Course Content

Course Code: **16EARC201**	Course Title: Analog and Digital Electronic Circuits	
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 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.	7
2.0 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
3.0Transistors 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.	6
Unit - 2	
4.0 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.	7
5.0 Printed Circuit Board (PCB) Design Issues Partitioning , Resistance Of Conductors ,"Kelvin Feedback" , Ground Noise And Ground Loops , Ground Isolation Techniques , Static PCB Effects , Inductance , Parasitic Effects In Inductors ,Capacitative Noise And Faraday Shields , Buffering ADCs against Logic Noise, Skin Effect , Transmission Lines , Basic Linear Design, Decoupling Mixed Signals ICs With	7

Low Digital Content, Sampling Clock Considerations , Mixed Signal Grounding, Grounding DSPs with Internal Phase-Locked Loops, Decoupling ,Ringing , Thermal Management Thermal Basics ,Data Converter Thermal Considerations	
6.0 First Order Transients in Linear Electrical Circuits Analysis of RC & RL circuits, Propagation Delays, State and State variables, Problems	6
Unit - 3	
7.0 Energy and Power in Digital Circuits Energy Storage Elements; capacitors and inductors , Power and Energy Relations for a Simple RC Circuit, Average Power in an RC Circuit, Power Dissipation in Logic Gates: Static Power Dissipation, Total Power Dissipation, CMOS Logic Gate Design.	5
8.0 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

Course Content

Course Code: 16EARC203	Course Title: Manufacturing Technology	
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

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. Cutting tools. 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 CNC machine-Coordinate systems. Elements of CNC machines, 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. Metrology and Inspection:	6 hrs

Definition, need of inspection, terminologies, methods of measurement. Standards of measurement-line standards, end standards & wavelength standards. Limits, fits & gauges- introduction, tolerances, limits of size, fit and tolerances, Limit gauges classification.	
Unit - 3	
Chapter No. 7. Comparators and Angular Measurement Devices Characteristics of comparators , classification of comparators- Mechanical, Electrical & Pneumatic comparators. Introduction to angular measurement - Vernier & optical Bevel Protractor ,sine bar, sine centre, angel gauges.	5 hrs
Chapter No. 8. Advanced Metrology: Introduction & applications of: Co-ordinate Measuring Machine-important features of CMM, possible causes of errors in CMM, Performance, applications & advantages of CMM. Universal Measuring Machine- comparison of CMM & UMM ,inspection on UMM. Precision instruments based on laser – principle- laser interferometer- application in linear, angular measurements	5 hrs

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Laboratory Plan

Semester: III *Year:* **2017 - 2018**

Laboratory Title: **Programming laboratory**	Lab. Code: 16EARP203
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: structured query		**Total Weightage: 80**		**No. of lab sessions: 11**
Expt./ Job No.	**Experiment / Job Details**	**No. of Lab Session(s) per batch (estimate)**	**Marks / Experiment**	**Correlation of Experiment with the theory**
1	Experiment on –Structure and union		10	
	Learning Objectives: The students should be able to: 1.Demonstrate how to compile and run a c program in Eclipse IDE C/C++ 2. Write program using operators and control statements. 3. Write program using structures and union.			Analysis of algorithms & Design of Programs -Unit II
2	Experiment on-queues		10	
	Learning Objectives: The students should be able to: 1. Write program using different types of arrays and strings. 2. Develop a program using circular queue.			Analysis of algorithms & Design of Programs -Unit II
3	Experiment on –doubly linked list		12	

	Learning Objectives: The students should be able to: 1.Demonstrate how to maintain information of an university 2. Demonstrate how to specify different types of constraints on a given set of operations. 3. Develop a program in c using doubly linked list.			Analysis of algorithms & Design of Programs -Unit II
4	Experiment on- self balancing binary tree		12	
	Learning Objectives: The students should be able to: 1. Demonstrate how to search operation in executed. 2. Develop a program in c using self balancing binary tree.			Analysis of algorithms & Design of Programs -Unit II
5	Experiment on –circular doubly link list.		12	
	Learning Objectives: The students should be able to: 1.Demonstrate how it will store Prerequisite subjects 2.Develop the programs using circular doubly linked list			Analysis of algorithms & Design of Programs -Unit II
6	Experiment on-Dynamic programming		12	
	Learning Objectives: The students should be able to: 1. Demonstrate the graphical solution for the problem. 2. Analyze the efficiency of the algorithm. 3. Develop the program in c using dynamic programming technique.			Analysis of algorithms & Design of Programs -Unit III
7	Experiment on-Dynamic programming		12	
	Learning Objectives: The students should be able to: 1. Demonstrate the graphical solution for the problem. 2. Analyze the efficiency of the algorithm. 3. Develop the program in c using dynamic programming			Analysis of algorithms & Design of Programs -Unit III

	technique.			
Category: Open Ended		**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**
11	Implement software using the knowledge of Analysis of algorithms & Design of Programs for building the applications in automation and robotics engineering. (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 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

Course Content

Course Code: 16EARC207	Course Title: Microcontrollers	
L-T-P-**SS**: **4-0-0-0**	Credits:4	Contact Hrs: 4
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 50		Exam Duration: 100

No	Content	Hrs
	Unit I	
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**

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Course Plan

Semester: IV Year: 2017-18

Course Title: **Product Realization**	Course Code: 16EARP208
Total Contact Credits: **2(0-0-2)**	Duration of SEE Credits:
ISA Marks: 80	ESA Marks: 20

Week wise Plan:

Week #	Particulars	Venue
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	Studio Engagement
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	Makers Space/
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.	Studio/ Makers Space

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Laboratory Plan

Laboratory Course Plan: B E in A&R

Semester IV Year:2018-2019

Laboratory Title: **Manufacturing & Metrology lab**	Lab. Code: 16EARP205
Total Hours: **24**	Duration of ESA 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: 5
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(Lathe)	4	15	
	Learning Objectives: The students should be able to: Perform various operations like Facing, Turning, drilling, boring on a work piece using Lathe machine. Perform operations like drilling of holes on a given work material using Drilling Machine. Perform surface milling operation on a given slab of metal. Demonstrate grinding operation on a given metal cube to achieve predefined dimensions. Demonstrate arc welding process Demonstrate sheet metal cutting operations- Shearing ,Bending operations, drilling & riveting process			Unit I, II & III
2.	Measurement	1	5	
	Learning Objectives: The students should be able to: Extract the dimensions of the given part using (CMM) Compare the dimensions of the given part between conventional machine & CMM			Unit III
Category: Exercise		Total Weightage: 50		No. of lab sessions: 7

Expt./ Job No.	Experiment / Job Details	No. of Lab Session(s) per batch (estimate)	Marks / Experiment	Correlation of Experiment with the theory
3	Measurement for Linear and angular dimensions	1	10	
	Learning Objectives: The students should be able to: Select proper instruments for measurement Calculate least count of instrument Take reading using the instrument, Collection / recording of data, Interpret the observation, results Measure dimensions of the given component using vernier caliper & micrometer Measure unknown angle of a component using Sine bar and slip gauges			Unit II & III
4	Sheet metal	3	20	
	Learning Objectives: The students should be able to: Demonstrate how to use tools and equipment safely Mark & cut the sheet metal as per the drawing Construct common sheet metal seams Construct a sheet metal product (outer casing).			
5	Fabricate the Parts for Table Clamping Device	3	20	
	Learning Objectives: The students should be able to: To machine a given raw metal sheet to actual dimensions. Perform drilling operations at suitable locations. Mark the work piece before going for manufacture. Taking measurements at every step of operations using vernier calipers. Perform welding operation on hinges to achieve perfect right angle. Fill machining time calculation chart. Performing threading on a circular bar to a given pitch. Fill operation chart and inspections reports			Unit I,II,III

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FMTH0303-3.0

Laboratory Plan

Semester: V Year: **2018 - 19**

Laboratory Title: **OOP and Python Practice**	Lab Code: **16EARP305**
Total Hours: **22**	Duration of ESA: 2 hours
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:			Object Oriented

	1. Write programs using different types of arrays and strings. 2. Write a program to catch different types of exceptions. 3. Demonstrate how the String Buffer is used in a program.			Programming - I
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	1	10	Python programming-II

	scripting elements python constructs, data structures.			
	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.			Object Oriented Programming –I/ Python programming-II

	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.	

