoc Networks and Sensor Networks. Wireless LAN security, WiFi versus 3G.	
3	**Chapter 3: Mobile Computing Architecture**	**4 Hrs**
	History of computers, History of Internet, Internet-the ubiquities networks, Architecture for mobile computing, The three-tier architectures, Design consideration for mobile computing, Mobile computing through internet, Making existing applications mobile enable.	
4	**Chapter 4: Mobile Computing through Telephony**	**4 Hrs**
	Evaluation of telephony, Multiple access procedure, Mobile computing through telephone, Developing an IVR application, Voice XML, Telephony application Programming Interphase(TAPI).	
	Unit II	
5	**Chapter 5:Emerging Technologies**	**4 Hrs**
	Introduction, Blue-tooth, Radio Frequency Identification (RFID), Wireless Broad Band (WiMAX), Mobile IP, Internet protocol Ver 6 (IP v6), Java card.	
6	**Chapter 6 : Global System for Mobile Communication (GSM)**	**4 Hrs**

Introduction, GSM architectures, GSM entities, Call routing in GSM, PLMN interface, GSM address and identifiers, Network aspect in GSM, GSM frequency allocation, Authentication and security,

7 **Chapter 7: Short Message Services (SMS)** **4 Hrs**

Mobile Computing over SMS, Short Message Services (SMS), Value Added Services through SMS, Accessing the SMS Bearer.

8 **Chapter 8: General Packet Radio Service (GPRS)** Introduction, GPRS and packet data network, GPRS network architecture, GPRS network operation, Data services in GPRS, Application for GPRS, Limitation of GPRS, Billing and Charging in GPRS. **4 Hrs**

Unit – III

9 **Chapter 09 : Wireless Application Protocol (WAP)** **5 Hrs**
Introduction, WAP, MMS, GPRS, Application

10 **Chapter 10 : CDMA & 3G** **5 Hrs**
Introduction, Spread Spectrum technology, IS-95, CDMA vs GSM, Wireless Data, 3rd generation network, Application on 3G.

Text Book:

1. Asoke K Talukder & Roopa R Yavagal . Mobile Computing , Tata McGraw Hill Education Private Limited, New Delhi.

References:

1. Raj Kamal , Mobile Computing, Oxford University Press

Evaluation Scheme

1. In Semester Assessment (ISA)

Assessment	**Marks**
ISA- 1	20
ISA- 2	20
Assignments	10
Total	**50**

2. End Semester Assessment (ESA)

UNIT	8 Questions to be set of 20 Marks Each	Chapter Nos.	Instructions
I	3 Questions to be set of 20 Marks Each	1,2,3,4	Any 2 questions are to be answered
II	3 Questions to be set of 20 Marks Each	5,6,7,8	Any 2 questions are to be answered
III	2 Questions to be set of 20 Marks Each	9,10	Any 1 question is to be answered

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16ECAP902	Project Work

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Program: MASTER OF COMPUTER APPLICATIONS		
Course Code: **16ECAP902**	Course Title: **Project Work**	
L-T-P: **0-0-18**	Credits: **18**	Contact Hrs: **Full Time**
ISA Marks: **100**	ESA Marks: **100+50**	Total Marks: **250**
Teaching Hrs: **Full Time**		Exam Duration: **3 Hours**
A student must carry out a project on any domain using cutting edge technologies and demonstrates the same at the end of the semester.		

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2019-20	
19ECAH701	Professional Communication

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Course Code: **19ECAH701**	Course Title: **Professional Communication**	
L-T-P: **2-1-0**	Credits: **3**	Contact Hrs: **4**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **50**		Exam Duration:**3Hrs**

No	**Content**	**Hrs**
	Unit I	
1	**Chapter 1 : Basics of Technical Communication**	**4 Hrs**
	Introduction, Process of Communication, Language as a Tool, Levels of Communication Levels of Communication, Communication Networks, Importance of Technical Communications.	
2	**Chapter 2 : Barriers to Communication**	**4 Hrs**
	Definition of Noise, Classification of Barriers.	
3	**Chapter 3 : Technology in Communication**	**4 Hrs**
	Impact of Technology, Software for Creating Messages, Software for Writing Documents, Software for Presenting Documents, Transmitting Documents, Effective use of Available Technology.	
4	**Chapter 4 : Active Listening**	**4 Hrs**

Introduction, Types of Listening, Traits of good Listener, Active versus passive listening, implications of effective listening.

5	**Chapter 5 : Effective Presentation Strategies**	**4 Hrs**
	Introduction, Defining purpose, Analyzing Audience and Locale, Organizing Contents, preparing outline, Visual Aids, Understanding Nuances of Delivery, Kinesics, Proxemics, Paralinguistic's, Chronemics, Sample speech.	
	Unit II	
6	**Chapter 6 : Group Communication**	**4 Hrs**
	Introduction, Group Discussion, Organizational Group discussion, Group discussion as part of selection process Meetings, conferences.	
7	**Chapter 7 : Words and Phrases**	**4 Hrs**
	Brief History of words, Dictionary, Thesaurus, Elements of Style, Guidelines for effectiveness.	
8	**Chapter 8 : Sentence Construction**	**4 Hrs**
	Introduction, Guidelines for effectiveness.	
9	**Chapter 9 : Paragraph Development**	**4 Hrs**
	Introduction, Central Components of a paragraph, Length, Techniques for Paragraph Development.	
10	**Chapter 10 :The Art of Condensation**	**4 Hrs**
	Introduction, Steps to effective precise writing.	
	Unit – III	
11	**Chapter 11: Letters and Emails**	**5 Hrs**
	Business letters Emails.	
12	**Chapter 12: Research paper, Dissertation and Thesis**	**5 Hrs**
	Introduction, Research paper, Dissertation, Thesis.	

Text Book:

1. Meenakshi Raman and Sangeeta Sharma, Technical Communication Principles and Practices, Oxford University Press, 2015, 3rd Edition,

References:

1. Rizivi, M.A., Effective Technical Communication, Tata McGraw Hill,

Evaluation Scheme

1. In Semester Assessment (ISA)

Assessment	Marks
ISA- 1	20

ISA- 2	20
Assignment	10
Total	**50**

2. End Semester Assessment (ESA)

UNIT	8 Questions to be set of 20 Marks Each	Chapter Nos.	Instructions
I	3 Questions to be set of 20 Marks Each	1, 2, 3, 4, 5	Any 2 questions are to be answered
II	3 Questions to be set of 20 Marks Each	6, 7, 8, 9, 10	Any 2 questions are to be answered
III	2 Questions to be set of 20 Marks Each	11,12	Any 1 question is to be answered

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19ECAP706	Computer Networks Lab

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Course Code:19ECAP706 Course Title: **Computer Networks Lab.**

L-T-P:0-0-1.5 Credits: 1.5 Contact Hrs:3

ISA Marks:: **100** ESA Marks: **--** Total Marks: **100** .

Teaching Hrs: **36** Exam Duration: **3 Hours**

#	Lab Assignment	No. of Lab slots per Batch(Estimate)
01	Introduction to hardware components and Ethernet LAN setup.	2
02	Investigation of IP addressing and subnet design.	1
03	Application of Windows OS Built-in Networks Diagnostic Tools.	2
04	Network Packet Monitoring and Analysis.	1
05	Analysis of the Data Link Layer Protocols (Ethernet, ARP)	1
06	Analysis of the Web Protocols (DNS, HTTP)	1
07	Analysis of the Email Protocols (SMTP, POP3)	1
08	Computer Network Routing Using Statical Routes and RIP Protocol	1
09	Computer Network Routing by Using Open shortest Path First (OSPF) Dynamic Routing Protocol.	1
10	Getting acquainted with switching environment	1

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(01FM18MCAXX)	
18ECAP801	Mini Project -1

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Course Code: **18ECAP801** Course Title: **Mini Project - 1**

L-T-P: **0-0-2** Credits: **2** Contact Hrs: **4**

ISA Marks: **100** ESA Marks: **100** Total Marks: **200**

Teaching Hrs: **48** Exam Duration: **3 Hours**

Theme: "Development of Rich Internet Applications using PHP"

Rich Internet Applications (RIAs) are web applications that offer the responsiveness, "rich" features and functionality approaching that of desktop applications. This course provides an end-to-end look at building Rich Internet Applications that employ HTML5, Ajax, jQuery, etc. This course provides platform for integrating various server-side and client-side technologies to create a robust applications.

Purpose:

- Developing rich reporting and analytics interfaces for enterprise-level information presentation.
- To build state-of-the-art web applications utilizing the powerful features provided by the combination of the PHP language, Ajax, and Web Services.
- To provide an authoritative overview to a set of key technologies for building web applications (HTML, HTML5, JavaScript, Dynamic HTML, CSS, ASP, AJAX, and XML).
- Able to apply the above key technologies for developing light-weighted and rich-content Web applications
- To offer users a better visual experience and more interactivity than traditional browser applications that use only HTML and HTTP.
- To create advanced user interfaces.

Evaluation:

Students Assessment through ISA (100%) + ESA (100%)

In Semester Assessment	**Assessment**	**Marks**
	Problem Definition, Literature Review	10
	Synopsis and SRS Deliverables	10
	Design (Module wise algorithmic design)	20
	Coding	10
	Integration and testing	10
	Report	20
	Presentation skills and Viva-voce	20

	Total	**100**
End Semester Assessment	Presentation	50
	Viva-voce	50
	Total	100

18ECAE806	Cyber Security and Forensics

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Course Code: **18ECAE806** Course Title: **Cyber Security and Forensics**

L-T-P: **2-0-1** Credits: **3** Contact Hrs: **4**

ISA Marks: **50** ESA Marks: **50** Total Marks: **100**

Teaching Hrs: **42+24** Exam Duration:**3Hrs**

No	Content	Hrs
	Unit I	
1	**Chapter 1: Introduction to Cybercrime, Cyber offenses & Cybercrime** Cybercrime definition and origins of the world, Cybercrime and information security, Classifications of cybercrime, A global Perspective on cybercrimes. Cyber attack plans, Social Engineering, Cyber stalking, Cyber cafe and Cybercrimes, Botnets, Proliferation of Mobile and Wireless Devices, Credit Card Frauds in Mobile and Wireless Computing Era.	**8 Hrs**
2	**Chapter No. 2. Methods used in Cybercrime** Phishing, password Cracking, Keyloggers and Spyware, Virus and Worms, Trojan and backdoors, Steganography, DOS and DDOS attack, SQL injection, Buffer Overflow, Attack on wireless networks, Identity theft.	**8 Hrs**
	Unit II	
3	**Cybercrimes and Cyber security: The Legal Perspectives** Why do we need Cyber law: The Indian Context, The Indian IT Act, Digital Signature and the Indian IT Act, Amendments to the Indian IT Act, Cybercrime and Punishment.	**8 Hrs**
4	**Chapter 4: Understanding computer Forensics, Forensics of Hand-held devices** Historical background of forensics; Digital forensics science; need for computer forensics; cyber forensics and digital evidence; Analysis E-mail; Digital forensics life cycle; chain of custody concepts; network forensics; Forensics and social networking; challenges in computer forensics; Hand-held devices and digital forensics; Toolkits for Hand-held device forensics; Techno-legal challenges form hand-held devices	**8 Hrs**
	Unit – III	
5	**Chapter 5: Social, political, Ethical and Psychological Dimensions** Intellectual property in the cyberspace; Ethical dimension of cybercrimes; Psychology, mindset and skills of hackers and other cybercriminals; Sociology of cybercriminals.	**5 Hrs**

6 Chapter 6: Cybercrime: Illustrations, Examples and Case studies **5 Hrs**

Introduction, Real-Life Examples, Case Studies: Illustrations of Financial Frauds in Cyber Domain, Digital Signature-Related Crime Scenarios, Digital forensics case illustrations Online Scams.

Text Book

1. Nina Godbole & Sunit Belapure, “Cyber Security”, Wiley India, 2011 and Reprint 2018.

References

1. Dhiren R Patel, “Information security theory & practice”, PHI learning PVT. Ltd, 2010.
2. Bill Nelson, “Guide to Computer Forensics and Investigations”, 4th Edition, CENGAGE Publication. 2009

Evaluation Scheme

In Semester Assessment (ISA)

Assessment	**Theory**
ISA- 1	15
ISA- 2	15
Lab practices	20
Total	**50**

End Semester Assessment (ESA)

UNIT	8 Questions to be set of 20 Marks Each	Chapter Nos.	Instructions
I	3 Questions to be set of 20 Marks Each	1, 2	Any 2 questions are to be answered
II	3 Questions to be set of 20 Marks Each	3,4	Any 2 questions are to be answered
III	2 Questions to be set of 20 Marks Each	5,6	Any 1 question is to be answered

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Proposed Cyber Security and Forensics Practices

S No	Practices	Tools
1	Implementation of SQL Injection and avoidance	Python Php Tools (Crime, Security or Forensics)
2	Implementation of Digital signature	
3	Implementation of .Steganography	
4	Writing Literature survey report on various issues in Cybersecurity and Forensics	
5	Presentation on domain chosen in Cybercrime, Cyber security or Cyber Forensics.	
6	Demonstration of tool/s used in Cybercrime, Cyber Security or Cyber Forensics	

18ECAE804	Cloud Computing

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Course Code: **18ECAE804** Course Title: **Cloud Computing**

L-T-P:**2-0-1** Credits: **3** Contact Hrs: **4**

ISA Marks: **50** ESA Marks: **50** Total Marks: **100**

Teaching Hrs: **42 + 24** Exam Duration: **3 Hours**

No	Content	Hrs
	Unit I	
1	**Chapter 1: Introduction, Parallel and distributed systems** Network-centric computing and network centric content, peer-to-peer systems, Cloud computing basics, delivery models and services, Ethical issues, cloud vulnerabilities, major challenges; parallel computing, parallel computer architecture, Distributed systems, communication protocol and process coordination, logical clocks, message delivery rules, casual delivery, Concurrency, atomic actions, consensus protocols, modularity: client-server paradigm.	**6 Hrs**
2	**Chapter 2: Cloud Infrastructure** Cloud computing at Amazon, cloud computing: the Google perspective, Microsoft windows Azure and online services; open-source software platforms for private clouds; Cloud storage diversity and vendor lock-in; Cloud computing interoperability: the intercloud; Energy use and ecological impact of large-scale data centers; Service and compliance level agreements; User experience; Software licensing.	**6 Hrs**
3	**Chapter 3: Cloud Computing: Applications and Paradigms** Challenges for cloud computing; Existing cloud applications and new application opportunities; Architectural styles for cloud applications; Workflows: Coordination of multiple activities; The MapReduce programming model; Case studies.	**4 Hrs**

Unit II

4 **Chapter 4: Cloud Resource Virtualization** **6 Hrs**

Virtualization; Layering and virtualization; Virtual machine monitors; Virtual machines; Performance and security isolation; Full virtualization and Para virtualization; Hardware support for virtualization; Case study; Optimization of network virtualization; vBlades; A performance comparison of virtual machines; Software fault isolation;

5 **Chapter 5: Cloud Resource Management and Scheduling** **6 Hrs**

Policies and mechanisms for resource management; Applications of control theory to task scheduling on a cloud; Stability of a two-level resource allocation architecture; Feedback control based on dynamic thresholds; Coordination of specialized autonomic performance managers; A utility-based model for cloud-based web services; Resource bundling; Scheduling algorithms for computing clouds; Fair queuing; Resource management and dynamic application scaling.

6 **Chapter 6: Networking Support** **4 Hrs**

Packet-switched networks; The Internet; Internet migration to IPV6; The transformation of the Internet; Web access and the TCP congestion control window; Network resource management; Interconnection networks for computer clouds; Content-delivery networks; Overlay networks and small-world networks.

Unit – III

7 **Chapter 7: Storage Systems** **5 Hrs**

The evolution of storage technology; Storage models, file systems and databases; Distributed file systems: The precursors; General parallel file system; Google File System; Apache Hadoop; Locks and Chubby: A locking service; Transaction processing and NoSQL and databases; BigTable; Megastore.

8 **Chapter 8: Cloud Security** **5 Hrs**

Cloud security risks; Security: The top concern for cloud users; Privacy and privacy impact assessment; Trust; Operating system security; Virtual machine security; Security of virtualization; Security risks posed by shared images; Security risks posed by a management OS; A trusted virtual machine monitor.

Text Book:

1. A Dan C. Marinescu, Cloud Computing: Theory and Practice, Morgan Kaufmann publishers, 2013

References

1 Michael Miller, Cloud Computing: Web-Based Applications that change the Way you work and collaborate Online, Pearson Publication, 2012.
2 Anthony T. Volte, Toby J. Volte, Robert Elsenpeter: Cloud Computing, A Practical Approach, McGraw Fill, 2010.
3 Cloud Computing for Dummies: J. Hurwitz, ISBN 978-0-470-484-8
4 Dr. Kumar Sourabh, Cloud Computing, 2nd Edition, Wiley India, 2011.

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Evaluation Scheme

Assessment

Assessment	Theory	Lab.
ISA- 1	25	100
ISA- 2	25	
ESA	50	00
Total	**100**	**100**

End Semester Assessment (ESA) Pattern:

UNIT	8 Questions to be set of 20 Marks Each	Chapter Nos.	Instructions
I	3 Questions to be set of 20 Marks Each	1,2,3	Any 2 questions are to be answered
II	3 Questions to be set of 20 Marks Each	4,5,6	Any 2 questions are to be answered
III	2 Questions to be set of 20 Marks Each	7,8	Any 1 question is to be answered

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Cloud Computing Practices

Expt No.	*Brief description about the experiment*	*Number Of Slots*
	DEMONSTRATION	
1	Cloud computing resources access using Windows Azure Infrastructure Services	1
2	Registering a DNS Server in Windows Azure	1
3	Introduction to Google app engine for Java.	1
4	Creation an Amazon VPC.	1
5	Setting up Routing in VPC and Deploying Amazon EC2 instance in Amazon VPC	1
	EXERCISE	
6	Introduction of cloud using windows Azure.	*1*
7	Collaborating on Calendars Schedules and Task Management, Event Management, Contact Management, Project Management, Word Processing, Spreadsheets, Databases, Presentations.	*1*
8	Implementation of web app on Google app engine.	*1*
9	Implementation of Amazon VPC.	*1*
10	Implementation of network programming using mininet.	*1*

11	Collaborating via Web Based Communication Tools, Social Networks and Groupware, Blogs and Wikis.	*1*
	STRUCTURED ENQUIRY	
12	Develop a tree topology structure with more than 20 hosts using controller and switches in mininet.	*2*

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18ECAP802	Mini Project-2

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Course Code: **18ECAP802** Course Title: **Mini Project-2**

L-T-P: **0-0-2** Credits: **2** Contact Hrs: **4**

ISA Marks: **100** ESA Marks: **100** Total Marks: **200**

Teaching Hrs: **48.** Exam Duration: **3 Hours**

Theme: "Mini project Using Java/Python"

Java is one of the fundamental programming languages that can be used in many applications as well as product developments. The simple reason for this is because Java can be put to use in various platforms due to its multi-platform nature. Java is one of the favorite choices for developers for many reasons like security, object oriented(reusability), cross platform computing, multithreaded capability, Rich API, Powerful development tools ,availability of various frameworks, Great collection of open source libraries, wonderful community support, Excellent documentation support. Support for various databases and many more.