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Laboratory Plan

FMTH0303-3.0

Semester: V *Year:* **2018-2019**

Laboratory Title: **DBMS Practice**	Laboratory Code 16EARP306
Total Contact Hours: **48**	Duration of ESA: 3 Hours
Total ISA Marks: **80**	Total ESA Marks: **20**

Experiment wise Plan

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

Category: Demonstration		**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 practice**
1	Preparing an ER diagram for given database	1	10	Basic Knowledge of data base design
	Learning Objectives: The students should be able to Demonstrate how structure of a database can be expressed graphically by an ER diagram. Demonstrate how to represent attributes, relationships among entity sets, link attribute to entity sets and entity sets to relationships			
Category: Exercise		**Total Weightage: 10**		**No. of lab sessions: 1**
2	Execute basic SQL queries on a given database. (DDL, DML, DCL commands)	1	10	DDL, DML, DCL commands

	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: Structured Enquiry		**Total Weightage: 60**		**No. of lab sessions: 10**
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, union, intersection and joins on a given database.	2	10	Nested queries
	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.	2	20	Nested queries using clauses- group by, having &aggregate functions.
	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	2	10	Views of SQL
	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.	2	10	Normalization-1NF,2NF,3NF & BCNF
	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.			
7	Design a database for the given specifications & implement the database and write and execute the queries for the given statements.	2	10	Basic Knowledge of data base design, DDL, DML, DCL commands
	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:**
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.		20	

	(FOR ESA)			
	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: 16EARE301	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: 50		Exam Duration: 3 hrs	
Content			**Hrs**
Unit - 1			
CHAPTER NO. 1. INTRODUCTION TO PE AND ELECTRIC DRIVE SYSTEMS - Power Electronics, Applications of Power Electronics, Types of Power Electronic Circuits, Peripheral Effects, Characteristics and Specifications of Switches. Basic components of an Electric drive system: Mechanical loads, electric motors, power sources, converters and controllers.			7 hrs
CHAPTER NO. 2. POWER DIODES, BJT, MOSFET AND RECTIFIERS: Introduction, Diode Characteristics, Reverse Recovery Characteristics, Power Diode Types, Freewheeling Diodes with Switched RL Load. power BJT, structure of BJT, MOSFET and IGBT, characteristics of BJT, MOSFET and IGBT, comparison of power devices. Introduction, Single-Phase Full-Wave Rectifiers, Single-Phase Full-Wave Rectifier with RL Load, Single-Phase Full-Wave Rectifier with a Highly Inductive Load.			7 hrs
CHAPTER NO. 3. THYRISTORS AND COMMUTATION THEORY Introduction, Principle of Operation of SCR, Static Anode-Cathode Characteristics of SCR, two transistor model of SCR, Gate Characteristics of SCR, Firing circuits for SCRs, Turn-On Methods, Turn-Off Mechanism, Turn-Off. Natural and Forced Commutation – Class A and Class B types, Gate Trigger Circuit: Resistance Firing Circuit, Resistance capacitance firing circuit.			6 hrs
Unit - 2			
CHAPTER NO. 4. STATIC SWITCHES AND POWER SUPPLIES Single phase ac static switches, three phase ac static switches, three phase reversing switches, Solid state relays, Design of static switches, DC power supplies, DC Switched Mode DC power supplies, bidirectional power supplies, Switched Mode AC power supplies.			7 hrs
CHAPTER NO. 5. DC-DC CONVERTERS - Introduction, principle of step-down operation and its analysis with RL load, principle of step-up operation, Step-up converter with a resistive load, Performance parameters, Converter classification, Switching mode regulators: Buck regulator, Boost regulator, Buck-Boost Regulators.			7 hrs
CHAPTER NO. 6. POWER ELECTRONICS FOR MOTOR AND DRIVE APPLICATIONS DC and AC motor control, Single phase SCR drive, Three phase SCR drive, Reversible SCR drive, Speed control of DC motor, chopper-controlled DC drives, Microprocessor-Controlled DC drives, AC motor characteristics, speed control methods of induction motor, commutator less DC motor and Electronic commutation.			6 hrs
Unit - 3			

CHAPTER NO. 7. STEPPER MOTOR Principle of Stepper motor, Classification of Stepper motor, Principle of variable reluctant stepper motor, Principle of Permanent magnet stepper motor, Principle of hybrid stepper motor, driver for stepper motor, Applications of Stepper motor.	5 hrs
CHAPTER NO. 8. DRIVES FOR INDUSTRIAL APPLICATIONS Rolling mill drives, cement mill drives, electric traction drives, textile mill drives and machine tool drives.	5 hrs

Laboratory Plan FMTH0303-3.1

*Semester:*6 *Year:* 2018-19

Laboratory Title: **Hydraulics And Pneumatics Lab**	*Lab. Code*: **16EARP302**
Total Hours: 24	*Duration of Exam*: 2 Hours
Total Exam Marks: 20	*Total 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.**To study the application of different center configuration of 4/3 DCV. (Tandem and closed centre)	1.00	8.00	

	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. 3. Demonstrate how a hydraulic cylinder is controlled by a 4/3 directional valve with different spool shapes (blocked and circulation position).			Unit II
3	In a machining station, a hydraulic rotary drive is to swivel a drum from the horizontal to the vertical position after a welding process. The movement is to be performed by a hydraulic motor. Despite varying loads, the motor speed must remain constant.	1.00	4.00	
	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 - II
4	On a machine tool the velocity of a feed cylinder is to be increased and thus the cycle time of the system shortened without changing the pump flow. The advance velocity (extending time of the hydraulic cylinder) is to be adjustable independently of the load.	1.00	4.00	
	Learning Objectives: The students should be able to:			Unit – I

	1. Understand and record the table of the travel times 2. Calculate the velocity of the piston.			
5	In a fixture, a tool is to be moved by means of a hydraulic cylinder into and out of the machining area. In the event of a hydraulic pump failure, the tool must be extended by means of stored energy.	1.00	5.00	
	Learning Objectives: The students should be able to: 1. Understand the working of hydraulic accumulator.			Unit - II
Category: Exercise		**Total Weightage: 24.00**		**No. of lab sessions: 4.00**
Expt./ Job No.	**Experiment / Job Details**	**No. of Lab Session(s) per batch**	**Marks / Experiment**	**Correlation of Experiment with the theory**
6	A. Study of indirect control of a double-acting cylinder with a pneumatically operated 5/2 directional control valve. B. To study position dependent control of a double acting cylinder using mechanical limit switches.	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

	2. Identify switches and push buttons and use them to build the circuits.			
7	A. Study of Speed Control of Single Acting Cylinder - Slow Speed Extension and Rapid Retraction. B. Stop control, double-acting cylinder with 5/3 directional control valve, tensile load	1.00	6.00	
	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. 2. Explain the use of a 5/3 directional control valve with closed mid-position for stopping a double-acting cylinder.			Unit - I
8	The sequential control with two hydraulic drives.	1.00	6.00	
	Learning Objectives: The students should be able to: 1. Explain how the sequencing occurs between multiple cylinders.			Unit I and II
9	Control of hydraulic circuit using logic gates, timers and counters.	1.00	6.00	
	Learning Objectives: The students should be able to: 1. Identify different logic gates 2. Demonstrate circuit using timers and counters.			Unit - III
Category: Structured Enquiry		**Total Weightage: 14.00**		**No. of lab sessions: 2.00**
Expt./	**Experiment / Job Details**	**No. of Lab**	**Marks / Experiment**	**Correlation**

Job No.		**Session(s) per batch**		**of Experiment with the theory**
10	Hydraulic feed drive with electrical control and proportional valve.	1.00	7.00	
	Learning Objectives: The students should be able to: 1. Explain how the double acting cylinder is controlled using proportional valve.			Unit - I
11	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	7.00	
	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: 7.00**		**No. of lab sessions: 1.00**
Expt./ Job No.	**Experiment / Job Details**	**No. of Lab Session(s) per batch**	**Marks / Experiment**	**Correlation of Experiment with the theory**
12	A double-acting cylinder is used to press together glued components. Upon pressing	1.00	7.00	

	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 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

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 subscriber compiling 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	8 hrs

spaces, sample complexity for infinite hypothesis spaces, instance based learning-K nearest neighbor 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.	7 hrs
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	5 hrs

Course Content

Course Code: 16EARE401	Course Title: Measurement Systems	
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 – I	
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.	5 hrs
Chapter No. 2. Sensors and Signal conditioning Sensor characterization, Relations between physical quantities, Sensor Classification, Specifications, Error reduction techniques, Loading errors, Signal conditioning processes, The operational amplifier, Filtering, Wheatstone bridge, Pulse modulation.	5 hrs
Chapter No. 3. Motion Measurement Fundamental Standards, Relative Displacement: Translation and Rotational, Relative Velocity: Translation and Rotational, Relative-Acceleration Measurements, Displacement Pickups, Velocity Pickups, Acceleration Pickups, Calibration and Vibration Pickups, Jerk Pickups.	5 hrs
Unit – II	
Chapter No. 4. 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.	5 hrs
Chapter No. 5. 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.	5 hrs
Chapter No. 6. 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.	5 hrs
Unit – III	
Chapter No.7. Data Acquisition Systems Data conversion devices, 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.	5 hrs
Chapter No. 8. Transmission and Recording of Data Cable Transmission of Analog Voltage and Current Signals, Cable Transmission of Digital Data, Fiber-Optic Data Transmission, Analog Voltmeters and Potentiometers, Electrical Instruments, Digital Voltmeters and Multimeters, Signal Generation, Electromechanical XT and XY Recorders, Fiber Optic Sensors.	5 hrs

Course Content

Course Code: 17EARC203	Course Title: **Algorithm Analysis & Program Design**	
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: 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,SDLC models, 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	7hrs
Chapter 3: PROGRAMMING CONCEPTS FOR DESIGN AND ANALYSIS OF ALGORITHMS- Algorithms and Procedure oriented concepts, Object oriented programming concepts, data types, control structures, class and class concepts ,oop principles-inheritance,polymorphism,abstraction, exception handling mechanisms 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.	8 hrs
Unit - 2	
Chapter 4: ARRAYS, STACKS & QUEUES: Arrays, Dynamically Allocated Arrays, , Polynomials, Sparse Matrices, Representation of Multidimensional Arrays,	10 hrs

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.	10hrs
Unit - 3	
Chapter 6:DYNAMIC PROGRAMMING & GREEDY METHOD: Depth First Search and Breadth 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**.**	5 hrs
Chapter 7: LIMITATIONS OF ALGORITHMIC POWER AND COPING WITH THEM: Lower-Bound Arguments, Decision Trees, P, NP, and NP-Complete Problems, Challenges of Numerical Algorithms	5 hrs

Course Content

Course Code: 17EARC207	Course Title: Microcontrollers	
L-T-P-**SS**: **4-0-0-0**	Credits:4	Contact Hrs: 4
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 50		Exam Duration: 100

No	Content	Hrs
	Unit I	
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 Microcontroller Architecture and assembly language programming** 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: High end processors** Introduction to 80386 and 80486, architecture and pin definitions of 80386 and 80486, EFLAG Register Of The 80486, 80486 Memory System, Real Address Mode, Features of 80386 and 80486.	**5 Hrs**
8	**Chapter 8: Introduction to MicroPython**: Design Philosophy, Exploring MicroPython, Object-Oriented Programming and Some Python Basics, Using MicroPython with a Pyboard, Bare-Metal Approach, programming to handle interrupts, ADC.	**5 Hrs**

Course Content

Course Code: **17EARC209**	Course Title: **Control Systems**	
L-T-P : 4-1-0	Credits: 5	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. Introduction to Control Systems and System Modeling in Frequency domain System Configurations (open-loop & closed loop systems), Analysis and Design Objectives, The Design Process. Mathematical modeling of physical Systems: Transfer function, Electrical networks, Mechanical systems, Transfer Functions for Systems with Gears, Electromechanical System Transfer Functions, Analogous systems, Block diagram representation and reduction, Signal flow graph representation and reduction using Mason's Gain formula.	**8**
Chapter No. 2. Time Response Introduction, Poles, Zeros, and System Response, Standard test signals, 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 of first and second order systems, Analysis and Design of Feedback Systems, Steady state errors and error constants.	**8**
Chapter No. 3. 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 simple applications.	**4**
Unit - 2	
Chapter No. 4. Stability Analysis Concepts of stability, Necessary conditions for Stability, Routh-Hurwitz Criterion, Routh-Hurwitz Criterion: Special Cases.	**5**
Chapter No. 5: Root Locus Techniques 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.	**5**
Chapter No. 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. Introduction to lead, lag and lead-lag compensating networks.	**10**
Unit - 3	

Chapter No. 7 : Design Via Frequency Response Transient Response via Gain Adjustment, Lag Compensation, Lead Compensation, Lag-Lead Compensation, tuning of PID controllers.	**5**
Chapter No. 8: Design Via Root Locus and Introduction to State Space Design Via Root Locus: Improving Transient Response and Steady-State Error via Cascade Compensation, Feedback Compensation, Physical Realization of Compensation, State Space: Introduction, General State-Space Representation	**5**

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DEPARTMENT OF AUTOMATION & ROBOTICS

Laboratory Plan

Laboratory Course Plan: B E in A&R

Semester IV Year:2018-19

Laboratory Title: **Microcontroller Lab**	Lab. Code: 17EARP207
Total Hours: 28	Duration of ESA Hours: 3
Total Exam Marks: **20**	Total ISA 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	Marks obtained	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.	1	5		Chap1
	Learning Objectives : The students should be able to: Study the data sheets and make a comparative study of the Architectures, resources, tools and applications of different microcontroller Compare and contrast different microcontrollers. Connect microcontroller to LED and blink LED with proper delay. Apply suitable method or logic to solve given problem. Pre-lab: Download the data sheets of PIC16F877a, ATMEGA328, 8051 microcontrollers from the following websites http://www.atmel.com/images/Atmel-8271-8-bit-AVR-Microcontroller-ATmega48A-48PA-88A-88PA-168A-168PA-328-328P_datasheet_Complete.pdf http://ww1.microchip.com/downloads/en/DeviceDoc/39582b.pdf http://ww1.microchip.com/downloads/en/devicedoc/41159d.pdf http://www.atmel.com/images/doc8161.pdf http://www.farnell.com/datasheets/46220.pdf http://www.nxp.com/documents/data_sheet/LPC2921_23_25.pdf Draw the architectural layout of the following microcontrollers with pin out diagrams.				