Students can use the following tools in web and mobile applications as well as product developments:

- Struts, Spring, Hibernate and JPA
- JAXB and Apache Axis 2/Java
- JSP, Servlets, JDBC, EJB, JMS, JTA and JUnit
- Apache Tomcat, JBoss and GlassFish
- JavaScript, JSF, GWT and jQuery
- Eclipse, Netbeans and JBoss tools
- TestNG
- jBPM and Drools
- JCR

Objectives:

Help students to utilize and strengthen the knowledge of java which they have learnt in previous semester.

Python :

Python is an interpreted, high-level, general-purpose programming language. Python has a design philosophy that emphasizes code readability, notably using significant whitespace. It provides constructs that enable clear programming on both small and large scales, Python features a dynamic type system and automatic memory management. It supports multiple programming paradigms, including object-oriented, imperative, functional and procedural. It also has a comprehensive standard library. Python interpreters are available for many operating systems. CPython, the reference implementation of Python, is open source software and has a community-based development model.

Students can use the following tools in web and product developments:

- **Django**
- **BootStarp**
- **Matplotlib**
- **Reportlab**
- **Numpy**
- **Pandas**
- **Falcon**

Objectives:

Help students to utilize and strengthen the knowledge of python which they have learnt in previous semester.

Methodology:

Students are asked to make a team of 3-4 members and can choose the different categories of projects like desktop applications, web applications, mobile application and distributed application and work once it is approved by the coordinator.

Assessment:

Students Assessment through ISA (100%) + ESA(100%)

In Semester Assessment	**Assessment**	**Marks**
	Problem Definition, Literature Review	10
	Synopsis and SRS Deliverables	10
	Design (Module wise algorithmic design)	20
	Coding	10
	Integration and testing	10
	Report	20
	Presentation skills and Viva-voce	20
	Total	**100**
End Semester Assessment	Presentation	50
	Viva-voce	50
	Total	**100**

18ECAE802	User Interface Design

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Course Code:18ECAE802 Course Title: **User Interface Design**

L-T-P: **2-0-1** Credits: **3** Contact Hrs: **4**

ISA Marks: **50** ESA Marks: **50** Total Marks: **100**

Teaching Hrs: **42+24** Exam Duration:**3Hrs**

No	**Content**	**Hrs**
	Unit I	
1	**Chapter 1 : What Users Do** The Basics of User Research ,Users' Motivation to Learn, The Patterns.	**5Hrs**
2	**Chapter 2 : Organizing the Content: Information Architecture and Application Structure** The Big Picture, The Patterns:- Feature, Search, and Browse, News Stream, Picture Manager, Dashboard, Canvas Plus Palette, Wizard.	**6 Hrs**
3	**Chapter 3 : Getting Around: Navigation, Signposts, and Wayfinding** Staying Found, The Cost of Navigation, Navigational Models, Design Conventions for Websites, The Patterns:- Clear Entry Points, Menu Page, Pyramid, Modal Panel, Deep-linked State, Escape Hatch, Fat Menus, Sitemap Footer, Sign-in Tools, Sequence Map, Breadcrumbs, Annotated Scrollbar, Animated Transition.	**6 Hrs**
	Unit II	
4	**Chapter 4 : Organizing the Page: Layout of Page Elements** The Basics of Page Layout, The Patterns:- Visual Framework, Center Stage, Grid of Equals, Titled Sections, Module Tabs, Collapsible Panels, Movable Panels, Right/Left Alignment, Diagonal Balance.	**5 Hrs**
5	**Chapter 5 : _Lists of Things**	**6 Hrs**

Use Cases for Lists, Back to Information Architecture, The Patterns:- Two-Panel Selector, One-Window Drilldown, List Inlay, Thumbnail Grid, Row Striping, Jump to Item, Cascading Lists, Tree Table.

6 **Chapter 6 : Doing Things: Actions and Commands** **6 Hrs**

Pushing the Boundaries, The Patterns:- Button Groups, Hover Tools, Action Panel, Smart Menu Items, Preview, Progress Indicator, Macros.

Unit – III

7 **Chapter 7: Showing Complex Data: Trees, Charts, and Other Information Graphics** **4 Hrs**

The Basics of Information Graphics, The Patterns:- Overview Plus Detail, Datatips, Data Spotlight, Dynamic Queries, Data Brushing, Local Zooming, Sortable Table, Radial Table, Multi-Y Graph, Small Multiples, Treemap.

8 **Chapter 8: Getting Input from Users: Forms and Controls** **4 Hrs**

The Basics of Form Design, Control Choice, The Patterns:- Forgiving Format, Structured Format, Fill-in-the-Blanks, Input Hints, Input Prompt, Password Strength Meter, Autocompletion, Dropdown Chooser, Same-Page Error Messages.

Text Book:

1. Jenifer Tidwell , Designing Interfaces, 2nd Edition, O'Reilly ,2010

References:

1. Jodie Moule., Killer UX Design, SitePoint,2012

Evaluation Scheme

In Semester Assessment (ISA)

Assessment	Marks
ISA- 1	20
ISA- 2	20
Assignment	10
Total	**50**

End Semester Assessment (ESA)

UNIT	8 Questions to be set of 20 Marks Each	Chapter Nos.	Instructions
I	3 Questions to be set of 20 Marks Each	1, 2, 3	Any 2 questions are to be answered

II	3 Questions to be set of 20 Marks Each	4.5.6	Any 2 questions are to be answered
III	2 Questions to be set of 20 Marks Each	7,8	Any 1 question is to be answered

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User Interface Design Practices		
Sl.No	**Activity**	**Hours**
1	Find two examples of user interfaces (might be desktop software, web applications, smartphone apps, consumer devices, car dashboards, building entrances, traffic intersections, shower controls, etc), one that you consider a good design and one that you consider a bad design. For each interface, you should: • Describe its purpose intended users. • Analyze its good and bad points of usability with reference to all the dimensions of usability (learnability, visibility, efficiency, errors) Illustrate your analysis with appropriate screenshots or photographs.	2
2	Design a user interface for a specific task that communicates its conceptual model to the user more effectively, so that users are less likely to make this mistake. Sketch your ideas (alternate designs) on a whiteboard. Critique it, and update the designs.	2
3	Guided by the categories below, make a list of what needs to be made visible, and then brainstorm (and sketch) how the interface might make it visible. • Actions: what can the user do? • State: what is the current state of the system? • Feedback: what was the effect of the user's actions	2
4	Explore the undo models used in single-user text editing. Choose a few different kinds of textboxes. Experiment with a web browser's undo model for text editing by typing, deleting, changing properties, and using Undo. Try to figure out: • How many undo streams are there—one, or many? • How is the history divided into undoable units? • How much previous state is recovered when you undo? (Selections? cursor positions?) • What visible feedback does Undo give? (e.g., if the Undo affects a location scrolled out of the box?)	2
5	User-centered design process, by conducting a lightweight UCD process on a few problems in the classroom.	2
6	User Analysis, Task Analysis, Domain Analysis by observing a real environment of people working.	2
7	Designing UIs by sketching.	2
8	Exploring some of the main structuring patterns of GUI software: the view tree, listeners, and model-view-controller using HTML, Javascript, and jQuery, along with a handy online HTML editor.	2
9	Explore about low-fidelity prototyping by creating a simple, hand-drawn prototype in less than 5 minutes, and simulating it with another user.	2

10	Information visualization by experimenting with modifications to an existing visualization using a browser.	2
11	Exploring some of the principles and pitfalls of color design and typography.	2
12	Heuristic evaluation of an e-commerce web site. Record the usability problems found. Justify every observation by naming one or more usability heuristics (design principles) that it violates. Assign a severity rating to each problem (cosmetic, minor, major, or catastrophic). Include at least one positive usability comment, again justifying it by naming one or more heuristics.	2

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17ECAE803	Digital Image Processing

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Program: MASTER OF COMPUTER APPLICATIONS

Course Code: **18ECAE803** Course Title: **Digital Image Processing**

L-T-P: **2-0-1** Credits: **3** Contact Hrs: **4**

ISA Marks-Theory: **50** +Practice: **100** ESA Marks: **50** Total Marks: **200**

Teaching Hrs: **42 + 24** Exam Duration: **3 Hours**

No	Content	Hrs
	Unit I	
1	**Chapter No. 1- Digital Image Fundamentals** Introduction: Origins of digital image processing, Electromagnetic spectrum, Applications, Components of image processing system, Image sensing and acquisition, Digitization, Sampling and Quantization	**4 Hrs**
2	**Chapter No. 2- Intensity Transformations and Spatial Filtering** Image Enhancement: Basic gray level transformations, histogram processing, enhancement using arithmetic/ logic operations, basics of spatial filtering, smoothing and sharpening spatial filters.	**6 Hrs**
3	**Chapter No. 3- Filtering in the frequency domain** Frequency domain: introduction to the Fourier transform and the Frequency domain, smoothing and sharpening frequency domain filters, Discrete Fourier transforms, Properties of DFT, FFT	**6 Hrs**
	Unit II	
4	**Chapter No. 4- Image Restoration and Reconstruction** A model of the image degradation/restoration process, noise models, Spatial Filtering- mean filters, order static filters, adaptive filters	**10Hrs**
5	**Chapter No. 5- Color Image Processing** Color models, pseudo color image processing, smoothing and sharpening.	**6 Hrs**
	Unit – III	

6 **Chapter No. 6- Morphological Image Processing** **5 Hrs**

Introduction, structuring elements, dilation and erosion, opening and closing, Hit-or-Miss transformation, basic morphological algorithms

7 **Chapter No. 7- Image Segmentation** **5 Hrs**

Detection of discontinuities, edge linking and boundary detection, Thresholding, Region based approach, segmentation by morphological watersheds

Text Book:

3. Rafael.C.Gonzalez, Richard.E.Woods, Digital Image Processing, Pearson, 3rd Edition, 2008.
4. http://opencv-python-tutroals.readthedocs.io/en/latest/py_tutorials/py_imgproc/py_table_of_contents_imgproc/py_table_of_contents_imgproc.html)

DIP Practices using Python

COURSE DESCRIPTION:

Computer vision is the automated extraction of information from images. Information can mean anything from 3D models, camera position, object detection and recognition to grouping and searching image content. This course provide hands-on programming practices and introduces basic tools for working with images using python OpenCV library.

OBJECTIVES

- To provide hands-on programming with images using Python.
- To demonstrate computer vision techniques behind a wide variety of real-world applications.
- To implement many of the fundamental algorithms using OpenCV library.

LAB REQUIREMENTS:

- Computer with latest configuration having Windows and Linux OS Versions.
- Python with OpenCV Library installed.

LIST OF EXERCISES

Expt./ Job No.	Lab assignments/experiment	Implementation	Number of Hours
1.	Changing Colorspaces	Learn to change images between different color spaces. Plus learn to track a colored object in a video.	1
2.	Geometric Transformations of Images :	Learn to apply different geometric transformations to images like rotation, translation etc.	
3.	Image Thresholding :	Learn to convert images to binary images using global thresholding, Adaptive thresholding, Otsu's binarization etc	1
4.	Smoothing Images:	Learn to blur the images, filter the images with custom kernels etc	
5.	Morphological Transformations	Learn about morphological transformations like Erosion, Dilation, Opening, Closing etc	1
6.	Image Gradients :	Learn to find image gradients, edges etc	
7.	Canny Edge Detection:	Learn to find edges with Canny Edge Detection	1
8.	Image Pyramids:	Learn about image pyramids and how to use them for image blending	
9.	Contours in OpenCV:	All about Contours in OpenCV	1
10.	Histograms in OpenCV:	All about histograms in OpenCV	
11.	Image Transforms in OpenCV:	Meet different Image Transforms in OpenCV like Fourier Transform, Cosine Transform etc.	1
12.	Template Matching :	Learn to search for an object in an image using Template Matching	1
13.	Hough Line Transform :	Learn to detect lines in an image	1
14.	Hough Circle Transform:	Learn to detect circles in an image	
15.	Image Segmentation with Watershed Algorithm:	Learn to segment images with watershed segmentation.	1
16.	Interactive Foreground Extraction using GrabCut Algorithm:	Learn to extract foreground with GrabCut algorithm	1

References:

4. https://www.tutorialspoint.com/mongodb/mongodb_tutorial.pdf
5. https://blog.codecentric.de/files/2012/12/MongoDB-CheatSheet-v1_0.pdf
6. http://www.guru99.com/mongodb-tutorials.html

Evaluation Scheme

3. Assessment

Assessment	Theory	Lab.
ISA- 1	25	100
ISA- 2	25	
ESA	50	00
Total	**100**	**100**

4. End Semester Assessment (ESA) Pattern:

UNIT	8 Questions to be set of 20 Marks Each	Chapter Nos.	Instructions
I	3 Questions to be set of 20 Marks Each	1,2	Any 2 questions are to be answered
II	3 Questions to be set of 20 Marks Each	3,4	Any 2 questions are to be answered
III	2 Questions to be set of 20 Marks Each	5,6	Any 1 question is to be answered

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18ECAE808	DevOps

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Course Code: 18ECAE808 | Course Title: **DevOps**

L-T-P: **2-0-1** | Credits: **3** | Contact Hrs: **4**

ISA Marks: **50** | ESA Marks: **50** | Total Marks: **100**

Teaching Hrs: **42+24** | Exam Duration:**3Hrs**

No	Content	Hrs
	Unit I	
1	**Chapter 1 : Introduction to DevOps and Continuous Delivery** Introducing DevOps, How fast is fast?, The Agile wheel of wheels, Beware the cargo cult Agile fallacy, DevOps and ITIL.	**4 Hrs**
2	**Chapter 2 : A View from Orbit :** **The DevOps process and Continuous Delivery – an overview :** The developers, The revision control system, The build server, The artifact repository, Package managers, Test environments, Staging/production,Release management, Scrum, Kanban, and the delivery pipeline, Wrapping up – a complete example, Identifying bottlenecks	**4 Hrs**
3	**Chapter 3 : How DevOps Affects Architecture** Introducing software architecture, The monolithic scenario, Architecture rules of thumb, The separation of concerns, The principle of cohesion, Coupling, Back to the monolithic scenario, A practical example, Three-tier systems, The presentation tier, The logic tier, The data tier, Handling database migrations, Rolling upgrades, Hello world in Liquibase, The changelog file, The pom.xml file, Manual installation,	**6 Hrs**

Microservices, Interlude – Conway's Law, How to keep service interfaces forward compatible, Microservices and the data tier, DevOps, architecture, and resilience

4 **Chapter 4 : Everything is Code** **6 Hrs**

The need for source code control,The history of source code management, Roles and code, Which source code management system? A word about source code management system migrations, Choosing a branching strategy, Branching problem areas, Artifact version naming, Choosing a client, Setting up a basic Git server, Shared authentication, Hosted Git servers, Large binary files, Trying out different Git server implementations, Docker intermission, Gerrit : a) Installing the git-review package, b)The value of history revisionism, The pull request model, GitLab

Unit II

5 **Chapter 5 : Building the Code** **6 Hrs**

Why do we build code? The many faces of build systems, The Jenkins build server, Managing build dependencies, The final artifact, Cheating with FPM, Continuous Integration, Continuous Delivery, Jenkins plugins, The host server, Build slaves, Software on the host, Triggers, Job chaining and build pipelines, A look at the Jenkins filesystem layout, Build servers and infrastructure as code, Building by dependency order, Build phases, Alternative build servers, Collating quality measures, About build status visualization, Taking build errors seriously, Robustness

6 **Chapter 6 : Testing the Code** **6 Hrs**

Manual testing, Pros and cons with test automation, Unit testing, JUnit in general and JUnit in particular, A JUnit example, Mocking, Test Coverage, Automated integration testing, Docker in automated testing, Arquillian, Performance testing, Automated acceptance testing, Automated GUI testing, Integrating Selenium tests in Jenkins, JavaScript testing, Testing backend integration points, Test-driven development, REPL-driven development, A complete test automation scenario : Manually testing our web application, Running the automated test, 3Finding a bug, Test walkthrough, Handling tricky dependencies with Docker

7 **Chapter 7 : Deploying the Code** **4 Hrs**

Why are there so many deployment systems? Configuring the base OS, Describing clusters, Delivering packages to a system, Virtualization stacks: Executing code on the client, A note about the exercises, The Puppet master and Puppet agents, Ansible, PalletOps, Deploying with Chef, Deploying with SaltStack, Salt versus Ansible versus Puppet versus PalletOps execution models, Vagrant, Deploying with Docker, Comparison tables, Cloud solutions, AWS, Azure.

8 **Chapter 8 : Monitoring the Code** **4 Hrs**

Nagios, Munin, Ganglia, Graphite, Log handling, Client-side logging libraries, The ELK stack.

Unit – III

9 **Chapter 9 : Issue Tracking** **5 Hrs**

What are issue trackers used for? Some examples of workflows and issues, What do we need from an issue tracker? Problems with issue tracker proliferation, All the trackers : Bugzilla, Trac, Redmine, The GitLab issue tracker, Jira

10 Chapter 10 : The Internet of Things and DevOps **5 Hrs**

Introducing the IoT and DevOps, The future of the IoT according to the market, Machine-to-machine communication, IoT deployment affects, software architecture, IoT deployment security, Okay, but what about DevOps and the IoT again?, A hands-on lab with an IoT device for DevOps

Text Book:

1. Practical DevOps by Joakim Verona Publisher: Packt Publishing, Release Date: February 2016, ISBN: 9781785882876

References:

1. **Effective DevOps,** Building a Culture of Collaboration, Affinity, and Tooling at Scale , By Jennifer Davis, Ryn Daniels, **Publisher:** O'Reilly Media, **Release Date:** June 2016 , **Pages:** 410.
2. **The DevOps Handbook:** How to Create World-Class Speed, Reliability, and Security in Technology Organizations, Gene Kim, Patrick Debois, John Willis, Jez HumbleIT Revolution Press, 2016 - Business & Economics - 480 pages.