	PIC16F877a ATMEGA328 8051 Make a comparative study and fill up the table 1 given in lab manual. Download the application notes. Prepare flowcharts and develop the code to demonstrate the use of the microcontroller as a simple digital output device. Study Proteus 8 Professional Study different ports and understand the basic LED program In lab: Must be able to explain difference between various types of Microcontrollers and its architectures. Setup the hardware platform and deploy the code on the hardware. If any errors debug the code until it works. Make a note of the number and types of errors. Simulate LED blink program on Proteus 8 Professional Post-lab: Analyze the cause for errors and make a note.				
2	Write a program to demonstrate a counting machine which count from 0000 to 9999 and display on 7 segment LED display using PIC16F877A and Arduino board.	1	5		Chap2
	Learning Objectives : The students should be able to: Use 7Segment LED for counting numbers. Use appropriate logic or method for counting. Pre-lab Study the application notes of Arduino and PIC16F877a Study advantages and disadvantages of Arduino and PIC16F877a microcontrollers Understand 7segment LED. Prepare flowcharts and develop the code to demonstrate the use of the microcontroller as a simple digital input and output device Study different segments of LED In-lab Write program for both Arduino and PIC If any errors debug the code until it works. Make a note of the number and types of errors. Simulate in Proteus Setup the hardware platform and deploy the code on the hardware. Execute the code and note the output. Post-lab Record the results and experience you got in lab Analyze the cause for errors and make a note				
3.	Write a program to read the values from the temperature sensor (LM35) and display the temperature in degree Celsius on LCD display	1	5		Chap2,3

	using PIC16F877A and Arduino board.				
	Learning Objectives : The students should be able to: Connect LM35, LCD and microcontroller. Write function to read values from LM35 and display it on LCD. Pre-lab Study the application notes of Arduino and PIC for interfacing LM35 and LCD. Prepare flowcharts and develop the code to demonstrate the use of the microcontroller as a simple digital input and output device. Study what is 16*2 LCD and how it works. Analyze the driver required for LCD. In-lab Write program for both Arduino and PIC Execute the code and note the output. If any errors debug the code until it works. Simulate LCD display in Proteus. Setup the hardware platform and deploy the code on the hardware. Make a note of the number and types of errors. Post-lab Analyze the cause for errors and make a note. List down different types of LCDs and sensors.				
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.	1	5		Chap2,3
	Learning Objectives : The students should be able to: Connect Keypad, LCD with microcontroller. Write logic to read key press event from keypad. Pre-lab Study the application notes of Arduino and PIC for interfacing keypad and LCD. Prepare flowcharts and develop the code to demonstrate the use of the microcontroller as a simple digital input and output device. List down different types of keypads Analyze the driver required for 4*3 keypad. In-lab Write programs for both Arduino and PIC Execute the code and note the output. If any errors debug the code until it works. Make a note of the number and types of errors. Simulate both in Proteus Setup the hardware platform and deploy the code on the hardware Post-lab				

	Record the results and experience in manual List down the different applications of Keypad in real world.(eg. In Security applications)				
	Category: Exercises Total Weightage: 20			No. of lab sessions:4	
Expt./ Job No.	Experiment/job Details	No. of Lab. Session/s per batch (estimate)	Marks/Experiment	Marks obtained	Correlation of Experiment with the theory
5	Write a program to measure the distance of an object using ultrasonic Sensors and display the distance in terms of centimeters and inches. Make the connections as per the schematic and develop the flowchart and the code to perform the required operation.	1	5		Chapter 4
	Learning Objectives : The students should be able to: Connect Ultrasonic Distance Sensor and microcontroller Logic to find distance in CM and Meters. Pre-lab Study the application notes of Arduino and PIC for interfacing Ultrasonic Sensors. Understand different types of sensors. List the advantages and disadvantages of different sensors. Prepare flowchart and develop the code to demonstrate the use of the microcontroller as a simple analog input sensor and convertor. In-lab Write programs for both arduino and PIC Execute the code and note the output. If any errors debug the code until it works. Make a note of the number and types of errors Setup the hardware platform and deploy the code on the hardware. Post-lab Record the results and experience in manual Try interfacing at least two other sensors and note down the readings. List real world applications of sensors.				
6	Write a program to control the speed and direction of DC, stepper and servo motors.	1	5		Chapter 4,5
	Learning Objectives : The students should be able to: Understand the connections from microcontroller to DC motor using drives. Discuss how motor driver helps in controlling the speed on a DC motor. Pre-lab: Study the application notes of Arduino and PIC for interfacing DC motor. Study the working principle of DC motor. Study in detail about different types of DC motors and list out them List advantages and disadvantages of DC motors				

	List the applications in the real world In lab: Write programs for both Arduino and PIC Simulate in Proteus Demonstrate the hardware for both Arduino and PIC. Post-lab Record the results and experience in manual Measure the speed of the DC motor w.r.t voltage.				
7	Design a development board using Atmega328 or PIC 18 using eagle/ Dip-trace	1	5		Chapter 4,5
	Learning Objectives : The students should be able to: Design circuit diagram of development board. Pre-lab: Get familiar with circuit design software like eagle or diptrace Sketch circuit diagram on paper. In lab: Design circuit. Simulate in Proteus Demonstrate the hardware for both Arduino and PIC. Post-lab Record the results and experience in manual Measure the speed of the stepper motor w.r.t step angle.				
8	Develop a printed circuit board (PCB) for your designed Atmega328 or PIC18 development board.	1	5		Chap 6
	Learning Objectives : The students should be able to: Develop a PCB and assemble the components. Pre-lab: Design of the PCB has to be ready. In lab: Develop the PCB and mount the components. Simulate in Proteus Demonstrate the hardware for both Arduino and PIC. Post-lab Record the results and experience in manual				
	Category: Structured Enquiry Total Weightage: 20 No. of lab sessions:4				

Expt./Job No.	Experiment/job Details	No. of Lab. Session/s per batch (estimate)	Marks/Experiment	Marks obtained	Correlation of Experiment with the theory
9	Design a programmer for your PIC18 development board to burn the program using PICkit2 or any similar software's.	1	10		Chapter 6,7

	Learning Objectives : The students should be able to: Design circuit diagram of development board. Pre-lab: Get familiar with circuit design software like eagle or diptrace Sketch circuit diagram on paper. In lab: Design circuit. Simulate in Proteus Demonstrate the hardware for both Arduino and PIC. Post-lab Record the results and experience in manual Measure the speed of the stepper motor w.r.t step angle.				
10	Develop a printed circuit board (PCB) for your designed and validated programmer which can burn programs on the PIC16 or PIC18 ICs.	1	10		Chapter 6,7
	Learning Objectives : The students should be able to: Develop a PCB and assemble the components. Pre-lab: Design of the PCB has to be ready. In lab: Develop the PCB and mount the components. Simulate in Proteus Demonstrate the hardware for both Arduino and PIC. Post-lab Record the results and experience in manual				
	Category: Open Ended	Total Weightage: 20		No. of lab session:2	
Expt./ Job No.	Experiment/job Details	No. of Lab. Slots per batch (estimate)	Marks/Experiment	Marks obtained	Correlation of Experiment with the theory
11	Write a program on Pyboard microcontroller using python programming and image processing to detect the tennis ball.	2	20		Chapter 1 to 7
	Learning Objectives : The students should be able to: Identify the problem and solve. Apply the knowledge of electronics and programming to measurement Liquid flow rate.				

Course Content

Course Code: 17EARC304	Course Title: Measurement Systems	
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 – I	
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.	5 hrs
Chapter No. 2. Sensors and Signal conditioning Sensor characterization, Relations between physical quantities, Sensor Classification, Specifications, Error reduction techniques, Loading errors, Signal conditioning processes, The operational amplifier, Filtering, Wheatstone bridge, Pulse modulation.	5 hrs
Chapter No. 3. Motion Measurement Fundamental Standards, Relative Displacement: Translation and Rotational, Relative Velocity: Translation and Rotational, Relative-Acceleration Measurements, Displacement Pickups, Velocity Pickups, Acceleration Pickups, Calibration and Vibration Pickups, Jerk Pickups.	5 hrs
Unit – II	
Chapter No. 4. 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.	5 hrs
Chapter No. 5. 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.	5 hrs
Chapter No. 6. 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.	5 hrs
Unit – III	
Chapter No.7. Data Acquisition Systems Data conversion devices, 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.	5 hrs
Chapter No. 8. Transmission and Recording of Data Cable Transmission of Analog Voltage and Current Signals, Cable Transmission of Digital Data, Fiber-Optic Data Transmission, Analog Voltmeters and Potentiometers, Electrical Instruments, Digital Voltmeters and Multimeters, Signal Generation, Electromechanical XT and XY Recorders, Fiber Optic Sensors.	5 hrs

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Laboratory Plan

*Semester:*V *Year: 2019-20*

Laboratory Title: Mechatronics & Measurements Lab	*Lab. Code*: 17EARP303
Total Hours: 24	*Duration of Exam*: 3 hrs
Total Exam Marks: 20	*Total ISA. 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**
1	Demo of Quanser Mechatronics Sensor kit, DC Motor Control Trainer module, Inverted Pendulum Trainer module with NI ELVIS Platform	1.00	5.00	Unit-1, Unit II
2	Data Acquisition process using DAQ card from NI using LABVIEW with strain guage load cell	1.00	5.00	
Category: Exercise		**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**
3	Sensor characterization using sensor modules, namely, Accelerometer, Ultrasonic sensor, Temperature sensor, Strain gauge	1.00	5.00	Unit I & Unit II
4	Sensor fusion of IMU and compass	1.00	5.00	
5	Development of a Data acquisition system , DAQ hardware as an embedded system	1.00	10.00	

Category: Structured Enquiry		**Total Weightage: 45.00**		**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**
6	System identification of DC motor	2.00	15.00	Unit – 1, Unit - 2 and Unit - 3
7	Hardware in Loop model for a stated problem using Speed goat / Controller/ Processor and MATLAB2018A	1.00	15.00	
8	Develop a plant model using Inverted pendulum in MATLAB and analyze its performance characteristics	2.00	15.00	
Category: Open Ended		**Total Weightage: 5.00**		**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**
9	Design and develop a Haptic kit for physically challenged people	2.00	5.00	Unit – 1, Unit - 2 and Unit - 3

Course Content

Course Code: **17EARC305**	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 subscriber compiling 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	8 hrs

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, 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.	7 hrs
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	5 hrs

Course Content

Course Code: 17EARC301	Course Title: Object Oriented Programming and Database Management Systems	
L-T-P: 4-0-0	Credits: 3	Contact Hrs: 50
ISA Marks: 50	ESA Marks: 50	Total Marks: 50
Teaching Hrs: 50		Exam Duration: 3 hrs

Content	Hrs
Unit - I	
Chapter 1 Introduction to Software Development Lifecycle and Unified Modeling Language: Software Development Lifecycle, SDLC Models, Requirement Modeling Framework, Computer Communication Methods Unified Modeling Language (UML): 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	6
Chapter 2 Data Modeling using the 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, Relationship Types of Degree Higher than Two, ER Diagrams, Naming Conventions and Design Issues	6
Chapter 3 Introduction to Object-Oriented Programming - I: Introduction to .NET Environment, The Java Virtual Machine, Variables and Data Types, Conditional and Looping Constructs, Arrays, Fields and Methods, Constructors, Overloading Methods, Garbage Collection, Nested Classes, Simple Inheritance, Multilevel Inheritance, Overriding, Overloading, Defining Interfaces, Implementing Interfaces, Polymorphism, Abstract Classes, Access Control, Access Modifiers, Access Protection	8
Unit - II	
Chapter 4 Object-Oriented Programming - II: Final Classes, Final Variables and Methods, Finalizer Method: finalise (), Exception Handling, Fundamentals of Exception Handling, Exception Types, Constructors and Methods in Throwable Class, Java's Built-in Exceptions, Unchecked and Checked Exception, Creating Your Own Exception Sub-Classes	4
Chapter 5 Object-Oriented Programming - III: Features of Python Variables, Operators and Branching, Core elements of Programs - Bindings, Strings, Input/Output, IDEs, Control Flow and Iteration, Functions - Decomposition and Abstraction, Functions and Scope, Keyword Arguments, Specifications, Lists, Tuples, Sets, Mutation, Aliasing, Cloning, Functions as Objects, Dictionaries, Example with a Dictionary, Fibonacci and Dictionaries, Global Variables, Classes and Inheritance: Object-Oriented Programming, Class Instances, Methods Classes, Examples, Hierarchies	10

Chapter 6 Introduction to Database Management Systems: Introduction to DBMS with 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, Database System Environment	6
Unit - III	
Chapter 7 Relational Data Model and SQL: Relational Model Concepts, Relational Model Constraints and Relational Database Schemas, Update Operations, Transactions and Dealing with Constraint Violations, SQL Data Definition and Data Types, Specifying Basic Constraints in SQL, Schema Change Statements in SQL, Insert, Delete and Update Statements in SQL, Specifying Constraints as Assertion and Trigger, Indexing Techniques, Views in SQL, Basic Queries in SQL, More Complex SQL Queries, 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	5
Chapter 8 Object-Relational Databases and Semantic Modeling Approach: Overview of Object Database Concepts, Object-Relational Features: Object Database Extensions to SQL, The ODMG Object Model and the Object Definition Language ODL, Object Database Conceptual Design, The Object Query Language OQL, Semantic Introduction to Databases, Semantic Modeling, Semantic Binary Schemas, Schema Quality Criteria, Subschemas and User views, Transaction Processing Concepts	5