Evaluation Scheme

In Semester Assessment (ISA)

Assessment	Marks
ISA- 1	20
ISA- 2	20
Assignment	10
Total	**50**

End Semester Assessment (ESA)

UNIT	8 Questions to be set of 20 Marks Each	Chapter Nos.	Instructions
I	3 Questions to be set of 20 Marks Each	1, 2, 3, 4,	Any 2 questions are to be answered
II	3 Questions to be set of 20 Marks Each	5, 6, 7, 8,	Any 2 questions are to be answered
III	2 Questions to be set of 20 Marks Each	9, 10	Any 1 question is to be answered

DevOps Practice Exercise:

The objectives of these practice exercise is to learn DevOps best practices and to define entire infrastructure as code and learn about infrastructure as code, continuous integration, continuous delivery, Terraform, AWS, Packer, Docker, and much more.

1) **DevOps basics:** Learn the origins of DevOps and the basic principles and techniques.
2) **AWS crash course:** Hands-on session where you learn to use the most important AWS services, including IAM, EC2, ASG, EBS, ELB, S3, and RDS.
3) **Infrastructure as code**: Overview of different techniques to manage infrastructure, including ad-hoc scripts (e.g., Bash, Python), configuration management tools (e.g., Chef, Puppet), machine images (e.g., VMs, Docker), and provisioning tools (e.g., Terraform, CloudFormation).

4) **Terraform introduction**: Go through a series of coding exercises that cover the basic Terraform syntax, state management, loops, conditionals, lifecycle management, and common gotchas.
5) **Advanced Terraform**: Go through a series of coding exercises that cover Terraform modules, file layout, keeping code DRY, team workflows, and automated testing.
6) **Immutable infrastructure:** Overview of immutable infrastructure practices, versioning artifacts, promoting artifacts through environments, and deployment.
7) **Packer introduction:** Build your own AMIs and other virtual machine images using Packer.
8) **Docker introduction**: Create your own Docker images and deploy them using Docker orchestration tools.
9) **Continuous delivery**: Learn how to integrate Terraform, Packer, and Docker into a continuous delivery pipeline.
10) **DevOps best practices**: Learn about continuous integration, microservices, feature toggles, canary deployments, monitoring, alerting, and log aggregation.
11) **Production readiness review:** A Gruntwork engineer goes through a checklist of questions with your team to see what work you need to do to be ready for prod.
12) **Architecture deployment:** Deploy your customized Reference Architecture in AWS.
13) **Architecture walkthrough:** Overview of how the architecture works and how to use it.
14) **Migrating to the new architecture:** Learn the process of migrating your apps and data to the new architecture.

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17ECAE902	Full Stack Development - MEAN

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Course Code:17ECAE902	Course Title: Full Stack Development - MEAN	
L-T-P: **3-0-1**	Credits: **4**	Contact Hrs: **5**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **42+24**		Exam Duration:**3Hrs**

No	**Content**	**Hrs**
	Unit I	
1	**Chapter 1 : Introduction to MEAN**	**5 Hrs**
	Three-tier web application development, The evolution of JavaScript, Introducing MEAN, Installing MongoDB, Installing Node.js, Introducing NPM.	
2	**Chapter 2 : Getting Started with Node.js**	**5 Hrs**
	Introduction to Node.js, JavaScript closures, Node modules, Developing Node.js web applications.	
3	**Chapter 3 : Building an Express Web Application**	**6 Hrs**
	Introduction to Express, Installing Express, Creating your first Express application, The application, request, and response objects, External middleware, Implementing the MVC pattern, Configuring an Express application, Rendering views, Serving static files, Configuring sessions.	

Unit II

4 **Chapter 4 : Introduction to MongoDB** **5 Hrs**

Introduction to NoSQL, Introducing MongoDB , Key features of MongoDB, MongoDB shell, MongoDB databases , MongoDB collections, MongoDB CRUD operations

5 **Chapter 5 : Introduction to Mongoose** **6 Hrs**

Introducing Mongoose, Understanding Mongoose schemas, Extending your Mongoose schema, Defining custom model methods, Model validation, Using Mongoose middleware, Using Mongoose DBRef.

6 **Chapter 6 : Managing User Authentication Using Passport** **6 Hrs**

Introducing Passport, Understanding Passport strategies, Understanding Passport OAuth strategies; **Introduction to AngularJS:-** Introducing AngularJS, Key concepts of AngularJS, Installing AngularJS, Structuring an AngularJS application, Bootstrapping your AngularJS application, AngularJS MVC entities

Unit – III

7 **Chapter 7: Creating a MEAN CRUD Module** **4 Hrs**

Introducing CRUD modules, Setting up the Express components, Introducing the ngResource module, Implementing the AngularJS MVC module, Finalizing your module implementation.

8 **Chapter 8: Testing MEAN Applications** **5 Hrs**

Introducing JavaScript testing, Testing your Express application, Testing your AngularJS application; Adding Real-time Functionality Using Socket.io:- Introducing WebSockets, Introducing Socket.io, Installing Socket.io, Building a Socket.io chat.

Text Book:

1. Amos Q, Haviv, Mean Web Development, Packt Publishing 2014.

References:

1. COLIN J. IHRIG, Full Stack Javascript Development with MEAN, Sitepoint.

Evaluation Scheme

In Semester Assessment (ISA)

Assessment	Marks
ISA- 1	20
ISA- 2	20
Assignment	10
Total	**50**

End Semester Assessment (ESA)

UNIT	8 Questions to be set of 20 Marks Each	Chapter Nos.	Instructions
I	3 Questions to be set of 20 Marks Each	1, 2, 3	Any 2 questions are to be answered
II	3 Questions to be set of 20 Marks Each	4.5.6	Any 2 questions are to be answered
III	2 Questions to be set of 20 Marks Each	7,8	Any 1 question is to be answered

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Practice Experiments for Full Stack

Sl No	EXPERIMENT NAME
1	Build a real-time polls application with Node.js, Express, AngularJS, and MongoDB
2	Setting Up a MEAN Stack Single Page Application
3	A Sample App with Node.js, Express and MongoDB
4	REST Service with Web Interface using the MEAN Stack
5	Creating an RSS Feed Reader With the MEAN Stack
6	Create a TV Show Tracker using AngularJS, Node.js and MongoDB
7	Deploying a MEAN App to Amazon EC2

17ECAP901	ASP .Net Lab.

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Course Code: 17ECAP901 Course Title: ASP .NET Lab **Lab.**

L-T-P:**0-0-1** Credits: **1** Contact Hrs: **2**

ISA Marks:**: 100** ESA Marks: **--** Total Marks: **100**

Teaching Hrs: **24** Exam Duration: **3 Hours**

Expt./ Job No.	*Lab assignments/experiment*	*No. of Lab. Slots per batch (estimate)*
	Demonstration	
1	Program to demonstrate ASP.Net Web Forms	01
2	Program to demonstrate validation in ASP.Net	01
3	Program to demonstrate working with Data Base applications.	01

4	Program to demonstrate session tracking in ASP.Net	01
	Exercises	
5	a) Write a program to display a feedback form. The different options for the list box must be ASP-XML, Dot NET, JavaPro and Unix, C, C++. When the Submit Form button is clicked after entering the data, a message must be displayed. **b)** Write a program containing the following controls: a. A List Box b. A Button c. An Image d. A Label The listbox is used to list items available in a store. When the user clicks on an item in the listbox, its image is displayed in the image control. When the user clicks the button,the cost of the selected item is displayed in the control.	01
6	a) Write a program to get a user input such as the boiling point of water and test it to the appropriate value using Compare Validator. b) Declare one TextBox control, one Button control, one Label control, and one RegularExpressionValidator control in an .aspx file. The submit() function checks if the page is valid. If it is valid, it returns "The page is valid!" in the Label control. If it is not valid, it returns "The page is not valid!" in the Label control. If validation fails, the text "The zip code must be 5 numeric digits!" will be displayed in the RegularExpressionValidator control.	01
7	**I.** Create table CANDIDATE with the following	01

Column name	Datatype
Ccode	Int
Name	Char(20)
DOJ	Date

i) Insert following records into the table:

Code	1001	1002	1003
Name	S.Raman	M.Sushil	Mohanyes
DOJ	12-Jun-97	12-Nov-97	30-Jul-97

	ii) Order the records on the basis of seniority of employees. iii) Drop the table.	
8	Write a Program in ASP that has a form taking the user's name as input. Store this name in a permanent cookie & whenever the page is opened again, then value of the name field should be attached with the cookie's content.	01
9	Create a Session dictionary using object tag. In session-on start add keys for Time, UserAgent, RemoteIP& add appropriate values. Create a simple page to display the values.	01
10	Write a Program to delete all cookies of your web site that has created on the client's computer	01
	Structured enquiry	
11	Write an application that contains a list of following technologies: • ASP.NET, ADO.NET, C#. • It also contains a textbox in which the user has to enter a name and a textarea in which the user has to enter his comments. When the Submit is clicked, the output should display the name entered in the textbox and the user-selection from the listbox. All the above should be displayed with the tracing for the page being enabled.	02

17ECAP902	Mini Project-4

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Course Code: 17ECAP902 Course Title: **Mini Project - 4**

L-T-P: **0-0-2** Credits: **2** Contact Hrs: **4**

ISA Marks: **100** ESA Marks: **100** Total Marks: **200**

Teaching Hrs: **48** Exam Duration: **3 Hours**

Theme: "Development of Applications using .NET/ Java Technology"

.NET Technology

The Microsoft .NET framework has major advantages over previous programming languages and environments. Applications written in .NET may be in any of several different programming languages (language interoperability). .NET consists of a re-useable library of classes (small components that help developers create applications). It also consists of a development environment to help developers rapidly and graphically build applications. All operating system functions can be encapsulated within

.NET. The framework manages the execution of applications and Web services, and provides many functionalities including security enforcement and memory management. Because of these advantages, corporations and industry are beginning to embrace .NET. They will need graduates who know how to use it. Hence, a project done using this technology would give an insight of the powerful features of .NET and help the students to find a job in this field. Below is a list of some of the types of applications that can be created using the .NET platform.

- Customer relationship management
- Accounting applications
- Product/inventory applications
- Warehousing applications using hand-held devices
- Web sites
- Value chain/supply management
- Integration with partners through the Internet
- XML Web services
- PDA (hand-held) applications

Objectives of using .NET Technology-

Student doing a project in .NET technology should be able to:

7. Develop an application that is pure OOP, platform independent, language independent and interoperable.
8. Use the features of .NET to make the application scalable, maintainable, easily deployable, reliable and secure.
9. Work with databases using ADO.NET.
10. Develop background processes windows services.
11. Create animations using .NET's WPF.
12. Create and use Web Services through SOA.

Java Technology

Java is one of the fundamental programming languages that can be used in many applications as well as product developments. The simple reason for this is because Java can be put to use in various platforms due to its multi-platform nature. Java is one of the favorite choices for developers for many reasons like security, object oriented(reusability), cross platform computing, multithreaded capability, Rich API, Powerful development tools ,availability of various frameworks, Great collection of open source libraries, wonderful community support, Excellent documentation support. Support for various databases and many more.

Students can use the following tools in web and mobile applications as well as product developments:

 Struts, Spring, Hibernate and JPA
 JAXB and Apache Axis 2/Java
 JSP, Servlets, JDBC, EJB, JMS, JTA and JUnit
 Apache Tomcat, JBoss and GlassFish
 JavaScript, JSF, GWT and jQuery
 Eclipse, Netbeans and JBoss tools

TestNG
jBPM and Drools
JCR

Objectives:

Help students to utilize and strengthen the knowledge of Java which they have learnt in previous semester.

Methodology:

Students are asked to make a team of 3-4 members and can choose the different categories of projects like desktop applications, web applications, mobile application and distributed application and work once it is approved by the coordinator.

Evaluation:

Students Assessment through ISA (100) + ESA (100%)

In Semester Assessment	**Assessment**	**Marks**
	Problem Definition, Literature Review	10
	Synopsis and SRS Deliverables	10
	Design (Module wise algorithmic design)	20
	Coding	10
	Integration and testing	10
	Report	20
	Presentation skills and Viva-voce	20
	Total	**100**
End Semester Assessment	Presentation	50
	Viva-voce	50
	Total	**100**

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17ECAE901	Block Chain Technologies

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Course Code:17ECAE901 | Course Title: **Block Chain Technologies**

L-T-P: **3-0-1** | Credits: **4** | Contact Hrs: **5**

ISA Marks: **50** | ESA Marks: **50** | Total Marks: 1**00**

Teaching Hrs: **42+24** | Exam Duration:**3Hrs**

No	**Content**	**Hrs**
	Unit I	
1	**Introduction** What blockchain is, What blockchain isn't, Blockchain definitions, How are blockchains different from databases? History of blockchain, Blockchain 2.0, The motivations behind blockchain, Characteristics of blockchain, Background of DLT, The	5 hrs

	different types of blockchain, Overview of blocks, Influence of Moore's law on blockchain technology.	
2	**A Bit of Cryptography**. Cryptography in blockchain, Classical cryptography, Cryptographic primitives, Symmetric key cryptography, Asymmetric key cryptography, Elliptic-curve cryptography, Digital signatures, Cryptographic hashing.	6 hrs
3	**Cryptography in Blockchain** Hashing in blockchain, Linking blocks in a blockchain, Linking blocks using an SHA256 hashing algorithm, Block structure, Blockchain functionality, Creating a blockchain, Byzantine failure problem in blockchain, Digital signatures in blockchain, Creating an identity, Signatures in transaction, Asset ownership in blockchain, Transferring an asset, Transmitting the transaction, Claiming the asset, Blockchain wallets.	6 hrs
	Unit - 2	
4	**Networking in Blockchain**. Peer-to-peer (P2P) networking, Network discovery, Block synchronization, Building a simple blockchain in a P2P network, Validating a new block, Selecting the longest chain, Conflict resolution, Block exchange between peers, Initial block synchronization, Broadcasting scenarios, Application interfaces.	6 hrs
5	**Cryptocurrency.** Bitcoin basics, Getting started with Bitcoin Core, Keys and addresses, Transactions, Mining and consensus, Blockchain, Blockchain networks, Bitcoin hard forks and altcoins, A simple cryptocurrency application: Transactions, Wallet, Transaction management.	6 hrs
6	Diving into Blockchain - Proof of Existence**.** MultiChain blockchain platform, Setting up a blockchain environment, Getting started with MultiChain, Proof of Existence architecture, Building the Proof of Existence application, Executing and deploying the application.	5 hrs
	Unit - 3	
7	Diving into Blockchain - Proof of Ownership**.** Digital assets and identity, Proof of ownership, Smart contracts, Choosing the smart contract platform, NEO blockchain: Building blocks of a NEO blockchain, NEO technology, NEO nodes, NEO network, NEO transactions, Ethereum blockchain: Ethereum nodes, Getting started, Creating a decentralized application.	4 hrs
8	Blockchain Security**.** Transaction security model, Decentralized security model, Attacks on the blockchain, Threats of quantum computing.	4 hrs

Text Book:

1. Foundations of Blockchain, O’REILLY publications, 2019

References:

Evaluation Scheme

In Semester Assessment (ISA)

Assessment	Marks
ISA- 1	20
ISA- 2	20
Assignment	10
Total	**50**

End Semester Assessment (ESA)

UNIT	8 Questions to be set of 20 Marks Each	Chapter Nos.	Instructions
I	3 Questions to be set of 20 Marks Each	1, 2, 3,	Any 2 questions are to be answered
II	3 Questions to be set of 20 Marks Each	4, 5, 6	Any 2 questions are to be answered
III	2 Questions to be set of 20 Marks Each	7, 8	Any 1 question is to be answered

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Practices

1. Implementation of basic cryptographic algorithms such as AES, ECC, RSA, ECDSA, SHA256.
2. Implementation of cryptographic primitives such as hash functions and digital signatures.
3. Implementation of P2P blockchain application.
4. Implementation of Interface for the cryptocurrency application such as wallet application and explorer application.
5. Implement decentralized application development using MultiChain blockchain framework by considering real time use case.
6. Develop decentralized application using smart contract concept in NEO and Ethereum blockchain platforms by considering real time use case.
7. Simulation of double spend attack on the Bitcoin unconfirmed transaction.

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17ECAE903	RESTful Web Services

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Course Code: 17ECAE903 Course Title: **RESTful Web Services**

L-T-P: **3-0-1** Credits: **4** Contact Hrs: **5**

ISA Marks: **50** ESA Marks: **50** Total Marks: **100**

Teaching Hrs: **42+24** Exam Duration:**3Hrs**

No	Content	Hrs
	Unit I	
1	**Chapter 1 : The Programmable Web and Its Inhabitants** Kinds of Things on the Programmable Web, HTTP: Documents in Envelopes, Method Information, Scoping Information, The Competing Architectures, RESTful, Resource-Oriented Architectures, RPC-Style Architectures, REST-RPC Hybrid Architectures, The Human Web Is on the Programmable Web, Technologies on the Programmable Web, HTTP, URI, XML-RPC, SOAP, WS-*, WSDL, WADL, Leftover Terminology.	**4 Hrs**
2	**Chapter 2 : Writing Web Service Clients** **Web Services Are Web Sites**, Wrappers, WADL, and ActiveResource, del.icio.us: The Sample Application, What the Sample Clients Do, Making the Request: HTTP Libraries, Optional Features, Ruby: rest-open-uri and net/http, Python: httplib2, Java: HttpClient, C#: System.Web.HTTPWebRequest, PHP: libcurl, JavaScript: XMLHttpRequest, The Command Line: curl, Other Languages.Processing the Response: XML Parsers: Ruby: REXML, I Guess, Python: ElementTree, Java: javax.xml, Xerces, or XMLPull, C#: System.Xml.XmlReader , PHP, JavaScript: responseXML, Other Languages, JSON Parsers: Handling Serialized Data , Clients Made Easy with WADL	**4 Hrs**
3	**Chapter 3 : What Makes RESTful Services Different?** Introducing the Simple Storage Service, Object-Oriented Design of S3 , A Few Words About Buckets, A Few Words About Objects, What If S3 Was a Standalone Library? Resources, HTTP Response Codes, An S3 Client, The Bucket List : The Bucket, The S3 Object, Request Signing and Access Control: Signing a URI, Setting Access Policy: Using the S3 Client Library, Clients Made Transparent with ActiveResource : Creating a Simple Service, An ActiveResource Client, A Python Client for the Simple Service, Parting Words.	**4 Hrs**
4	**Chapter 4 : The Resource-Oriented Architecture** Resource-Oriented What Now? What's a Resource? URIs: URIs Should Be Descriptive, The Relationship Between URIs and Resources : Addressability, Statelessness : Application State Versus Resource State, Representations: Deciding Between Representations, Links and Connectedness, The Uniform Interface: GET, PUT, and DELETE : HEAD and OPTIONS, POST: Creating subordinate resources, Appending to the resource state, Overloaded POST: The not-so-uniform interface, Safety and Idempotence, Safety: Idempotence ,Why safety and idempotence matter Why the Uniform Interface Matters, That's It!	**4 Hrs**
5	**Chapter 5 : Designing Read-Only Resource-Oriented Services** Resource Design, Turning Requirements Into Read-Only Resources, Figure Out the Data Set, General Lessons, Split the Data Set into Resources, General Lessons, Name the Resources, Encode Hierarchy into Path Variables, No Hierarchy? Use Commas or Semicolons, Map URIs, Scale, Algorithmic Resource? Use Query Variables, URI Recap, Design Your Representations: The Representation Talks About the State of the Resource, The Representation Links to Other States, Representing the List of Planets,	**4 Hrs**

Representing Maps and Points on Maps, Representing the Map Tiles, Representing Planets and Other Places, Representing Lists of Search Results, Link the Resources to Each Other, The HTTP Response : What's Supposed to Happen? Conditional HTTP GET, What Might Go Wrong? Conclusion.

Unit II

6 **Chapter 6 : Designing Read/Write Resource-Oriented Services** 4 Hrs

User Accounts as Resources : Why Should User Accounts Be Resources? Authentication, Authorization, Privacy, and Trust, Turning Requirements into Read/Write Resources, Figure Out the Data Set, Split the Data Set into Resources , Name the Resources with URIs, Expose a Subset of the Uniform Interface, Design the Representation(s) Accepted from the Client, Design the Representation(s) to Be Served to the Client, Link This Resource to Existing Resources, What's Supposed to Happen? What Might Go Wrong?

Custom Places : Figure Out the Data Set, Split the Data Set into Resources, Name the Resources with URIs, Expose a Subset of the Uniform Interface ,Design the Representation(s) Accepted from the Client, Design the Representation(s) Served to the Client, Link This Resource to Existing Resources, What's Supposed to Happen? What Might Go Wrong?

A Look Back at the Map Service

7 **Chapter 7 : A Service Implementation :** 4 Hrs

A Social Bookmarking Web Service, Figuring Out the Data Set, **Resource Design:** REST in Rails, The User Controller, The Bookmarks Controller, The User Tags Controller, The Calendar Controller, The URI Controller, The Recent Bookmarks Controller, The Bundles Controller, The Leftovers, Remodeling the REST Way, Implementation: The routes.rb File. Design the Representation(s) Accepted from the Client, Design the Representation(s) Served to the Client, Connect Resources to Each Other, What's Supposed to Happen? What Might Go Wrong? **Controller Code :** What Rails Doesn't Do:Conditional GET: param[:id] for things that aren't IDs, The Application Controller, The Users Controller The Bookmarks Controller, The Tags Controller, The Lesser Controllers, The Calendar Controller : The RecentController, The UrisController, Model Code: The User Model The Bookmark Model, What Does the Client Need to Know? Natural-Language Service Description, Description Through Standardization ,Hypermedia Descriptions

8 **Chapter 8 : REST and ROA Best Practices** 4 Hrs

Resource-Oriented Basics, The Generic ROA Procedure, Addressability : Representations Should Be Addressable : State and Statelessness: Connectedness, The Uniform Interface : Safety and Idempotence, New Resources: PUT Versus POSTOverloading POST, This Stuff Matters : Why Addressability Matters, Why Statelessness Matters, Why the Uniform Interface Matters, Why Connectedness Matters A terrifying example. Resource Design : Relationships Between Resources, Asynchronous Operations, Batch Operations, Transactions: When In Doubt, Make It a Resource, URI Design, Outgoing Representations, Incoming Representations, Service Versioning, Permanent URIs Versus Readable URIs, **Standard Features of HTTP :** Authentication and Authorization: Basic authentication, Digest authentication, WSSE

	username token : Compression, Conditional GET, Caching : Please cache Thank you for not caching, Default caching rules, Look-Before-You-Leap, Requests Partial GET : Faking PUT and DELETE, The Trouble with Cookies, Why Should a User Trust the HTTP Client?, Applications with a Web Interface, Applications with No Web Interface What Problem Does this Solve?	
9	**Chapter 9 : The Building Blocks of Services** **Representation Formats :** XHTML, XHTML with Microformats, Atom, OpenSearch SVG, Form-Encoded Key-Value Pairs, JSON, RDF and RDFa, **Framework-Specific Serialization Formats :** Ad Hoc XHTML, Other XML Standards and Ad Hoc Vocabularies, Encoding Issues, XML and HTTP: Battle of the encodings, The character encoding of a JSON document **Prepackaged Control Flows:** General Rules, Database-Backed Control Flow, GET, PUT, POST for creating a new resource, POST for appending to a resource, DELETE **The Atom Publishing Protocol:** Collections, Members, Service document, Category documents, Binary documents as APP members, **GData:** Querying collections, Data extensions, POST Once Exactly, **Hypermedia Technologies :** URI Templates, XHTML 4, XHTML 4 links, XHTML 4 forms, Shortcomings of XHTML 4, XHTML 5, WADL : Describing a del.icio.us resource, Describing an APP collection, Is WADL evil?	**4 Hrs**
10	**Chapter 10 : The Resource-Oriented Architecture Versus Big Web Services** What Problems Are Big Web Services Trying to Solve? SOAP :The Resource-Oriented Alternative, WSDL: The Resource-Oriented Alternative, UDDI: The Resource-Oriented Alternative, Security: The Resource-Oriented Alternative, Reliable Messaging : The Resource-Oriented Alternative, Transactions: The Resource-Oriented Alternative, BPEL, ESB, and SOA, Conclusion.	**4 Hrs**
	Unit – III	
11	**Chapter 11 : Ajax Applications as REST Clients** From AJAX to Ajax, The Ajax Architecture, A del.icio.us Example, The Advantages of Ajax, The Disadvantages of Ajax, REST Goes Better, Making the Request, Handling the Response, JSON, Don’t Bogart the Benefits of REST, Cross-Browser Issues and Ajax Libraries : Prototype, Dojo, Subverting the Browser Security Model, Request Proxying, JavaScript on Demand: Dynamically writing the script tag, Library support.	**5 Hrs**
12	**Chapter 12 : Frameworks for RESTful Services** Ruby on Rails : Routing, Resources, Controllers, and Views, Outgoing Representations, Incoming Representations, Web Applications as Web Services, The Rails/ROA Design Procedure. Restlet: Basic Concepts: Writing Restlet Clients, Writing Restlet Services: Resource and URI design, Request handling and representations, Compiling, running, and testing, Conclusion. Django: Create the Data Model, Define Resources and Give Them URIs, Implement Resources as Django Views, The bookmark list view, The bookmark detail view: Further directions, Conclusion	**5 Hrs**

Text Book:

1 RESTful Web Services by Sam Ruby, Leonard Richardson, Publisher: O'Reilly Media, Inc. Release Date: May 2007 ISBN: 9780596529260

References:

1. Hands-On RESTful Python Web Services: Develop RESTful web services or APIs ... **By Gaston C. Hillar**

Evaluation Scheme

In Semester Assessment (ISA)

Assessment	Marks
ISA- 1	20
ISA- 2	20
Assignment	10
Total	**50**

End Semester Assessment (ESA)

UNIT	8 Questions to be set of 20 Marks Each	Chapter Nos.	Instructions
I	3 Questions to be set of 20 Marks Each	1, 2, 3, 4, 5	Any 2 questions are to be answered
II	3 Questions to be set of 20 Marks Each	6, 7, 8, 9,10	Any 2 questions are to be answered
III	2 Questions to be set of 20 Marks Each	11, 12	Any 1 question is to be answered

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RESTFull Web Services

SI NO	Topics
1.	Working on XML-RPC and SOAP Protocol
2.	Working on Web Service Client using httplib2 python library
3.	Understanding of CURL command and its options
4.	Implementation of XML and JSON Parsing using Python
5.	Working on client application to store and retrive the data using S3 Bucket
6.	Implementation of RESTfull services for data request and response
7.	Working on Authentication and Authorization for RESTfull services
8.	Implementation of RESTfull services for data and serialization formats, Database connectivity
9.	Integration of AJAX and REST Clients

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17ECAP904	Robotic Process Automation.

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Program: MASTER OF COMPUTER APPLICATIONS		
Course Code: **17ECAP904**	Course Title: **Robotics Process Automation**	
L-T-P: **0-0-2**	Credits: **2**	Contact Hrs: **Full Time**
ISA Marks: **100**	ESA Marks: **--**	Total Marks: **100**
Teaching Hrs: **Full Time**		Exam Duration: **3 Hours**
The students shall undergo certification on Robotics Process Automation (RPA) during the IV or V semester vacation by choosing Automation Anywhere or UiPath course or both. The evaluation for the course shall be done after successful completion of certification on any one or both during VI semest er followed by internal assessment and submission of report.		

18ECAE903	Web Mapping

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To be approved in April 2021 BoS

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School of Management Studies and Research

Course Code: **15MBAC703**		Course Title: **Accounting for Managers**
L-T-P**: 2-1-0**	Credits: **3**	Contact Hrs: **04 hrs/week**
CIE Marks: **50**	SEE Marks: **50**	Total Marks: **100**
Teaching Hrs: **30hrs**		Exam Duration: **3 hrs**

Module 1:

Introduction of management accounting, distinction between management and financial accounting, accounting concepts and convention, GAAP and accounting standards, International Financial Reporting Standards (IFRS) and X-tensible Business Reporting Language (XBRL)

06 hrs

Module 2:

Final Accounts – Journal and ledger entries, Trading and profit and loss account, Introduction to Partnership account, Final accounts for companies

Depreciation Methods: Straight line method and Written-down value method.

10 hrs

Module3:

Financial statement analysis: analysis and interpretation of financial statements, ratio analysis, liquidity, leverage, activity and profitability ratios, DuPont analysis, advantages and limitation of ratio analysis as a management tool, Fund-flow and Cash-flow statement

10 hrs

Module 4:

Elements of Costs

Materials Costs: - Materials purchasing, receiving, storing and issuing

Labor costs and labor turnover

Overheads- Identifying the overheads with cost centre. Allocation, apportionment and absorption – accounting treatment of under and over absorption

Preparation of cost sheet – Marginal costing and Standard Costing

04 hrs

References:

1. R. Narayanaswamy, *Financial Accounting: A Managerial Perspective*, 3rd edn, Prentice Hall of India.
2. N. Ramachandran and Ram Kumar Kakani, *Financial Accounting for Management*, 1st edn, TMH Publications.
3. S. N. Maheshwari and S K Maheshwari, *A Text Book of Accounting for Management,* Vikas Publishing.
4. Ashish K Bhattacharya, *Financial Accounting for Business Managers*, 3rd edn, Prentice Hall of India.
5. Ambarish Gupta, *Financial Accounting for Managers: An Analytical Perspective,* 1st edn, Pearson.
6. Jawaharlal, *Accounting for Managers,* Himalaya Publishing House

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School of Management Studies and Research

Course Code: **15MBAC704**		Course Title: **Business Research**
L-T-P**: 2-0-0**	Credits: **2**	Contact Hrs: **02 hrs/week**
CIE Marks: **50**	SEE Marks: **50**	Total Marks: **100**
Teaching Hrs: **30hrs**		Exam Duration: **3 hrs**

Module 1:

Introduction to Business Research – scope, definition, need for research, stages in research process, need for Literature Review, report writing, ethical issues, plagiarism, decision making

07 hrs

Module 2:

Types of Research – Exploratory, Descriptive, Casual, their categories, Measurement Scales – Nominal, Ordinal, Interval, Scale, Attitude rating scales, Sampling Techniques

06 hrs

Module3:

Introduction to Hypothesis Testing

Methods of Data collection – data classification as primary and secondary

Modes of data collection – Personal Interviews, Telephonic or Internet Interview, Observation, Focus group interviews, Expert opinions, Self administered questionnaire – Likert, Thurstone, Semantic Differential (theory only), Secondary data analysis, basic issues in Experimental design Type I & Type II Errors

09 hrs

Module 4:

Types of Methodology – Quantitative, Qualitative, Mixed Methodology, Research Gap and Research Question

08 hrs

References:

1. Cooper and Schlinder, *Business Research Methods,* TMH
2. William Zikmund, *Business Research Methods*, Cengage Publication
3. G. C. Ramamurthy, *Research Methodology*, Dreamtech Press
4. Uma Sekaran and Roger Bougie, *Research Methods for Business*, Wiley Publications
5. Uwe Flick, *An Introduction to Qualitative Research*, Sage Publications
6. Gerard Guthrie, *Basic Research Methods*, Sage Publications

School of Management Studies and Research

Course Code: **15MBAC706** Course Title: **Effectual Entrepreneurship**
L-T-P**: 1-1-0** Credits: **2** Contact Hrs: **03 hrs/week**
CIE Marks: **100** SEE Marks: - Total Marks: **100**
Teaching Hrs: **15 hrs**

Module 1:

Effectuation, Principles of Effectuation- 1) Bird-in-hand: when expect entrepreneurs set out to build a new venture, they start with their means: who I am, what I know, and whom I know. Then the entrepreneurs imagine the possibilities that originate from their means. 2) Affordable loss- Focus is on down side risk: Expert entrepreneurs limit the risk by understanding what they can afford to lose at each step, instead seeking large all or nothing opportunities. 3) Lemonade- Leverage contingencies: Instead of making what if scenarios to deal with wrist case scenarios entrepreneurs interpret bad news and surprises as potential clues to create new markets. 4) Patchwork Quilt – form partnership: build the partnership with self selecting stakeholders; by obtaining pre-commitments from these key partners early in venture, this reduces the uncertainties and co-creates new market with likeminded people. 5) Pilot-in-the-plane- control vs. predict: by focusing on the activities with their control, expert entrepreneurs can predict the result or desired outcomes.

10 hrs

Module 2:

World making: Understand Transformation, Financing: Bootstrap the venture, Current trends in Entrepreneurship, Entrepreneurship as a technology for social change, Contingency management

5 hrs

References:

- Stuart Read, Saras Sarasvathy, Nick Dew, Effectual Entrepreneurship, Routledge

School of Management Studies and Research

Course Code: **15MBAC707**		Course Title: **Business Statistics**
L-T-P**: 1-1-1**	Credits: **03**	Contact Hrs: **5 hrs/week**
CIE Marks: **50**	SEE Marks: **50**	Total Marks: **100**
Teaching Hrs: **15hrs**		Exam Duration: **1.5 hrs**

Module 1:

Introduction to business statistics: Importance of statistics in managerial decision-making, the nature of study, limitations and misuse of statistics, subdivisions within statistics.

Data types, Frequency Distribution, Tables and Graphical Representation, Measures of Central Tendency, Measures of Dispersion

09 hrs

Module 2:

Probability distribution: Normal distribution, Correlation and Regression Analysis, Test for means and Proportions, Test for equality of population means, confidence interval, introduction to Chi-square test.

06 hrs

References:

1. G. C. Beri, 2005, *Business Statistics*, 2nd edition, Tata McGraw-Hill.
2. R I Lewin and David S Rubin, *Statistics for Management*, 7th edition, Pearson.
3. Robert E. Stine, Dean Foster, *Statistics for Business: Decision Making and Analysis*, 1st edition, Pearson
4. Bruce Bowerman, Emly S. Murphree, Richard O'Connell *Business Statistics in Practice*, 5th edition, Tata McGraw-Hill.
5. J K Sharma, *Business Statistics*, 3rd edition, Vikas Publication.

School of Management Studies and Research

Course Code: **15MBAP701** Course Title: **Industry Experience Phase- I**
L-T-P**: 0-0-1** Credits: **1** Contact Hrs: **02 hrs/week**
CIE Marks: **100** SEE Marks: **--** Total Marks: **100**
Teaching Hrs: **30 hrs**

- Organization Profile (Ownership type, MSME, MD/Owner, Revenue and employee strength, Product or services and Business model)
- Organization structure & code of conduct
- Ethical Practices & Corporate Social Responsibility
- Business Processes Study in Organization
- Interdependency of different Business Processes

School of Management Studies and Research

Course Code: 15MBAP703 | Course Title: **Fundamentals of Communication**

L-T-P**: 0-0-1** | Credits: **1** | Contact Hrs: **02hrs/week**

CIE Marks: **100** | SEE Marks: **--** | Total Marks: **100**

Teaching Hrs: **30 hrs**

Topic 1: Vocabulary and Verbal Skill

- Analogies, Synonyms and Antonyms
- Pronunciation and Pronunciation for accent neutralization
- Listening dictations
- Reading Comprehension
- Sentence Completion
- Error Detection

Topic 2: Writing Skills

- Essay
- Short Notes
- Interpretation
- Correcting grammatical errors

Topic 3: Art of Communication

- Components of Communication
- Confident Body Language
- Empathetic Vocabulary
- Modulating Voice
- Active Listening

Topic 4: Presentation Skills

- Successful Presentations
- Overcoming Fear of Audience
- E-Presentations
- Working with PowerPoint

Topic 5: Discussions and Debates

- Convincing Speech
- Introduction to Rhetoric and Syllogistic Logic
- Importance of Pause, Pitch and Pace
- Handling different topics

References:

- Vilanilam J V, *More Effective Communication: A Manual for Professionals,* Sage Publications.
- Shirley Taylor, 2005, *Communication for Business: A Practical Approach*, 4th Edition, Pearson Longman.
- John M Penrose, Robert W. Rasberry, and Robert J. Myers, *Advanced Business Communication*, 3rd edition, Thomson South-Western.
- Urmila Rai and S.M. Rai, *Business Communication*, Himalaya Publishing House.
- Raymond V. Lesikar, Basic Business Communication: Irwin/McGraw-Hill, 1999
- Sam Phillips, 3000 Synonyms and Antonyms 1st Edition, Goodwill Publishing House

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School of Management Studies and Research

Course Code: **15MBAC709**		Course Title: **Decision Modeling**
L-T-P**: 3-0-0**	Credits: **3**	Contact Hrs: **03hrs/week**
CIE Marks: **50**	SEE Marks: **50**	Total Marks: **100**
Teaching Hrs: **40hrs**		Exam Duration: **3 hrs**

Module 1:

Introduction to Operations Management (OR)

Linear Programming: Introduction, formulation, assumptions, solution: feasible, optimal, multiple

Solutions to Linear Programming problems: Graphical method, simplex method, Big-M method

Dual Theory: Existence of dual of a LP problem

14 hrs

Module 2:

Transportations problems: Introduction, assumptions, variants

Assignment problem: Introduction, representation, Hungarian method

Introduction to Qualitative analysis and bonded rationality

11 hrs

Module 3:

Queuing Theory: Characteristics of the queuing system, M/M/1 queuing system

04 hrs

Module 4:

Introduction to network scheduling, Project scheduling with CPM, Network construction, Computation of activity times, critical path

05 hrs

Module 5:

Game theory: Formulation of games, two-person zero-sum game with and without saddle point, dominance property, Current trends and applications of Decision Modeling

06 hrs

References:

1. Vohra N. D., 2004, *Quantitative Techniques in Management*, Tata-McGraw Hill.
2. Frederick S. Hillier and Gerald J. Lieberman, *Introduction to Operations Research*, McGraw-Hill Science.
3. Prem Kumar Gupta and Hira D. S., 2007, *Operations Research*, S Chand & Co.
4. Ravindran A., Don T. Phillips, and James J. Solberg, 1987, *Operations Research: Principles and Practice*, 2nd edition, Wiley International.