Course Content

Course Code: 17EARC303	Course Title: Mechatronics System 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 - I	
1. Introduction to Mechatronics Systems and elements Introduction to Mechatronic Systems and Design, Mechatronic systems in Precision mechanics, Micromechanics and Process Engineering , Confinement of Mechatronic Systems , Functions, Distribution of Mechanical and Electronic Functions, Integration Forms of Processes and Electronics , Ways of Information Processing , Multi-level Control Systems , Special Signal Preprocessing,Design Procedures for Mechatronics Systems, V model	8
2. Modeling of Processes Theoretical and Experimental Modeling , Classification of Process Elements , Process Elements with Lumped and Distributed Parameters , Mechanical System model ,Mechanical Elements : Bars ,Springs, Dampers , Mechanical Systems with Friction , Backlash , Electrical System model, Analogies between Mechanical and Electrical Systems, Dynamics of Mechanical Systems, Newton's Laws of Kinetics , Translational and RotationalMotion, Principles of Mechanics, d'Alembert's Principle , Lagrange's Equations, Problems.	12
Unit - II	
3.Electrical Drives Types of Electrical Drives,Electromagnets , Direct Current Motors , Dynamic Behavior , Static Behavior , Special Types of DC Motors , Alternating Current Motors (AC) , Induction Motors, Synchronous Motors , Single-phase Motors , Commutator Motors (Universal Motors) ,Squirrel-cage Motors , Power Electronics Circuits , Internally or Externally Commutated Electro-motors , Electrical Motor Sizing and Selection Procedure, Electric Motor Operational Conditions, Motion Profile, Load Torque Calculation, Motor Shaft Torque Calculation, Load Torque–Speed Profile , DC Motor Parameter Estimation, Process Dynamics Particularities, Electrical Binary Actuators.	10
4. Model based Design of Systems & Identification Introduction to model based design ,Basic block diagrams, Model-based Methods of Control,Supervision and Fault Diagnosis, Intelligent Systems,Non-linear Control and Fault Detection , Model-based Compensation of Non-linearities, Modeling and Fault Diagnosis , Examples for the Design of Mechatronic Systems using UML and SysML, Identification Methods , classification of Identification Methods ,Test Signals , Closed-loop Identification , Type of Application, Parameter Estimation for Discrete Time-varying Systems, Non-linear Processes, Problems.	10
Unit - III	
5. Recent trends in Mechatronics System Design process Mechatronics systems contributing to economic growth, Changes in technological processes and products, Tools and methods in mechatronics system design and development, Use of Artificial Neural Networks and Fuzzy-logic Models , Fields of application, Future Mechatronics systems.	5
6. Case studies Dynamic Models ofa Electromagnetic actuator, Control Prototyping and Hardware-in-the-loop	5

Simulation, Rapid Control Prototyping for Engine Control, Hardware-in-the-loop Simulation for Industrial Robot , Process control system, etc, UML/ SysML and State chart modeling for each example.	

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DEPARTMENT OF AUTOMATION & ROBOTICS

Laboratory Plan

FMTH0303-3.1

Semester: V

Year: 2019-20

Laboratory Title: Object-Oriented Programming and Database Management Systems Lab	*Lab. Code*: 17EARP301
Total Hours: 24	*Duration of Exam*: 2 hrs
Total Exam Marks: 100	*Total ISA. Marks*: 80

Experiment-wise plan

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

Category: Demonstration Total Weightage: 35 No. of lab sessions: 7

Learning Outcomes:
The students should be able to:
Design and model using UML diagrams and ER models.
Demonstrate how to compile and run a program in JAVA, Python, and .NET environment.
Write programs using class, inheritance, and other fundamentals of OOP.
Write SQL statements concerning data manipulation using retrieving, inserting, updating, and deleting commands.
Write packages/procedure for manipulating data and triggers to enhance data retrieval.

Expt./Job No.	Experiment/job Details	No. of Lab. Session/s per batch (estimate)	Marks/ Experiment	Correlation of Experiment with the theory
1	SysML - Getting used to tool, use case, creating class diagram, sequence diagram, and state diagram.	1	5	Introduction to Software Development Lifecycle and Unified Modeling Language
2	Creating ER models considering different relationship and attributes.	1	5	Data Modeling using the ER Model
3	Write programs in Java or .NET using the concept of OOP like arrays, strings, functions, overloading, and exception handling.	1	5	Introduction to Object-Oriented Programming - I
4	Write programs in JAVA or .NET using the concept of a generic class, inheritance, interface, and package.	1	5	Object-Oriented Programming - II
5	Write programs in PYTHON using the concept of generic classes, inheritance, interface, and package.	1	5	Object-Oriented Programming - III

6	Write SQL statements related to data manipulation, like insert, delete, and update.	1	5	Relational Data Model and SQL
7	Write statements to create views, procedures, packages, and indexing for fast retrieval.	1	5	Relational Data Model and SQL

Category: Exercises Total Weightage: 20 No. of lab sessions: 2

Learning Outcomes:
The students should be able to:
Design and model using UML diagrams.
Implement classes in JAVA or .NET environment.
Compile and build JAR/DLL files.
Design and mode ER models for different scenarios.
Construct a database schema with data manipulation SQL statement, a proper procedure in place, and create triggers for fast data retrieval.

Expt./Job No.	Experiment/job Details	No. of Lab. Session/s per batch (estimate)	Marks/Experiment	Correlation of Experiment with the theory
1	Develop a class diagram concerning sensor, actuators and controls, implement these classes, and build JAR/DLL files.	1	10	Introduction to Software Development Lifecycle and Unified Modeling Language Introduction to Object-Oriented Programming - I Object-Oriented Programming - II Object-Oriented Programming - III
	Develop an ER model and construct a database schema for a given manufacturing scenario.	1	10	Data Modeling using the ER Model Relational Data Model and SQL Relational Data Model and SQL

Category: Structured Enquiry Total Weightage: 25 No. of lab sessions: 2

Learning Outcomes:
The students should be able to:
Design, develop and implement application utilizing previously developed JAR/DLL files.
Store data from the application into the database.
Design, development and implement the user interface for visualization of data from the database.

Expt./Job No.	Experiment/job Details	No. of Lab. Session/s per batch (estimate)	Marks/ Experiment	Correlation of Experiment with the theory
	Implement a project which utilizes previously generated JAR/DLL files and database schema to store data from automation devices and control the actuators. Additionally, proper checks have to be implemented and with necessary visualization.	2	25	
Category: Open Ended	Total Weightage: 20	No. of lab sessions: 2		
Learning Outcomes: The students should be able to: Use the OOP concepts to implement the project. Use database concept to implement the project Select the appropriate tool/software to implement the project. Write a technical report using a predefined template. Present the technical report of the implemented project. Demonstrate the learning experiences of working in a team.				
Expt./Job No.	Experiment/job Details	No. of Lab. Slots per batch (estimate)	Marks/ Experiment	Correlation of Experiment with the theory
1.	Implement a project using C++/Java/python/DB concepts, for automation and robotics applications.	2	20	

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	Total Marks: 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,knowledgebasedagents propositionallogic predicatecalculus inferencerules	5hrs
Chapter2:Roboticsoftwarearchitectures Subsumptionarchitecture,Three-layerarchitecture, Pipelinearchitecture,HierarchicalParadigm-AttributesoftheHierarchicalParadigm,ReactiveParadigm-AttributesofReactiveParadigm,HybridDeliberative/ReactiveParadigm-AttributesofHybridParadigm,ArchitecturalAspects,ManagerialArchitectures-AutonomousRobotArchitecture(AuRA),SensorFusionEffects(SFX),State-HierarchyArchitectures,Model-OrientedArchitectures,InterleavingDeliberationandReactiveControl.	5hrs.
Chapter3:BiologicalFoundationsoftheReactiveParadigm Agencyandcomputationaltheory,AnimalBehaviors,Reflexivebehaviors ,CoordinationandControlofBehaviors,Innatereleasingmechanisms,Concurrentbehaviors,PerceptioninBehaviors,Action-perceptioncycle,TwofunctionsofperceptionGibson:Ecologicalapproach,Neisser:Twoperceptualsystems,SchemaTheory,Behaviorsandschematheory,PrinciplesandIssuesinTransferringInsightstoRobots	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,Relational Methods,AssociativeMethods,CaseStudyofTopologicalNavigationwithaHybridArchitecture	7hrs

Course Content

Course Code: 17EARE304	Course Title: Digital System Design and FPGA programming	
L-T-P: 3-0-0	Credits: 3	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. Review of Logic Design Fundamentals: Combinational logic, Boolean algebra and algebraic Simplification Karnaugh maps, designing with NAND and NOR gates, hazards in combinational circuits, flip-flops and latches, Mealy sequential circuit design, design of a Moore sequential circuit, equivalent states and reduction of state tables, sequential circuit timing, tristate logic and busses. Advanced Design Issues: Meta-stability, Noise Margins, Power, Fan-out, TimingConsiderations, Brief overview of programmable logic devices, simple programmable logic devices (SPLDs), complex programmable logic devices (CPLDs), field-programmable gate arrays (FPGAs),	9hrs
Chapter No. 2. Introduction to State Machine Charts and Microprogramming: State machine(SM) charts, derivation of SM charts, realization of SM charts, implementation of the dice game, microprogramming,: Design Examples	6hrs
Unit – 2	
Chapter No. 3. Designing with Field Programmable Gate Arrays: Implementing functions in FPGAs, implementing functions using Shannon's decomposition, carry chains in FPGAs, cascade chains in FPGAs, examples of logic blocks in commercial FPGAs, dedicated memory in FPGAs, dedicated multipliers in FPGAs, cost of programmability, FPGAs and One-Hot state assignment	7hrs
Chapter No. 4. Modeling and design with HDL Basic Concepts, Dataflow Descriptions, Behavioral Descriptions ,Structural Descriptions, Design examples,Timing and Delays, BCD to 7-Segment Display Decoder, BCD Adder, 32-Bit Adders, Traffic Light Controller, Shift-and-Add Multiplier, Array Multiplier. **Introduction to Verilog and VHDL**: Data Types, Modeling Concepts, Task and Functions, Specify Block and Timing Checks , Architecture study of popular FPGA families	8hrs
Unit – 3	
Chapter No. 5. Testing and Verification What is Verification, what is a Test bench, The Importance of Verification, Convergence Model, What Is Being Verified, Functional Verification Approaches, Testing Versus Verification, Design and Verification Reuse, Cost of Verification	5 hrs
Chapter No. 6 Case studies on FPGA technologies in Automation and Robotics applications Robotic Car from Georgia Institute of Technology Robotic Controller: ASIC versus FPGA	5 hrs

Expanding a robot's life: Low power object recognition via FPGA-based DCNN deployment FPGA-powered parallel, pipelined vision algorithms	

Course Content

Course Code: **17EARC308**	Course Title: **Hydraulics and Pneumatics**	
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

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. Problems on determining the pump flow rate, pump efficiency and pump power.	5hrs
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. Problems on determining motor speed, torque, power ,motor efficiency and Mechanics of Hydraulic Cylinder loading.	5hrs
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.	5hrs
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.	5hrs
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	5hrs

Direct and indirect control of single acting cylinder, control of 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.	
Unit - 3	
Chapter No. 7. 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.	5 hrs
Chapter No. 8. 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

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DEPARTMENT OF AUTOMATION & ROBOTICS

Laboratory Plan

Laboratory Course Plan: B.E in A&R

Semester: VI Year: 2019-2020

Laboratory Title: Industrial Robotics Lab	Lab. Code: 17EARP306
Total Hours: 28	Duration of Exam: 3 hrs.
ISA Marks: 80	ESA. Marks: 20

Experiment wise Plan

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

Category: Exercise		Total Weightage: 70.00		No. of lab sessions: 8.00
Expt./ Job No.	Experiment / Job Details	No. of Lab Session(s) per batch (estimate)	Marks / Experiment	Correlation of Experiment with the theory
1	Matlab Introduction	1.00	10	
	Millions of engineers and scientists worldwide use MATLAB® to analyze and design the systems and products transforming our world. The matrix-based MATLAB language is the world's most natural way to express computational mathematics. Built-in graphics make it easy to visualize and gain insights from data. The desktop environment invites experimentation, exploration, and discovery. These MATLAB tools and capabilities are all rigorously tested and designed to work together. MATLAB helps you take your ideas beyond the desktop. You can run your analyses on larger data sets, and scale up to clusters and clouds. MATLAB code can be integrated with other languages, enabling you to deploy algorithms and applications within web, enterprise, and production systems. Topics: Basic commands Vectors and Matrices Importing Data Plotting Data Technically speaking, MATLAB is not a programming language but it is a tool with which you can find engineering solutions based on mathematics. Robotic developers need to learn MATLAB if they want to analyze data, produce advanced graphs or implement control systems.			UNIT – I

<table>
<tr><td></td><td colspan="3">MATLAB, and its open source relatives, such as Octave, is very popular with some robotic engineers for analyzing data and developing control systems.
Programming for a robot requires designing the controller that governs robot behavior. Modeling and simulation became vital to understand how the controller interacts with the robot’s environment perception, mobility, and interaction.
Why MATLAB is the Most Used Programming Language in Robotics?
• MATLAB is highly useful in designing the entire robotic system.
• It is widely used in the robotics industry as it is deeply rooted in the foundation and development of robots.
• It is a simulation tool whereby you can provide your algorithm or design and it simulates the result.
• On the other hand, simulation helps engineers to refine the system design and eliminate errors before developing hardware prototypes.</td><td></td></tr>
<tr><td>2</td><td>Robotics Toolbox</td><td>1.00</td><td>10</td><td></td></tr>
<tr><td></td><td colspan="3">The Toolbox has always provided many functions that are useful for the study and simulation of classical arm-type robotics, for example such things as kinematics, dynamics, and trajectory generation.
The toolbox contains functions and classes to represent orientation and pose in 2D and 3D (SO (2), SE (2), SO (3), SE (3)) as matrices, quaternions, twists, triple angles, and matrix exponentials. The Toolbox also provides functions for manipulating and converting between data types such as vectors, homogeneous transformations and unit-quaternions which are necessary to represent 3-dimensional position and orientation.</td><td>UNIT – I</td></tr>
<tr><td>3</td><td>RoboAnalyzer</td><td>2.00</td><td>20</td><td></td></tr>
<tr><td></td><td colspan="3">Explaining the concepts in a course on Robotics typically requires a 3D model of a serial-robot/manipulator, either in the form of a physical robot or a virtual robot in software environment, for a better understanding.
With the experience of handling Robotics courses and the feedback received so far, we have come up with a list of Virtual Experiments using RoboAnalyzer.
List of Virtual Experiments using RoboAnalyzer
<table>
<tr><th>Sl No.</th><th>Practical Assignments using RoboAnalyzer</th><th>Topics Covered</th></tr>
<tr><td>1</td><td>Introduction to RoboAnalyzer</td><td>Usage of RoboAnalyzer</td></tr>
<tr><td>2</td><td>Virtual Models of Industrial Robots</td><td>Industrial Robots</td></tr>
<tr><td>3</td><td>Understanding coordinate frames and</td><td>DH Parameters, Robot</td></tr>
</table></td><td>UNIT-I & II</td></tr>
</table>