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School of Management Studies and Research

Course Code: **15MBAC710**	Course Title: **Marketing Management**
L-T-P**: 2-1-0** Credits: 3	Contact Hrs: **04 hrs/week**
CIE Marks: **50** SEE Marks: **50**	Total Marks: **100**
Teaching Hrs: **30 hrs**	Exam Duration: **3 hrs**

Module 1:

Introduction to Marketing, Core Concepts, Marketing Mix, Marketing Planning and Strategies, Scanning the Marketing Environment, Creating Customer Value and Customer Relationships

09 hrs

Module 2:

Analyzing Consumer Markets, Analyzing Business Markets, Identifying Market Segments and Targets, Competitive Dynamics

07 hrs

Module 3

Brand Positioning, Brand Equity, Setting Product Strategy, Managing Services, Pricing Strategies and Programs, Integrated Marketing Channels, Retailing, Wholesaling, and Logistics

07 hrs

Module 4

Integrated Marketing Communications, Managing Mass Communications, Managing Personal Communications, Introducing New Market Offerings, Tapping into Global Markets, Contemporary issues in marketing

07 hrs

References:

1. Philip Kolter, Kevin keller, Abhraham Koshy and Mithleshwar Jha ,*Marketing Management – A south Asian Perspective,* Pearson Publication 14th Edition
2. Arunkumar and N Meenakshi, *Marketing Management* Vikas Publication, 2nd Edition

School of Management Studies and Research

Course Code: **15MBAC712**		Course Title: **Financial Management**
L-T-P**: 2-1-0**	Credits: **3**	Contact Hrs: **04hrs/week**
CIE Marks: **50**	SEE Marks: **50**	Total Marks: **100**
Teaching Hrs: **30 hrs**		Exam Duration: **3 hrs**

Module 1:

Introduction, Planning and Financial System

Introduction – Nature and scope of Financial Management, meaning of business finance, Profit Vs Wealth maximization, Agency problem, financial planning, budgets and budgetary control: production-sales-cash and master budgets. Introduction of Indian Financial System

07 hrs

Module 2:

Time Value and Capital Budgeting

Time value of money, capital budgeting, different phases of capital budgeting, criteria for selection of projects, NPV, IRR, BCR,ARR, simple and discounted payback period criteria. (Problems using excel)
Capital rationing and replacement projects.

08 hrs

Module 3:

Working Capital Management

Working capital management, different sources of working capital, deciding requirement of working capital Working capital financing: Short term financing of working capital, long term financing of working capital.

Cash and Receivables

Cash management – Nature and motives, marketable securities, Basic strategies. Receivables Management – Objectives, Credit policies, Credit terms, Collection policies. (Only basics)

Long Term and short term Sources of Capital

Introduction to long term **and short term** sources of capital, leverages: operating, financial, and combined leverages, capital structure decisions, planning the capital structure, cost of capital, specific and composite cost. Hybrid Financing

11 hrs

Module 4:

Personal Financial Planning

Basic financial planning, tax issues, managing savings and other liquid accounts, buying a house, the use of credit, managing investments and saving for retirement, insurance (health, vehicle etc)

04 hrs

References:

1. Prasanna Chandra, *Fundamentals of Financial Management,* 7th edn, Tata McGraw Hill.
2. I M Pandey, *Essentials of Financial Management*, 9th edn, Vikas.
3. M. Y. Khan and P. K. Jain, *Financial Management*, 5th edn, Tata McGraw Hill.
4. Stephen A. Ross, Randolph W. Westerfield, Bradford D. Jordan, *Fundamentals of Corporate Finance*, 6th edn, Tata McGraw Hill.

5. Aswath Damodaran, *Corporate Finance – Theory and Finance*, 2nd edition, Wiley India.
6. Richard A. Brearley, and Stewart C. Myers, *Principles of Corporate Finance*, 7th edn, Prentice Hall of India.

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School of Management Studies and Research

Course Code: **15MBAC713**	Course Title: **Human Resource Management**
L-T-P: **3-0-0** Credits: **3**	Contact Hrs: **03hrs/week**
CIE Marks: **50** SEE Marks: **50**	Total Marks: **100**
Teaching hrs: **40 hrs**	Exam Duration: **3 hrs**

Module 1:
Introduction, characteristics, scope, objectives, functions and role of HRM, HRM versus personnel management, difference between HRM and HRD (HRD), qualities of Human Resource (HR) manager, HR manager as a strategic partner.

08 hrs

Module 2:
Job design, job analysis, job description, job specification, job enrichment, job enlargement, job rotation, introduction to compensation benefits and management - purpose, meaning, factors, challenges and process

06 hrs

Module 3:
Acquisition of human resources, objectives of man power planning, man power planning, recruitment, sources of recruitment, selection, interview, tests, selection techniques, procedure for placement, induction.

10 hrs

Module 4:
Performance management and appraisal - meaning, purpose, factors affecting appraisal, merits & demerits of performance appraisal, performance counseling, employee engagement, competency mapping. Introduction to compensation management

06 hrs

Module 5:
Training and development, meaning and distinction between training and education, responsibilities, need and objectives of training, training methods & evaluation, managing careers, welfare facilities, industrial relations, work life balance, Introduction IHRM (International Human Resource Management), HR Ethical issues, Contemporary issues in HRM

10 hrs

References:

1. Gary Dessler, Human Resource Management, 10th edition, Prentice Hall
2. Cynthia D. Fisher, Lyle F. Schoenfeldt, and James B. Shaw, Human Resource Management, Biztantra.
3. Ashwatappa K, Human Resource and Personnel Management, 4th edition, Tata McGraw Hill.
4. Subba Rao P, Personnel and Human Resource Management, Himalaya Publishing House
5. Rao V S P, Human Resource Management, Excel Books

School of Management Studies and Research

Course Code: **15MBAC714**		Course Title: **Operations Management**
L-T-P**: 3-1-0**	Credits: **04**	Contact Hrs: **05 hrs/week**
CIE Marks: **50**	SEE Marks: **50**	Total Marks: **100**
Teaching Hrs: **40hrs**		Exam Duration: **3 hrs**

Module 1:

Introduction to OM, nature and scope of operations/production management, trends and challenges in OM, road map for competitive operations, OM across the organisations, operations as a key functional area in an organisation

Facility Planning–Location: globalisation of operations, factors affecting location decisions, location planning methods

TQM: defining quality, Quality management tools with emphasis on control charts for variables and attributes.

07 hrs

Module 2:

Capacity planning: definition and measures of capacity, time horizon and framework in capacity planning, alternatives for capacity augmentation, decision tree for capacity planning.

Facility Planning–layout: implications of layout planning, types of layout, performance measures for layout design, design of process and product layout.

Material Handling: principles, various material handling systems

09 hrs

Module 3:

Aggregate planning: Planning hierarchies in operations, aggregate production planning, necessity of aggregate plan, frame work for aggregate production planning, alternatives for managing demand and supply. Resources planning: dependent demand attributes, framework, Materials Requirement Planning (MRP).

08 hrs

Module 4:

Scheduling of operations: need and basis for scheduling, loading of machines, scheduling of flow and job shops, issues in mass production systems, Sequencing

06 hrs

Module 5:

Role of materials management- materials and profitability, purchase functions, procurement procedures including bid systems, vendor selection and development, vendor rating, ethics in purchasing, roles and responsibilities of purchase professionals, concepts of lead time, purchase requisition, purchase order, amendments, forms used and records maintained. Inventory Management: concepts of inventory, types, classification, selective inventory management, ABC VED, and FSN analysis. Inventory costs, Inventory models – Economic order quantity (EOQ), safety stocks, re-order point, quantity discounts. Stores- types, functions, roles responsibilities, Inventory records

10 hrs

References:

1. Mahadevan B, *Operations Management: Theory and Practice*, Pearson Education.
2. Ritzman LP and Krajewski LJ, ***Foundations of Operations Management*, Prentice Hall.**

3. Gaither N and Fraizier G, *Operations Management*, Thomson South-Western.
4. Monks JG, *Operations Management: Theory and Problems,* 3rd edition, McGraw Hill.
5. Klassen RD and Larry J. Menor LJ, *Cases in operations Management,* Sage.

School of Management Studies and Research

Course Code: **15MBAP704**		Course Title: **Managerial Aptitude**
L-T-P**: 0-0-1**	Credits: **1**	Contact Hrs: **02hrs/week**
CIE Marks: **100**	SEE Marks: **NA**	Total Marks: **100**
Teaching Hrs: **30hrs**		Exam Duration: **N/A**

Module 1:

Arithmetical Reasoning - Number Systems and Speed Math, Factors and Multiples, Combinations, Probability, Percentages, Interest, Alligations and Averages, Man-Hour Calculations

Analytical Thinking- Data Analysis, Data Interpretation, Data Sufficiency, Puzzle Tests

17 hrs

Module 2:

Verbal Logic- Verbal Analogy, Verbal Classification, Letter and Number Series, Decoding the Codes

Non – Verbal Logic - Non – Verbal Analogy, Non – Verbal Classification, Pattern Completion, Pattern Comparison

13 hrs

References:

1. A Modern Approach to Verbal and Non – Verbal Reasoning – R. S. Aggarwal, Sultan Chand and Sons, New Delhi
2. Verbal and Non – Verbal Reasoning – Chopra, MacMillan India
3. Quantitative Aptitude – R. S. Aggarwal, Sultan Chand and Sons, New Delhi
4. Lateral Thinking – Dr. Edward De Bono, Penguin Books, New Delhi

School of Management Studies and Research

Course Code: **15MBAP705** Course Title: **Industry Experience phase- II**
L-T-P**: 0-0-1** Credits: **1** Contact Hrs: **02hrs/week**
CIE Marks: **100** SEE Marks: **--** Total Marks: **100**
Teaching Hrs: **30 hrs**

Industry experience:

- Literature Review,
- Problem Statement (Observation, Discussions, Extension of Previous Report)
- Objectives
- Scope
- Research Methodology

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Course Code: **15MBAP706**		Course Title: **Corporate Communication**
L-T-P**: 0-0-1**	Credits: **1**	Contact Hrs: **02hrs/week**
CIE Marks: **100**	SEE Marks: **--**	Total Marks: **100**
Teaching Hrs: **50 hrs**		

1. Public speaking
2. Report writing
3. Business letters: Inquiries, Circulars, Quotations, Orders, Acknowledgments Executions,
4. Business letters: Complaints, Claims & adjustments, Collection letter, Banking correspondence, Agency correspondence, Bad news and persuading letters.
5. Business letters: Sales letters, Job application letters, Covering Letter.
6. Business letters: Interview Letters, Letter of Reference,
7. Memos, minutes, Circulars & notices.
8. Organize meetings, group discussions, videoconferencing, interviews, virtual meetings
9. Crisis communication
10. Apply business etiquettes-netiquettes, telephonic, email etiquettes & table etiquettes.
11. Prepare Business presentations.

References:

1. Vilanilam J V, More Effective Communication: A Manual for Professionals, Sage Publications.
2. Shirley Taylor, 2005, Communication for Business: A Practical Approach, 4th Edition, Pearson Longman.
3. John M Penrose, Robert W. Rasberry, and Robert J. Myers, Advanced Business Communication, 3rd edition, Thomson South-Western.
4. Urmila Rai and S.M. Rai, Business Communication, Himalaya Publishing House.
5. Raymond V. Lesikar, Basic Business Communication: Irwin/McGraw-Hill, 1999
6. Sam Phillips, 3000 Synonyms and Antonyms 1st Edition, Goodwill Publishing House
7. John Jackman and Wendy Wren, Nelson English Evaluation Pack – Book 5, Thomas Nelson

School of Management Studies and Research

Course Code: **15MBAC805**		Course Title: **Social Entrepreneurship**
L-T-P-S**: 1-1-0**	Credits: **2**	Contact Hrs: **03hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **50**
Teaching Hrs: **14hrs**		Exam Duration: **1.5 hrs**

Module 1:

Social Entrepreneurship – Definition of Social Entrepreneurship, Characteristics of Social Entrepreneurs, Lifecycle of Social Entrepreneurship, Boundaries of Social Entrepreneurship, Social Entrepreneurship in developing countries, social entrepreneurship vs charity

5 hrs

Module 2:

Social impact analysis, Corporate Social Entrepreneurship, Technology and Social Innovations leading to Social Entrepreneurship, Learning from Social Enterprises

5 hrs

Module 3:

Social Enterprise and Social Marketing, Social Enterprise funding – Social finance, Cloud funding, Current trends in Social Entrepreneurship in India and World

4 hrs

References:

- Robert Philips, Margret Bonefiel, Ritesh Sharma, 2011, *Social Entrepreneurship-The next big business opportunity* Global Vision Publishing House
- Alex Nicholls, 2008, *Social Entrepreneurship: New Models of Sustainable Social Change*, Oxford University Press
- David Bornstein, 2007, *How to Change the World: Social Entrepreneurs and the Power of New Ideas*, Oxford University Press

School of Management Studies and Research

Course Code: **15MBAC806**		Course Title: **Technology: an enabler**
L-T-P**: 2-0-0**	Credits: **2**	Contact Hrs: **03 hrs/week**
ISA Marks: **100**	ESA Marks:	Total Marks: **100**
Teaching Hrs: **28 hrs**		**E**xam Duration: 3 hrs

Module 1

Data and information, Concepts of management information systems, Information systems in organization, information as resource of competitive advantage, Decision making with MIS, Contemporary approaches to MIS, Data Warehouse, ICT for Development and E-commerce, ethical and social issues related to systems

10 hrs

Module 2

Technology management, knowledge based economy, Internet on things (IoT), Smart city, GPS & RFID

10 hrs

Module 3

E-governance : Central and State government services

08 hrs

References:

- Rahul De, *Managing Information Systems in Business, Government and Society*, Wily India Publication; 1st Edition
- Gordon B. Davis and Margrethe H. Olson, *Management Information Systems (Conceptual foundations, Structure and Development)*McGraw Hill Education India Private Limited; 2 edition
- James O'Brien and George Marakas, *McGraw Hill Education India Private Limited*; 10 edition

School of Management Studies and Research

Course Code: **15MBAI801** Course Title: **Summer Internship**
L-T-P**: 0-0-3** Credits: **3** Contact Hrs: **06Sessions/week**
ITA Marks: **100** ETA Marks: **--** Total Marks: **100**
Teaching Hrs: **80hrs**

Tasks:

- Data collection
- Analysis and Interpretation
- Findings, recommendations and conclusion
- Report writing
- Experience worth noting

School of Management Studies and Research

Course Code: **15MBAW802** Course Title: **Entrepreneurship Project -Phase I**
L-T-P**: 0-0-2** Credits: **2** Contact Hrs: **04 Sessions/week**
ITA Marks: **100** ETA Marks: **--** Total Marks: **100**
Teaching Hrs: **84hrs**

This track will be offered to few selected and interested students.

Tasks:

- Self Awareness and assessment relating to entrepreneurship
- Literature survey and review
- Review effectuation process
- Ideation and finalizing one idea

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School of Management Studies and Research

Course Code: **15MBAE812** Course Title: **Advanced Financial Management**
L-T-P: **3-0-0** Credits: **3** Contact Hrs: **03 hrs/week**
ISA Marks: **50** ESA Marks: **50** Total Marks: **100**
Teaching Hrs: **40hrs** Exam Duration: **3 hrs**

Module 1:
Working capital management – Determination of level of current assets. Sources for financing working capital. Bank finance for working capital. (problems on estimation of working capital). Working capital leverages.

09 hrs

Module 2:
Cash Management – Forecasting cash flows – Cash budgets, long-term cash forecasting, monitoring collections and receivables, optimal cash balances – Baumol model, Miller-orr model. Strategies for managing surplus fund. (No problems)
Receivables Management – Credit management through credit policy variables, marginal analysis, Credit evaluation : Numerical credit scoring and Discriminate analysis. Control of accounts receivables, Problems on credit granting decision.

12 hrs

Module 3:
Leasing: Concept, Steps in Leasing Transactions, Types of Lease, Legal frameworks, Advantages and dis advantages of Leasing, Contents of a Lease Agreement, Matters on Depreciation and Tax, Problems in leasing, Factors influencing Buy or Borrow or Lease Decision.
Hire Purchasing: Concepts and features, Hire Purchase Agreement, Comparison of Hire Purchase with Credit sale, Installment sale and Leasing. Banks and Hire Purchase. Reverse mortgage.(Problems related to outright purchase, Hire purchase and Leasing)

10 hrs

Module 4:
Capital structure decisions – capital structure & market value of a firm. Theories of capital structure – NI approach, NOI approach, Modigliani Miller approach, traditional approach. Arbitrage process in capital structure. Planning the capital structure: EBIT and EPS analysis. ROI & ROE analysis. Capital structure policy .

Dividend policy – Theories of dividend policy : relevance and irrelevance dividend decision. Walter's & Gordon's model, Modigliani & Miller approach. Dividend policies – stable dividend, stable payout and growth. Bonus shares and stock split corporate dividend behavior. Legal and procedural aspects of dividends Corporate Dividend Tax. **09 hrs**

Recommended Books:

- Financial Management - Prasanna Chandra, 8/e,TMH, 2011.
- Financial Management - M.Y. Khan & P.K. Jain, 6/e, TMH, 2011.
- Advanced Financial Management – Sudhindra Bhat – Excel Books.

Reference books:

- Financial Management: Theory & Practice - Brigham & Ehrhardt, 10/e, Cenage Learning, 2004.

- Ross, Westerfield & Jaffe, Corporate Finance– TMH – 8/e, 2010
- Financial Management & Policy - Vanhorne, 12/e, Pearson
- Financial management :principles and applications- Keown, Martin, Petty. Scott, PHI.
- Principle of Corporate Finance– Brearly and Myers, 10/e, TMH, 2012.
- Corporate Finance:Theory & Practice – Ashwath Damodaran, 2/e, Wiley India Pvt. Ltd., 2009.

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School of Management Studies and Research

Course Code: **15MBAE822** Course Title: **Industrial Legal Environment**
L-T-P**: 3-0-0** Credits: **3** Contact Hrs: **03 hrs/week**
ISA Marks: **50** ESA Marks: **50** Total Marks: **100**
Teaching Hrs: **40hrs** Exam Duration: **3 hrs**

Module 1:
Introduction to labour legislation, Indian constitution and Labour Legislations, International Labour Organization and its influence on Labour Legislations in India

6 hrs

Module 2:
Laws on working conditions:
The Factories Act, 1948, Shops and Establishment Law, Contract Labour (Regulation and Abolition Act, 1986).

10 hrs

Module 3:
Industrial relations laws :
Trade Union Act, 1926, Industrial Disputes Act, Industrial Employment (Standing Orders) Act, 1946.

10 hrs

Module 4:
Wages and labour laws :
Minimum Wages Act, 1948, Payment of Wages Act, 1936, Equal Remuneration Act, 1976, Payment of Bonus Act

05 hrs

Module 5:
Laws for labour welfare and social security:
Employees Compensation Act, 1923, The Employees' State Insurance Act, 1948, The Maternity Benefit Act, 1961, The Employee's Provident Fund and Miscellaneous Provision Act, 1952, Payment of Gratuity Act
Recent amendments in labour laws

09 hrs

References:

- Agarwal, S. L, *Labour Relations Law in India*, McMillan.
- B.D. Singh, *Labour Laws for Managers,* Excel Books.
- Pathak, A, *Legal Aspects of Business,* Tata McGraw Hill.
- Srivastava. S. C, *Labour Law in Factories, Mines, Plantations* etc, Printice Hall.
- Mishra S.N, *Labour and Industrial Laws,* Central Law Publications, Allahabad.
- Bare Acts

School of Management Studies and Research

Course Code: **15MBAE805** Course Title: **Integrated Marketing Communications and Brand Management**

L-T-P-S**: 2-1-0-0** Credits: **03** Contact Hrs: **04 hrs/week**

ISA Marks: **50** ESA Marks: **50** Total Marks: **100**

Teaching Hrs: **28 hrs** Exam Duration: **3 hrs**

Module 1:

Integrated marketing communication: The evolution of IMC, reasons for growing importance of IMC, the promotional mix- advertising, direct marketing, internet marketing, sales promotion, publicity, public relations, personal selling, promotion management, IMC planning process

05 hrs

Module 2:

Organizing for advertising and promotion: The role of ad agencies, agency compensation, evaluating agenISAs, developing the integrated marketing communication program, Importance of creative advertising.

Media planning & strategy: An overview on media planning, developing media plan, market analysis and target market identification, establishing media objective, developing and implementation media strategies, evaluation and follow up.

Internet and IMC: Measuring the effectiveness of Internet advertising, advantages and disadvantages of Internet marketing, direct marketing on Internet budgeting for marketing communication

12 hrs

Module 3:

Types of branding: Product branding, line branding, range branding, umbrella branding source and double branding, celebrity endorsement branding, choosing branding strategy, brand valuation.

06 hrs

Module 4:

Contemporary topics **05 hrs**

References:

- Belch, M.A., and Belch, G.E., *Advertising and Promotion*, Tata Mc-Graw Hill Publication
- Keller Kevin, Strategic Brand Management, Pearson Publication, Third Edition
- Shah, K. and D'souza, A., *Advertising & Promotion*, Tata Mc-Graw Hill Publication
- Verma, H.V., *Brand Management*, Excel Books, Second Edition.

School of Management Studies and Research

Course Code: **15MBAE821** Course Title: **Learning and Development**
L-T-P-S: 2-**0-1** Credits: **3** Contact Hrs: **04 hrs/week**
ISA Marks: **50** ESA Marks: **50** Total Marks: **100**
Teaching Hrs: **28 hrs** Exam Duration: **3 hrs**

Module 1:

Introduction to learning and development

Introduction to learning, training and development, theories of learning and theories of adult learning, needs analysis of training, design and development, training methodology: pre-placement, management development, on the- job training, off –the- job management training and development techniques. **07 hrs**

Module 2:

Performance evaluation and Appraisal

Performance Appraisal: meaning, types, various methods, process, potential appraisal and pitfalls, Succession planning **06 hrs**

Module 3:

Evaluating Training Programs

Meaning, Donald Kirkpatrick's evaluation model, data collection for training evaluation, designs of training evaluation, introduction training evaluation and process, ROI: Measuring: a search for best practices, model, collecting post-program data and converting data to monetary benefits **09 hrs**

Module 4:

Trends of learning and development

E-learning and use of technology for training, creativity and its role in management, time management and stress management, social learning & knowledge collaboration **06 hrs**

Module 5:

Life Skill

Nature & environment, Academic excellence & human values, Discipline, Relationship
Precious life & career

References:

- Noe A Raymond, Employee Training & Development, McGraw Hill Publication.
- Rolf Lynton & Udai Pareek, Training for organizational transformation, Sage Publications, New Delhi.
- Krishnaveni R, Human Resource Development, Excel books.
- Jackie Clifford & Sara Thorpe, Workplace Learning & Development: Delivering Competitive Advantage for your organisation, Kogan Page Limited (2007)
- The New Social Learning, 1st Edition, **Author:** Tony Bingham, 2012, Cengage Learning India Pvt. Ltd, New Delhi
- Skills for Life: The Fundamentals You Need to Succeed, **Author:** Jonathan Peck , Mike Jarvis, 2003, Skills For Life LLC Publishing
- Performance Appraisal – Theory and Pract ice – Rao T.V.

School of Management Studies and Research

Course Code: **15MBAE801**		Course Title: **Sales and Distribution Management**
L-T-P-S**: 2-1-0-0**	Credits: **03**	Contact Hrs: **04hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **28 hrs**		Exam Duration: **3 hrs**

Module 1:

Introduction to Sales Management:

Introduction, Evolution of sales management, nature importance of sales management, role and skills of modern sales people, sales management positions/sales as a career, responsibilities (social, ethical, legal) of sales person.

05 hrs

Module 2:

Planning sales team:

Nature of organization, types, characteristics of the organization, sales budget, designing of sales territories, sales objectives, quotas and targets, role of ICT in sales organization.

05 hrs

Module 3:

Sales force Management: Sales force recruitment and placement, sales force training and development, personal selling process, motivating sales people, leadership in sales force management, analysis and evaluation of sales-force management, Distribution and Channel Management: Introduction, channel design and implementation, channel flow and efficiency analysis, channel structure, sales discounting practices.

13 hrs

Module 4:

Contemporary topics: Global Sales force management, Role of technology inSales force and Distribution Channel Management, ethical and social issues in sales management.

5 hrs

References:

- Spiro, Stanton, Rich, *Management of Sales force*, 11th Edition Tata McGRAW Hill
- Krishna K Havaldar, M Cavale, *Sales and Distribution Management: Text and Cases*, McGRAW Hill
- Tapan K Panda, Sunil Sahadev, *Sales and Distribution Management,* 2nd Edition, Oxford Higher Education.

School of Management Studies and Research

Course Code: **15MBAE811** Course Title: **Security Analysis and Portfolio Management**

L-T-P**: 3-0-0**	Credits: **3**	Contact Hrs: **03 hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **40hrs**		Exam Duration: **3 hrs**

Module 1:

Introduction to Investments: Concepts of investment-characteristics and objectives of investment, investment Vs speculation, forms of investment, alternative investments, marketable and non marketable financial assets

Analysis of risk & return, concept of total risk, elements of risk - systematic and unsystematic risk, business risk, interest rate risk, market risk, management risk, purchasing power risk. Measuring Risk and Return

08 hrs

Module 2:

Fundamental analysis, equity valuation, balance sheet techniques, discounted cash flow technique, dividend discount model, zero growth model, constant growth, two stage growth, earning multiplier approach

Bond characteristics, bond price, bond yield, Price, yield relationship, risk in bonds, rating, yield theories, segmentation theory.

10 hrs

Module 3:

Technical analysis: introduction, the concept of Dow theory, trend and trend reversals, chart patterns, Eliot wave theory, mathematical indicators, CAMELS model approach

05 hrs

Module 4:

Efficient market hypothesis and portfolio management**:** behavior of market, efficient market hypothesis, portfolio Analysis, return and risk of portfolio, portfolios with more than two securities

Portfolio Selection, feasible set of portfolios, optimal portfolio, Ideal vs Desired Portfolio

Markowitz model, single index model, multi index model, CAPM, Arbitrage Pricing Theory

11 hrs

Module 5:

Portfolio Performance, Evaluation and Revision**:** portfolio revision, meaning and constraints, revision strategies portfolio evaluation, need and meaning, differential return, Treynor ratio pros and cons, residential and other forms.

06 hrs

References:

- Chndra Prasanna, *Investment Analysis and Portfolio Management*, 3rd Edition, TMH
- Alexander, Sharpe, Bailley, *Fundamentals of Investment*, Pearson
- Punithavati Pandyan, *Security Analysis and Portfolio Management*, Vikas Publishers
- Kevin S, *Portfolio Management*, 2nd edition, Prentice Hall of India

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School of Management Studies and Research

Course Code: **15MBAE832**	Course Title: **Service Operation Management**
L-T-P**: 3-0-0** Credits: **3**	Contact Hrs: **03 hrs/week**
ISA Marks: 5**0** ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **40hrs**	Exam Duration: **3 hrs**

Module 1:
Role of Services in an Economy, Nature of Services, Service Strategy,

08 hrs

Module 2:
Technology in services, Service Quality, Service Encounter, Support Facility, Service Facility Location**,** Service Documentation

08 hrs

Module 3:
Forecasting Demand for services, Managing Capacity w.r.t demand, managing waiting lines, capacity planning, service supply relationships

08 hrs

Module 4:
Customer relationship management: Customer requirement assessment, customer satisfaction parameters and indices, customer feedback collection and analysis, customer service evaluation, Service Training, Service Costing, Grievance Management

08 hrs

Module 5:
IT enabled customer service: Call-centre operations and management, web-enabled services, (Enterprise Resource Planning) ERP enabled field and technical support services, telemarketing and servicing

08 hrs

References:

- Fitzsimons, AJ and Fitzsimmons MJ, *Service Management Operations, Strategy and Information Technology*, Tata McGraw Hill, 2006.
- Haksever C, Render, Russell RS, Murdick RG, *Service Management and Operations*, Pearson.
- Schemenner R, Service Operations Management, Prentice Hall
- Hill, AV, Field Service Management: *An Integrated Approach to Increasing Customer Satisfaction,* Business One Irwin/ APICS

School of Management Studies and Research

Course Code: **15MBAC804**		Course Title: **Small Business Management**
L-T-P**: 1-1-0**	Credits: **2**	Contact Hrs: **03 hrs/week**
ISA Marks: **50**	ESA Marks: - 50	Total Marks: **100**
Teaching Hrs: **14 hrs**		Exam Duration: **1.5 hrs**

Module 1:

Foundation for Small Business in the Indian Context: A Brief History of Small Business, Definition of Small Business, Small Business in the Indian Economy, Success and Failure in Small Businesses, Evolution, Ethics, SBM and E-Commerce, E-Commerce operations and Technology, Family owned small business: An Overview and Family Business Issues

08 hrs

Module 2:

Human resource management (HRM) in SBMs, Process of decision making in SBM, HRM challenges in SBM. Marketing: Marketing for small businesses, market challenges - local and global markets, Opportunities for exporting small businesses products. Finance: Financial performance of small businesses, SBM challenges of acceding funds, government funding agencies

06 hrs

References:

Research paper based curriculum:

M. Aggarwal, Aneet, *Small and Medium Enterprises In Transitional Economies: Challenges And Opportunities*

School of Management Studies and Research

Course Code: **15MBAW801**	Course Title: **Project work**
L-T-P**: 0-0-3**	Credits: **3** Contact Hrs: **06Sessions/week**
ITA Marks: **50** ETA Marks: **50**	Total Marks: **100**
Teaching Hrs: **45 hrs**	Viva-voce: **3 hrs**

Detailed industry profile based on secondary source

Tasks

- Data collection
- Analysis
- Interpretation using tools leading to Challenges, Megatrends and Impact in the global context
- Scope and Opportunities in local prospective.

School of Management Studies and Research

Course Code: **15MBAW803** Course Title: **Entrepreneurship Project -Phase II**
L-T-P**: 0-0-5** Credits: **5**Contact Hrs: **10Sessions/week**
ITA Marks: **100** ETA Marks: **--** Total Marks: **100**
Teaching Hrs: **70 hrs**

Tasks:

- Report of feasibility study in the framework of effectuation
- Preliminary survey
- Developing alternative business models
- Selection of resources
- finalization of business model
- Prepare for commercial launch
- Report on Business plan and reflections on experience

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Course Code: **15MBAE802**		Course Title: **Retail Management**
L-T-P-S**: 2-1-0-0**	Credits: **03**	Contact Hrs: **04hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **28 hrs**		Exam Duration: **3 hrs**

Module 1:

Introduction: Meaning of retailing, social and economic significance, opportunities in retailing, retail management decision process, retailing in India- present and future, un-organized retail sector in India present and future challenges.

Types of Retailers: Retail Characteristics, Food Retailers, General Merchandise Retailers, Non- store Retailers, Service Retailing, Types of Ownership and Multichannel Retailing.

05 hrs

Module 2:

Customer buying behavior: Buying process, types of buying decisions, social factors influencing buying process, market segmentation

Retail market strategy: Definition, target market and retail format, building sustainable competitive advantage, growth strategies, strategic retail planning process, financial strategy in retailing management and retail locations.

07 hrs

Module 3:

Information & supply chain management: Creating strategic advantage, information flow, logistics, distribution center, collaboration between retailers & vendors

Customer relationship management (CRM): CRM process, identifying target customers, developing CRM programs, technology is retail and merchandise management.

11 hrs

Module 4:

Contemporary topics: Green retailing, social and ethical issues in retail management, global practices in retail management.

05 hrs

References:

- Michael Levy, Barton Weitz, Ajay Pandit, *Retail Management*, Tata Mc GRAW Hill
- Swapna Pradhan, *Retail Management*, Tata McGRAW Hill

School of Management Studies and Research

Course Code:**15MBAE804** Course Title: **Services Marketing**
L-T-P-S**: 2-1-0-0** Credits: **03** Contact Hrs: **04hrs/week**
ISA Marks: **50** ESA Marks: **50** Total Marks: **100**
Teaching Hrs: **28 hrs** Exam Duration: **3 hrs**

Module1:
Introduction: Meaning of services, service and technology, characteristics of services, services marketing mix
Gaps model of service quality: Customer gap, provider gap
Consumer behavior in services: Consumer choice, consumer experience, and post experience evaluation, understanding differences among consumer
Customer expectations of services: Meaning and types of service expectations, factors that influence customer expectations, issues involving customer service, customer perceptions of services: Customer perceptions, customer satisfaction, service quality, service encounters

07 hrs

Module2:
Building customer relationship: Relationship marketing, relationship value of customers, customer profitability segments, relationship development strategies, and relationship challenges
Service recovery: Impact of service failure and recovery, how customers respond to service failures, customers recovery expectations, service recovery strategies, service guarantees

05 hrs

Module 3:
Service development and design: Challenges of service design, new service development, types of new services, stages in new services, service blue printing.
Use of Customer defined service standards, physical evidence, service inventory, pricing services and managing demand and supply

11 hrs

Module 4:
Contemporary topics **05 hrs**

References:

- V. A. Zeitaml, D. D. Gremler, M. J. Bitner and Ajay Pandit, *Services Marketing*, TMH
- Christopher Lovelock, *Principles of Services Marketing*, Pearson Education

School of Management Studies and Research

Course Code: **15MBAE814**		Course Title: **International Financial Management**
L-T-P-S**: 3-0-0**	Credits: **3**	Contact Hrs: **03 hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **40hrs**		Exam Duration: **3 hrs**

Module 1:

Introduction

International financial environment, the emerging challenges , recent changes in global financial market, risk management and wealth maximization, the nature and measurement of exposure and risk, Exposure and risk Classification of exposure and risk , exchange rate, interest rate, Inflation rate and exposure. IBRD (International Bank for Reconstruction and Development), The International Monetary System Introduction, exchange rate regimes, IMF, EMU Balance of Payments. Introduction, accounting principles, importance, valuation and timing, debits and credit entries and corrections methods

08 hrs

Module 2:

Global financial markets and interest rates

Introduction, domestic and offshore markets, Euro markets, the foreign exchange market, PPP.

Forwards, swaps and interest parity – Introduction, swaps and deposit markets, Interbank forward dealing, option forwards, Forward Spread Agreements (FSA), Exchange Rate Agreements (ERA), Forward Exchange Agreements (FEA), forward currency market in India

Currency and Interest rate future -Future contract and trading process, spot and future prices, , Interest futures, Hedging and speculation with interest rate and currency futures,

Currency options – Exchange rate determination, swift mechanism

12 hrs

Module 3:

Exposure management :Introduction, types of exposure, tools and techniques of foreign exchange risk management, management of transactions exposure, management of operating exposure, economic exposure. **09 hrs**

Module 4:

Short term and Long term borrowing and investment

Short term borrowing and investment, long term borrowing in global capital market, international equity investment, the international CAPM, risk and return, accounting for foreign currency transaction and operations. **06 hrs**

Module 5:

International Capital Budgeting:

Review of Domestic Capital Budgeting, The Adjusted Present Value Model, Capital Budgeting from the Parent Firm's Perspective, Risk Adjustment in the Capital Budgeting Process, Sensitivity Analysis.

05 hrs

References:

- Jeff Madhura, *International Financial Management,* South-Western
- Madhu Vij, *International Financial Management*, 2nd Edn, Excel Books
- David K Eiteman, Arthur I Stonehill and Michel H Moffett, *Multinational Business Finance*, 10th edn, Pearson Education
- Prakash G Apte, *International Financial Management*, 5th edn, TMH

- Sharan*, International Financial Management*, Prentice Hall
- Shapiro, *International Financial Management* , Prentice Hall

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Course Code: **15MBAE816**		Course Title: **Risk Management**
L-T-P**: 3-0-0**	Credits: **3**	Contact Hrs: **03 hrs/week**
ISA Marks: 5**0**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **40hrs**		Exam Duration: **3 hrs**

Module 1:

Introduction to derivatives and risk

Introduction to Derivatives, types of derivatives, forward, futures, options, futures, pricing of future contract, forward contract

Introduction to risk, types, need for risk management system, risk management process, risk Identification and evaluation, risk control

10 hrs

Module 2:

Futures and forwards, valuation of futures and forwards, buying and selling futures, margins, hedging using futures, commodity futures index futures, interest rate futures and arbitrage.

10 hrs

Module 3:

Risk management using swaps: mechanics of interest rate swaps, volatility of interest rate swaps, currency swaps, valuation of currency swaps

10 hrs

Module 4:

Risk management using options, option pricing, option valuation, basic, binomial and black & scholes model, hedging and trading strategies, arbitrage profits in options, Value at Risk

10 hrs

References:

- John C Hull, *Options, Futures and other Derivatives*, 6th edn, Pearson Education
- Gupta, *Derivatives*, PHI
- Dubofsky & Miller, *Derivatives- valuation and Risk management*, Oxford University press
- Vohra and Bagri, *Options and Futures*, 2nd edn, TMH

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Course Code: **15MBAE823**		Course Title: **HR Operations**
L-T-P-S**: 3-0-0**	Credits: **3**	Contact Hrs: **03 hrs/week**
ISA Marks: 5**0**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **40hrs**		Exam Duration: **3 hrs**

Module 1:

Introduction to HR Operations, HR Policies, importance, types of HR Policies, On boarding: importance, objectives, process, HRIS (human resource information system) – concept, objectives, how Managers Use the HRIS?

08 hrs

Module 2:

Compensation Management (CM):

Introduction to Compensation Management: Overview of HRM, role of compensation in organizations, introduction to compensation management, Factors influencing employee remuneration, Process of Compensation Management, Architecture of Compensation

06 hrs

Module 3:

Indian Industrial Relations (IR) – An overview, need and objectives. Importance of harmonious IR, Conditions for congenial IR, IR in the post Independence period,

Grievance procedure and Discipline management: Grievance, meaning and forms, approaches to grievance machinery, Grievance procedures, Industrial Discipline and Misconduct, Domestic Enquiry, Code of Discipline in Industry, Retention, Attrition, Exit interviews

10 hrs

Module 4:

Collective Bargaining in India: Definition, Essential conditions for the success of collective bargaining, collective bargaining process, prerequisites for collective bargaining.

Industrial Conflicts: Nature of conflicts causes and types of Industrial conflicts, prevention of Industrial conflicts, and settlement of Industrial conflicts. Workers Participation in Management: Introduction, Concept, Determinants of WPM, WPM in India, WPM Scheme of 1975.

10 hrs

Module 5:

Contemporary topics

06 hrs

References:

- Monappa Arun *Industrial Relations*, Tata McGraw Hill Publishing Company Ltd, 1/e, 2002.
- Mamoria & Mamoria, *Dynamics of Industrial Relations*, Himalaya Publishing house
- Mumbai, 2004.
- Singh B.D, Industrial relations emerging paradigms, Excel Books.
- Singh B.D, *Labour Laws for managers*, Excel Books.
- Mishra S.N.*Labour and Industrial Laws*, Central Law Publications, Allahabad
- Michael J. Kavanagh (Editor), Mohan Thite , *Human Resource Information Systems: Basics, Applications, and Future Directions,* SAGE Publications.

School of Management Studies and Research

Course Code: **15MBAE824** Course Title: **Emerging Trends in HR Practices**
L-T-P-S: **3-0-0** Credits: **3** Contact Hrs: **03 hrs/week**
ISA Marks: **50** ESA Marks: **50** Total Marks: **100**
Teaching Hrs: **40hrs** Exam Duration: **3 hrs**

Module 1:

Changing Environment and Strategic HRM

Introduction, changing environment, business complexities, process and structure related strategic responses. Strategic Perspective: importance, business strategy and HRD, business policy and HRD, life cycle of organizations and HRD, strategic HRD system, equal employment opportunity, selecting talents for high performance and employment standards **09 hrs**

Module 2:

HR Analytics

What is HR Analytics, why now and how is it used? How to get started, needed skills, and common pitfalls to avoid **06 hrs**

Module 3:

Re-Engineering HR

Functions and Processes, implementing re-engineering changes, employee empowerment, managing diversity in workplace **07 hrs**

Module 4:

HRD Accounting and Audit :

HRA Introduction, need and objectives, methods and valuation models, benefits of HRA. HRD Audit: Meaning, methodology, issues, audit instruments, HRD Scorecard, Report. **08 hrs**

Module 5:

International HRM

HR in International Context: Issues that change the context, differences between HRM Domestic and International perspectives, linking HR to international expansion, international recruitment at different levels, issues in staff selection and retention, Performance Management–Criteria's used, factors associated, evaluation systems. Training and Development, Expatriate Training, Developing International teams, managing virtual teams, Compensation Management, Objectives and Approaches, Repatriation Process, Labor Relations – Key Issues **10 hrs**

References:

- HRD Audit, Author: T. V. Rao, Pub: "Response Books" Leading HR
- Re-engineering of HR, Author: Lyle Spencer (Jr) Pub: John Wiley and Sons
- International HRM – Managing People in International Context, Author: Dowling, Welch Pub: Thompson Learning, South Western Publications
- Empowering Employees, Author: Kenneth L. Murrell and Mimi Meredith, 2000, Paperback
- Managing Diversity in the Workplace, Author: Iryna Shakhray 2013, Grin Verla
- Strategic Human Resource Management, 2Nd Ed, Author: Susan E. Jackson Randall S. Schuler, 2012, Wiley India Pvt. Ltd.
- The Benefits and Challenges of Leveraging Social Media Recruitment Practices, Author: Patrick Hayes, 2013, Grin Verlag
- Strategic Human Resource Development - Srinivas R Kaudula, PHI, 2001.

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Course Code: **15MBAE834**		Course Title: **Heuristics and Optimization Techniques**
L-T-P**: 3-0-0**	Credits: **3**	Contact Hrs: **03 hrs/week**
ISA Marks: 5**0**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **40hrs**		Exam Duration: **3 hrs**

Module 1:
Introduction to decision making Anatomy of a decision, bounded rationality, judgmental heuristics, biases emanating from heuristics

06 hrs

Module 2:
Nominal Group Techniques: Interpretive Structural Modeling (ISM)- Conceptual view of ISM, why does ISM work so well?, **complex problems & solution forming processes,** ISM as a transform function, ISM applications & examples, Strategic planning with ISM, Scenario planning with ISM, **creating an interpretive structural model**

10 hrs

Module 3:
Analytical hierarchy process structure of a decision problem, Saaty's scale, seven pillars, structuring a hierarchy, problems

08 hrs

Module 4:
Data Envelopment Analysis (DEA): Data envelopment analysis and different efficiency concepts, operationalising the concepts, Scale efficiency, Input and output orientation, Input congestion, Adjusting for operating environments, advantages and limitations of DEA, specifying outputs, inputs and coverage, DEA formula and a single example, introducing scale effects, case study

10 hrs

Module 5:
Theory of Constraints: Introduction, example, application and Benefits

06 hrs

References:

- Sorach, *Structured decision making with interpretive structural modeling*,.
- LM Seiford, K Tone, WW Cooper, Kluwer, *Data Envelopment Analysis: A Comprehensive Text with Models, Applications, References and DEA Solver*.
- TL Saaty, LG Vargas, Springer, *Models, Methods, Concepts & Applications of the Analytic Hierarchy Process*
- MH Bazerman, *Managerial decision making* Wiley text books.
- E. Goldratt, *What is this thing called-Theory of constraints,* North River publication, I Edition

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School of Management Studies and Research

Course Code: **15MBAE833**		Course Title: **Project Management**
L-T-P-S**: 3-0-0**	Credits: **3**	Contact Hrs: **03 hrs/week**
ISA Marks: 5**0**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **40hrs**		Exam Duration: **3 hrs**

Module 1
Introduction, Organizational Context, Project Selection and Portfolio Management, Project Life Cycle Management, Process Groups

08 hrs

Module 2
Leadership and Project Manager's role, Scope Management, Stake holder's management, Project Team Building and Negotiation

08 hrs

Module 3
Risk Management, Cost Estimation and Budgeting, Project Scheduling: Networks, Duration Estimation and Critical Path

10 hrs

Module 4
Project Scheduling: Lagging, Crashing and Activity Networks, Critical Chain Project Scheduling, Resource Management, Team work, conflict & resolution

10 hrs

Module 5
Project Evaluation and Control, Project Closeout and Termination

04 hrs

References:

- Jeffrey K.Pinto, *Project Management* Pearson Publication 2009
- Gido I Clements, *Project Management*   Cengage Learning
- The Managerail Process ,*Project Management*- by Clifford Gray and Erik Larson TMH, 3rd Edition

Course Code: **16MBAP704** Course Title: **Managerial Communication and Aptitude**
L-T-P**: 0-0-2** Credits: **2** Contact Hrs: **04 Sessions /week**
ISA Marks: **100** ESA Marks: **--** Total Marks: **100**
Teaching Hrs: **56hrs**

Part 1: Managerial Communication

Topic 1: Discussions and Debates

- Understanding discussion
- Parameters measured in Group Discussions
- Video Analysis of Group Discussions **10 hrs**

Topic 2: Writing Skills

- Business letters
- Covering letter
- Resume writing
- Email etiquette

10 hrs

Topic 3: Interview Skills

- What companies expect
- Showing Commitment and Learning Ability
- Handling difficult questions
- Understanding interviewer psychology
- Situation Reaction and Presence of Mind
- Dressing right
- Interview etiquette

10hrs

Part 2: Managerial Aptitude

Arithmetical Reasoning:

- Number Systems and Speed Math
- Factors and Multiples
- Combinations
- Probability
- Percentages
- Interest
- Alligations and Averages
- Man-Hour Calculations

14 hrs

Analytical Thinking

- Data Analysis
- Data Interpretation
- Data Sufficiency
- Puzzles

06 hrs

Verbal Logic

- Verbal Analogy
- Verbal Classification
- Letter and Number Series
- Decoding the Codes

04 hrs

Non – Verbal Logic

- Non – Verbal Analogy
- Non – Verbal Classification
- Pattern Completion
- Pattern Comparison

02 hrs

References:

- Vilanilam J V, *More Effective Communication: A Manual for Professionals*, Sage Publications.
- Shirley Taylor, 2005, *Communication for Business: A Practical Approach*, 4th Edition, Pearson Longman.
- John M Penrose, Robert W. Rasberry, and Robert J. Myers, *Advanced Business Communication*, 3rd edition, Thomson South-Western.
- Raymond V. Lesikar, *Basic Business Communication*: Irwin/McGraw-Hill, 1999
- Sam Phillips, 3000 *Synonyms and Antonyms 1st Edition*, Goodwill Publishing House
- John Jackman and Wendy Wren, Nelson English Evaluation Pack – Book 5, Thomas Nelson

School of Management Studies and Research

Course Code: **16MBAC712**		Course Title: **Human Resource Management**
L-T-P**: 2-0-0**	Credits: **2**	Contact Hrs: **02hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching hrs: **28 hrs**		Exam Duration: **3 hrs**

Module 1:
Introduction, characteristics, scope, objectives, functions and role of Human Resource Management(HRM), HRM versus personnel management, difference between HRM and HRD (Human Resource Development), qualities of Human Resource (HR) manager, HR manager as a strategic partner.

08 hrs

Module 2:
Job design, analysis, description, specification, enrichment, enlargement and rotation,
Introduction to compensation and benefits management - purpose, meaning, factors, challenges

06 hrs

Module 3:
Acquisition of human resources: Man power planning, objectives, Recruitment, sources of recruitment, selection techniques, Placement, Induction.

08 hrs

Module 4:
Employee engagement, competency mapping, Managing careers, welfare facilities, industrial relations, work life balance, Introduction to IHRM (International Human Resource Management), HR Ethical issues, contemporary HRM

06 hrs

References:

- Gary Dessler, Human Resource Management, 10th edition, Prentice Hall
- Cynthia D. Fisher, Lyle F. Schoenfeldt, and James B. Shaw, Human Resource Management, Biztantra.
- Ashwatappa K, Human Resource and Personnel Management, 4th edition, Tata McGraw Hill.
- Rao V S P, Human Resource Management, Excel Books

School of Management Studies and Research

Course Code: **16MBAC804**		Course Title: **Technology: an enabler**
L-T-P**: 1-0-0**	Credits: **1**	Contact Hrs: **01 hrs/week**
ISA Marks: **100**	ESA Marks:	Total Marks: **100**
Teaching Hrs: **14 hrs**		**E**xam Duration: 3 hrs

Module 1

Introduction

Data and information, Concepts of management information systems, Information systems in organization, information as resource of competitive advantage, Decision making with MIS, Contemporary approaches to MIS, Data Warehouse, ethical and social issues related to systems.

08 hrs

Module 2

Technology Management

Technology management, Internet on things (IoT), Smart city, GPS & RFID. **06 hrs**

References:

- Rahul De, *Managing Information Systems in Business, Government and Society*, Wily India Publication; 1st Edition
- Gordon B. Davis and Margrethe H. Olson, *Management Information Systems (Conceptual foundations, Structure and Development)*McGraw Hill Education India Private Limited; 2 edition
- James O'Brien and George Marakas, *McGraw Hill Education India Private Limited*; 10 edition

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School of Management Studies and Research

Course Code:**16MBAE801**		Course Title: **Sales Management**
L-T-P**: 2-1-0**	Credits: **03**	Contact Hrs: **04hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **28 hrs**		Exam Duration: **3 hrs**

Module 1:

Introduction to Sales Management:

Introduction, Evolution of sales management, nature importance of sales management, role and skills of modern sales people, sales management positions/sales as a career, responsibilities (social, ethical, legal) of sales person

06 hrs

Module 2:

Planning sales team:

Nature of organization, types, characteristics of the organization, sales budget, designing of sales territories, sales objectives, quotas and targets, role of ICT in sales organization

07 hrs

Module 3:

Sales-force Management: recruitment and placement, training and development, personal selling, motivation, leadership, analysis and evaluation

10 hrs

Module 4:

Contemporary topics: Global Sales-force management, Role of technology in Sales-force and Distribution channel management, ethical, social and technological issues in sales-force management.

5 hrs

References:

- Spiro, Stanton, Rich, *Management of Sales force*, 11th Edition Tata McGRAW Hill
- Krishna K Havaldar, M Cavale, *Sales and Distribution Management: Text and Cases*, McGRAW Hill
- Tapan K Panda, Sunil Sahadev, *Sales and Distribution Management,* 2nd Edition, Oxford Higher Education.

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Course Code: **16MBAE821** Course Title: **Learning and Development**
L-T-P: **3-0-0** Credits: **3** Contact Hrs: **03 hrs/week**
ISA Marks: **50** ESA Marks: **50** Total Marks: **100**
Teaching Hrs: **40 hrs** Exam Duration: **3 hrs**

Module 1:
Introduction to learning, training and development, Meaning and significance of learning, theories of learning, learning process, Training meaning, significance, purpose and process, Training Department and Trainers' Roles

08 hrs

Module 2:
Training Needs Analysis: Meaning and significance of training needs, types of needs, components of needs, data collection, analysis and interpretation. Training design and development

08 hrs

Module 3:
Training methods: on the- job and off –the- job training
Management Development Program (MDP): Need, factors affecting MDP, methods, process

10 hrs

Module 4:
Evaluating Training Programs: Meaning, significance, Donald Kirkpatrick's evaluation model, data collection for training evaluation, designs of training evaluation, process, Return on Investment in training, a search for best practices in evaluation

08 hrs

Module 5:
Trends of learning and development, E-learning and use of technology for training, creativity and its role in Learning and Development, knowledge management, Career in Training

06 hrs

References:

- Noe A Raymond, Employee *Training & Development*, McGraw Hill Publication.
- Rolf Lynton & Udai Pareek, *Training for organizational transformation*, Sage Publications, New Delhi.
- Jackie Clifford & Sara Thorpe, *Workplace Learning & Development: Delivering Competitive Advantage for your organisation,* Kogan Page Limited (2007)
- Tony Bingham, *The New Social Learning*, 1st Edition, , 2012, Cengage Learning India Pvt. Ltd, New Delhi
- Rao T.V, *Performance Appraisal – Theory and Pract ice*
- Jack J. Phillips, Butterworth-Heinemann *Return on Investment in Training and Performance Improvement Programs*, 2nd Edition

School of Management Studies and Research

Course Code: **16MBAE823**		Course Title: **HR Operations**
L-T-P**: 2-1-0**	Credits: **3**	Contact Hrs: **04 hrs/week**
ISA Marks: 5**0**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **28hrs**		Exam Duration: **3 hrs**

Module 1:

Introduction to HR Operations, HR Policies, importance, types of HR Policies, On boarding: importance, objectives, process, HRIS (human resource information system) – concept, objectives, how Managers Use the HRIS?, Implications on local organizations, Digitalization of HR

07 hrs

Module 2:

Compensation Management (CM):

Introduction to Compensation Management: Overview of HRM, role of compensation in organizations, introduction to compensation management, Factors influencing employee remuneration, Process of Compensation Management, Architecture of Compensation, Performance appraisal

07 hrs

Module 3:

Indian Industrial Relations (IR) – An overview, need and objectives. Importance of harmonious IR, Conditions for congenial IR, IR in the post Independence period,

Industrial relations in the region

Grievance procedure and Discipline management: Grievance, meaning and forms, approaches to grievance machinery, Grievance procedures, Industrial Discipline and Misconduct, Domestic Enquiry, Code of Discipline in Industry, Retention, Attrition, Exit interviews

08 hrs

Module 4:

Collective Bargaining in India: Definition, Essential conditions for the success of collective bargaining, collective bargaining process, prerequisites for collective bargaining.

Contemporary topics

06 hrs

References:

- Monappa Arun *Industrial Relations*, Tata McGraw Hill Publishing Company Ltd, 1/e, 2002.
- Mishra S.N.*Labour and Industrial Laws*, Central Law Publications, Allahabad
- Michael J. Kavanagh (Editor), Mohan Thite , *Human Resource Information Systems: Basics, Applications, and Future Directions,* SAGE Publications
- Piyali Ghosh, Shefali Nandan, *Industrial Relations and Labour Laws,* Mc Graw Hill Education(India) Private Ltd

School of Management Studies and Research

Course Code: **16MBAE806**		Course Title: **Digital Marketing**
L-T-P**: 2-1-0**	Credits: **03**	Contact Hrs: **04hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **28 hrs**		Exam Duration: **3 hrs**

Module 1:

Introduction to digital marketing: Need and relevance for digital marketing, evolution of digital marketing, challenges/issues concerning digital marketing and future of digital marketing.

06 hrs

Module 2:

Ethical components in digital marketing

Social media campaigns: analyzing successful green campaigns,

Social media and customer engagement: the social feedback cycle, open access to information and the connected customers.

The social web and engagement: the engagement process

Introduction to social media as a business tool: use of face book, YouTube, twitter and LinkedIn as modern tools for business operations and communications.

12 hrs

Module 3:

The new role of the customer: social interactions on social media.

Customer Relationships: Social CRM.

Overview of social business: building a social business ecosystem, social profiles, social applications, using brand outposts and communities

05 hrs

Module 4:

Contemporary topics **05 hrs**

References:

- Dave Evans,*Social Media Marketing: The Next Generation of Business Engagement* Wiley Publication Inc
- Sameer Deshpande and Nancy R Lee,*Social Marketing in India* , Sage Publications
- Diane Martin and John Schouten,*Sustainable Marketing,* Prentice Hall Publications
- Robert Dahlstorm, *Green Marketing: Theory, Practice, and Strategies* (English) 1st Edition South Western Publications

School of Management Studies and Research

Course Code: **16MBAE834**		Course Title: **Inventory Management**
L-T-P**: 3-0-0**	Credits: **3**	Contact Hrs: **03 hrs/week**
ISA Marks: 5**0**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **40hrs**		Exam Duration: **3 hrs**

Module 1

Dependent and independent demand, Demand Forecasting, Need for inventory, types of inventory, effect of inventory on profitability. **08hrs**

Module 2

Basic inventory Model, Inventory model with continuous replenishment, inventory model with discounts, Inventory model with uncertain demand, Inventory model with variable demand and fixed lead time, Inventory model with fixed demand and variable lead time, inventory model with variable demand and lead time **12 hrs**

Module 3

Selective inventory control, dependent inventory management(MRP), Collaborative Planning, Forecasting and Replenishment, JIT systems **06 hrs**

Module 4

Inventory as substitute for capacity, Multilocation inventory models –one origin several destinations, several origin several destinations system **10 hrs**

Module 5

Role of inventory in food security, impact of real time data communication on inventory management **04 hrs**

References

- Buffa and Sarin ,*Operations Management*
- Max Muller ,*Essentials of Inventory Management*
- NarasimhanSitaramn and Mcleavey Dennis, *Production Planning and Inventory Control*

School of Management Studies and Research

Course Code: **16MBAE835**		Course Title: **Logistics and Warehouse Management**
L-T-P**: 3-0-0**	Credits: **3**	Contact Hrs: **03 hrs/week**
ISA Marks: 5**0**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **40hrs**		Exam Duration: **3 hrs**

Module 1

Introduction

Inventory Flow, Information Flow, Planning and Coordination flows , Operational flows, Difference between Logistics and Supply Chain Management Linkage of Logistics to other functions, Objectives of Logistics Management, 5Ps and & 7 Rs of Logistics. Modes of transportation and documentation

10 hrs

Module 2

Location Selection and Network Design

Transportation – Location Trade-offs, , Location Models, Locating Service Organisations

Transportation Modeling, Routing, Transshipment, Multi location and multi item ware house modeling.

12 hrs

Module 3

Warehouse Management

Warehouse Operations, Material Handling and Packaging, Parts and Service Support, Bar coding, RFID, Electronic Data Interchange (EDI),Automated material handling,Warehouse Management Systems (WMS) **08 hrs**

Module 4

Strategic Logistic Practices

International Logistics, Third party and Fourth party logistics,ERP and Ecommerce & Logistics

06 hrs

Module 5

Reverse Logistics and its impact on Environment

Definition, evolution and trends. Economic and environmental impact

04 hrs

References

- G. Raghuram and Rangaraj,*Logistics and Supply Chain Management: Cases and Concepts* Laxmi Publications (2015)
- Christopher, M; Richard Irwin *Logistics and Supply Chain Management*
- Chopra and Mendal, *Supply Chain Management*

School of Management Studies and Research

Course Code: **17MBAC704**		Course Title: **Business Research and Statistics**
L-T-P**: 3-1-0**	Credits: **4**	Contact Hrs: **05 hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **40 hrs**		Exam Duration: **3 hrs**

Module 1:

Introduction to business research:

Meaning and objectives of research, Types of research, Stages in research process, Characteristics of Good Research. Philosophy of Research Methodology: Ontology, Logic of Procedure, epistemology, Research Gap.

07 hrs

Module 2:

Concepts in Research:

Variables, Qualitative and Quantitative Research

Research design: Meaning, Importance, Steps in research design, Types- Descriptive, Exploratory and causal

Sampling :meaning of sample and sampling, methods of sampling-

i)Non– Probability Sampling Convenient, Judgment, Quota, Snow ball,

ii) Probability – Simple Random, Stratified, Cluster, Multi Stage.

06 hrs

Module3:

Types of Data& Data Collection:

Primary and secondary

Methods of Data collection– Personal Interviews, Telephonic or Internet Interview, Observation, Focus group interviews, Expert opinions, self administered questionnaire.

Schemes of analysis Secondary data analysis, Qualitative data analysis

Introduction to business statistics: Importance of statistics in managerial decision-making, the nature of study, limitations and misuse of statistical data, subdivisions within statistics.

Data: types, Frequency Distribution, Representation, Measures of Central Tendency, Measures of dispersion

14 hrs

Module 4:

Types of measurement and Scales:

Nominal, Ordinal, Interval, Scale,

Types of Measurement Scales, Attitude rating, Likert, Thurstone, Semantic Differential

04 hrs

Module 5:

Hypothesis and Probability distribution:

Meaning, Nature, Significance, Types of Hypothesis,

Normal distribution, Correlation and Regression Analysis, Test for means and Proportions, Test for equality of population means, confidence interval, introduction to Chi-square test.
Report writing, ethical issues, and plagiarism

09 hrs

References:

- Cooper and Schlinder, *Business Research Methods,* TMH
- William Zikmund, *Business Research Methods*, Cengage Publication
- G. C. Ramamurthy, *Research Methodology*, Dreamtech Press
- Uma Sekaran and Roger Bougie, *Research Methods for Business*, Wiley Publications
- Uwe Flick, *An Introduction to Qualitative Research*, Sage Publications
- Gerard Guthrie, *Basic Research Methods*, Sage Publications

- G. C. Beri, 2005, *Business Statistics*, 2nd edition, Tata McGraw-Hill.
- R I Lewin and David S Rubin, *Statistics for Management*, 7th edition, Pearson.
- Robert E. Stine, Dean Foster, *Statistics for Business: Decision Making and Analysis*, 1st edition, Pearson
- Bruce Bowerman, Emly S. Murphree, Richard O'Connell*Business Statistics in Practice*, 5th edition, Tata McGraw-Hill.
- J K Sharma, *Business Statistics*, 2rd edition, Pearson

School of Management Studies and Research

Course Code: **17MBAP803**	Course Title: **MS Excel for Managers**
L-T-P**: 0-0-2** Credits: **2**	Contact Hrs: **04Sessions/week**
ITA Marks: **100** ETA Marks: **--**	Total Marks: **100**
Teaching Hrs: **56hrs**	

MS Excel

- MS Excel Basics
- Editing Worksheet
- Formatting Cells
- Formatting Worksheets
- Working with Formula
- Advanced Operations
- MS Excel Resources

School of Management Studies and Research

Course Code: **17MBAW802** Course Title: **Project work Phase - I**
L-T-P**: 0-0-2** Credits: **2** Contact Hrs: **04Sessions/week**
ITA Marks: **100** ETA Marks: **--** Total Marks: **100**
Teaching Hrs: **56hrs**

Student has to execute the below mentioned tasks about the industry related to his/her SIIT firm

Task s:

- Review of literature (Strategic Management models and tools)
- Value chain study
- Internal value chain and identification of drivers
- Report writing

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Course Code: **17MBAW803** | Course Title: **Entrepreneurship Project -Phase III**
L-T-P**: 0-0-3** Credits: **3** | Contact Hrs: **06Sessions/week**
ITA Marks: **100** ETA Marks: **--** | Total Marks: **100**
Teaching Hrs: **56hrs**

Tasks

- Finalization of business model
- Prepare for commercial launch
- Report on Business plan and reflections on experience

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Course Code: **17MBAW804**	Course Title: **Project work Phase - II**
L-T-P**: 0-0-2** Credits: **2**	Contact Hrs: **04Sessions/week**
ITA Marks: **50** ETA Marks: **50**	Total Marks: **100**
Teaching Hrs: **56hrs**	Viva-voce: **3 hrs**

Project work Phase – I is prerequisite

Student has to execute the below mentioned tasks
Tasks

- Industry value chain and identification of drivers
- Compare and contrast Company value chain with industry value chain
- Industry Trends and futuristic outlook
- Report writing

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Course Code: **18MBAE805**	Course Title: **Integrated Marketing Communications**
L-T-P**: 2-1-0**	Credits: **03**Contact Hrs: **04 Sessions/week**
ITA Marks: **50**	ETA Marks: **50**Total Marks: **100**
Teaching Hrs: **28 hrs**	Exam Duration: **3 hrs**

Module 1:

Integrated marketing communication: Integrated marketing communication: The evolution of IMC, reasons for growing importance of IMC, the promotional mix- advertising, direct marketing, internet marketing, sales promotion, publicity, public relations, personal selling, promotion management, IMC planning process

06hrs

Module 2:

Organizing for advertising and promotion: The role of advertising agencies, agency compensation, evaluating agencies, developing the integrated marketing communication program, Importance of creative advertising

Media planning & strategy: An overview on media planning, developing media plan, market analysis and target market identification, establishing media objective, developing and implementation media strategies, evaluation and follow up.

Internet and IMC: Measuring the effectiveness of Internet advertising, advantages of Internet marketing, direct marketing on Internet budgeting for marketing communication.

12hrs

Module 3:

Consumer Decision Making Process: Steps of effective communication, communication objectives, consumer decision making process, how advertising works- AIDA and hierarchy effects model, convincing senior executives on the marketing communication budget**.**

05hrs

Module 4:

Contemporary topics: Shift to Mobile and Beyond, Social Media Impact on Communication and Brand Journalism

05hrs

References:

- Belch, M.A., and Belch, G.E., *Advertising and Promotion*, Tata Mc-Graw Hill Publication
- Keller Kevin, Strategic Brand Management, Pearson Publication, Third Edition
- Shah, K. and D'souza, A., *Advertising & Promotion*, Tata Mc-Graw Hill Publication

School of Management Studies and Research

Course Code: **18MBAE807** Course Title: **Industrial Marketing**
L-T-P**: 2-1-0** Credits: **03** Contact Hrs: **04 Sessions/week**
ITA Marks: **50** ETA Marks: **50** Total Marks: **100**
Teaching Hrs: **28 hrs** Exam Duration: **3 hrs**

Module1:

Basic concept of Industrial Marketing: Industrial Marketing, consumer and industrial products, consumer and industrial marketing, differences of consumer and industrial marketing.

Industrial markets: Industrial customers, specificities of industrial markets, the environment of Industrial Marketing. The specificities and the risks in international markets. The trends in globalization of industrial markets

5 hrs

Module 2:

Organization's purchasing behaviour, system of purchasing decisions: System of taking decisions in the Industrial Marketing. The poles in the system of taking purchasing decisions in Industrial Marketing.Factors that affect the purchasing decision in Industrial Marketing.

Process of taking purchasing decisions for industrial products.Types of purchasing activities in Industrial Marketing.Marketing Strategies for the purchasing activities and the stages of the process of taking purchasing decisions. Information sources that are used from members of the Taking purchasing decisions' system

10 hrs

Module 3:

Pricing and Promotion in Industrial Marketing: The importance of pricing in Industrial Marketing. In-house and external factors determine the price. Procedures, processes and pricing policies.The mixture promotion in industrial marketing. Sales promotion, advertising, direct marketing, public relations and personal selling.

Distribution of industrial products: The importance of industrial products. Administration and revitalization of existing industrial products. The Marketing distribution functions, main forms of intermediate, forms of industrial channels. Design, selection and management of distribution channels.

08 hrs

Module 4:

Contemporary topics

Systematic approach to the management and control of supplier/customer relationships, interactive strategic marketing planning: A new approach. Smart Business to business strategy.

05 hrs

References:

1. Tomaras P. (2009). Industrial Marketing. Published by the author. Athens, (ISBN: 978-960-90674-3-0). (in Greek)
2. Ralph S Alexander, Richard M Hill, Industrial Marketing-Edition-3

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Course Code: **18MBAE808**	Course Title: **Product and Brand Management**
L-T-P**: 2-1-0**	Credits: **03**Contact Hrs: **04hrs/week**
ITA Marks: **50**	ETA Marks: **50** Total Marks: **100**
Teaching Hrs: **28hrs**	Exam Duration: **3 hrs**

Module 1:

Introduction to Product Management, Role and Functions of Product Managers,Product Mix and SBU Strategies, Portfolio analysis (BCG / GE Multifactor Matrix), Marketing Planning

7 hrs

Module 2:

Product Decisions over the PLC, New Product Development Process, Pricing and Promotion strategies, channel management

7 hrs

Module 3:

Introduction to Brand Management- Branded House Vs House of Brands, Corporate Brand,Brand prism by Kapferer Model, Brand Anatomy,Branding Decisions- Line Extensions, Category Extension, Brand Equity – Concept and measure

10hrs

Module 4:

Contemporary Practices **04hrs**

References:

- Donald R Lehamann, Product management 4th Edition, Mcgrow Higher Ed
- Marc Annacchino, New Product Development, 2003 Ed, Elsevier Butterworh-Heinemann
- Saaksvuori Antti, Product Lifecycle management, Springer- Verlag
- Kevin Lane Keller, M G Parameswaran, Isaac Jacob, Strategic Brand Management, 2008, Person publication
- David Aaker, Brand Management, TMH publication
- YLR Murthy, Brand management Indian prospective, Vikas Publications

School of Management Studies and Research

Course Code: **19MBAE811** Course Title: **Security Analysis and Portfolio Management**
L-T-P**: 2-1-0** Credits: **3** Contact Hrs: **04 Sessions/week**
ITA Marks: **50** ETA Marks: **50** Total Marks: **100**
Teaching Hrs: **28hrs**Exam Duration: **3 hrs**

Module 1:

Introduction to Investments

Introduction to Investments: Concepts of investment-characteristics and objectives of investment, investment Vs speculation, forms of investment, alternative investments, marketable and non marketable financial assets, Foreign Portfolio Investment (FPI), Sovereign Wealth Funds (SWFs). Analysis of risk & return, concept of total risk, elements of risk – systematic and unsystematic risk, business risk, interest rate risk, market risk, management risk, purchasing power risk. Measuring Risk and Return.

08 hrs

Module 2:

Introduction of fundamental and technical analysis

Fundamental analysis, equity valuation, balance sheet techniques, discounted cash flow technique, dividend discount model, zero growth model, constant growth, two stage growth, earning multiplier approach Bond characteristics, bond price, bond yield, Price, yield relationship, risk in bonds, rating, yield theories, segmentation theory.

Technical analysis: introduction, the concept of Dow Theory, trend and trend reversals, chart patterns, Eliot wave theory, mathematical indicators

05hrs

Module 3:

Efficient market hypothesis and portfolio Management

Behavior of market, efficient market hypothesis, portfolio Analysis, return and risk of portfolio, portfolios with more than two securities Portfolio Selection, feasible set of portfolios, optimal portfolio, Markowitz model, single index model, multi index model, CAPM, Arbitrage Pricing Theory.

09hrs

Module 4:

Portfolio Performance, Evaluation and Revision

Portfolio revision, meaning and constraints, revision strategies portfolio evaluation, need and meaning, differential return, Treynor ratio pros and cons, residential and other forms

06 hrs

References:

- PunithavatiPandyan, *Security Analysis and Portfolio Management*, Latest edition, VikasPubl,
- Kevin S*, Portfolio Management*, 2nd edition, Prentice H,
- Alexander, Sharpe, Bailley*, Fundamentals of Investment,* Pearson,
- ChndraPrasanna*, Investment Analysis and Portfolio Management*, 3rd Edition, TMH

School of Management Studies and Research

Course Code:**19MBAW802** Course Title: **Internship and Project work**
L-T-P**: 0-0-7** Credits: **7** Contact Hrs: **14Sessions/week**
ITA Marks: **50** ETA Marks: **50** Total Marks: **100**
Teaching Hrs: **98 hrs** Viva-voce: **3 hrs**

PART I

- Broad overview pertaining industry and detailed organization profile in the framework of foundation courses (Human Resource Management, Marketing Management, Operations Management and Financial Management)
- Student has to work on the research area
- Data collection
- Analysis and Interpretation
- Findings, recommendations and conclusion
- Report writing
- Experience worth noting

PART II

Detailed industry profile based on secondary source

Tasks

- Data collection
- Analysis
- Interpretation using tools leading to Challenges, Megatrends and Impact in the global context
- Scope and Opportunities in local prospective

Course Code: **19MBAW803**
Course Title: **Entrepreneurship Project -Phase II**
L-T-P**: 0-0-5**
Credits: **5**Contact Hrs: **10Sessions/week**
ITA Marks: **100**
ETA Marks: **--**
Total Marks: **100**
Teaching Hrs: **70 hrs**

Pre-requisite: Entrepreneurship Project- Phase I

Tasks:

- Report of feasibility study in the framework of effectuation
- Preliminary survey
- Developing alternative business models
- Selection of resources
- finalization of business model
- Prepare for commercial launch
- Report on Business plan and reflections on experience