		transformations	Geometry	
	4	Forward kinematics of robots	Robot Kinematic Analysis	
	5	Inverse kinematics of robots	Robot Kinematic Analysis	
	6	Case Study: Kinematics of MTAB Mini Robot	Robot Kinematic Analysis	
	7	Case Study: Workspace Analysis of a 6 axis robot	Workspace Analysis	
	8	Inverse and Forward dynamics of robots	Robot Dynamics	
	9	Creating robot joint trajectories	Trajectory Planning	
4	Introduction to ABB Robotstudio	1.00	5.00	
	Offline programming is the best way to maximize return on investment for robot systems. ABB's simulation and offline programming software, RobotStudio, allows robot programming to be done on a PC in the office without shutting down production. RobotStudio provides the tools to increase the profitability of your robot system by letting you perform tasks such as training, programming, and optimization without disturbing production. This provides numerous benefits including: Risk reduction Quicker start-up Shorter change-over Increased productivity RobotStudio is built on the ABB VirtualController, an exact copy of the real software that runs your robots in production. This allows very realistic simulations to be performed, using real robot programs and configuration files identical to those used on the shop floor.			UNIT-I & II
5	Simulation/Offline Programming (Robotstudio)	2.00	15.00	
	Topics to be covered: Create mechanism AutoPath Set Task Frame Collision control Reachability Create MultiMove System from Layout			UNIT-I & II

6	Online Programming	1.00	10	
	To perform a particular action, robots are programmed either by guiding or by off-line programming. Most of the industrial robots are programmed by guiding a robot from point to point through the phases of an operation, with each point stored in the robotic control system. Robots receive instructions through computer commands and this is referred to as manipulator level off-line programming. Usage of off-line programming involves higher-level languages, in which robotic actions are defined by tasks or objectives. Robotic programmers must have knowledge on different types of programming languages as switching from computers to robots is not the smooth transition that many developers/programmers may think.			UNIT-I & II
Category: Structured Enquiry		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
7	Project Students should form a team of 4 in numbers and select a problem or need statement in industrial robotics area. The project should consists of following requirements: Minimum 3 to 6 DOF robot arm DH Parameters Students are free to choose the software to complete the project	1	20.00	UNIT-I & II

Laboratory Plan

FMTH0303-3.1

Semester: VII Year: 2020-21

Laboratory Title: Project	Lab Code: 18EARW401
Total Hours: 30	Duration of Exam: 3 Hrs
Total ESA Marks: 50	Total ISA. Marks: 50

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 Content

Course Code: **18EARC201**	Course Title: **Analog and Digital Electronic Circuits**	
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 - 1	
1.0 Introduction of PN junctions and analog electronics Diode theory, forward and reverse biased junctions, reverse- bias breakdown, load line analysis, diode applications – limiters, clippers, clampers, voltage multipliers, half wave and full wave rectification, voltage regulators, voltage dividers,pull up, pull down, optocoupler,special purpose diodes – Zener diode, varactor, light emitting diodes, photodiodes. Network theorems and applications: KVL, KCL, Node Method, Loop Method, Superposition, Thevenin's Theorem and Norton's Theorem.	7
2.0 Transistors Bipolar Junction Transistors and introduction to MOSFET: 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, Introduction to MOSFETs, MOSFET as a switch.	7
3.0 Operational Amplifiers Op-Amp Basics, practical Op-Amp circuits, differential and Common mode operation, Inverting &Non-Inverting Amplifier, differential and cascade amplifier, Op-Amp applications: Voltage follower, Comparator, summing, integrator, differentiator, instrumentation amplifiers, Schmitt trigger, Op-amp based oscillators.	6
Unit - 2	
4.0 Number system and digital logic gates Decimal, binary, octal, hexadecimal number system and conversion, binary weighted codes, signed numbers, 1s and 2s complement codes, Binary arithmetic. Logical Operators, Logic Gates-Basic Gates, Other gates, Active high and Active low concepts, Universal Gates and realization of other gates using universal gates, Gate Performance Characteristics and Parameters.	6
5.0 Boolean algebra and combinational logic circuits Binary logic functions, Boolean laws, truth tables, half adder, full adder, subtractor, associative and distributive properties, DE Morgan's theorems, realization of switching functions using logic gates. Switching equations, canonical logic forms, sum of product & product of sums, Karnaugh maps, two, three and four variable Karnaugh maps, simplification of expressions.	7
6.0 Design of combinational logic circuits and sequential logic	7

Introduction to combinational circuits, code conversions, decoder, encoder, priority encoder, multiplexers as function generators, binary adder, subtractor, BCD adder, Binary comparator, arithmetic logic units. Sequential circuits, flip-flops, clocked and edge triggered flipflops, timing specifications, asynchronous and synchronous counters, counter design with state equations, Registers, serial in serial out shift registers, tristate register, timing considerations.	
Unit - 3	
7.0 Data conversions Introduction to data conversions, $R/2^nR$ DAC, R/2R, Flash, Digital ramp ADC, Successive approximation ADC, Slope (integrating) ADC, Delta-Sigma ($\Delta\Sigma$) ADC, Practical considerations of ADC circuits.	5
8.0 Digital integrated circuits Logic levels, propagation delay time, power dissipation fan-out and fan-in, noise margin, logic families and their characteristics TTL, LSTTL CMOS and ECL integrated circuits and their performance comparison, open collector and tristate gates and buffers.	4

Course Content

Course Code: 18EARC203	Course Title:**Data structures ,Algorithm design and analysis**	
L-T-P : 4-1-0	Credits: 4	Contact Hrs: 50
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 50		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.	6hrs
Chapter 2: DESIGN AND ANALYSIS OF ALGORITHMS-Algorithms and Their Representations, Modifying 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.	7 hrs
Chapter 3: 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, Queues, Single- and Double-Ended Priority Queues.	7 hrs
Unit - 2	
Chapter 4: 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, Graph representation, Adjacency matrix, Adjancey list, Application of graphs.	8 hrs
Chapter 5:DYNAMIC PROGRAMMING & GREEDY METHOD: Depth First Search and Breadth First Search, The General Method, Warshall's Algorithm, Floyd's Algorithm for the All-Pairs Shortest Paths Problem, Single-Source Shortest Paths, The	7 hrs

Traveling Salesperson problem, Kruskal's algorithm, Huffman trees**.**	
Unit - 3	
Chapter 6: INTRODUCTION TO C++: Overview of C++, Sample C++ program, Different data types, operators, expressions, and statements, arrays and strings, pointers & user defined types. Class Specification, Class Objects, Scope resolution operator, Access members, Defining member functions, Data hiding, Constructors, Destructors, Parameterized constructors,	8hrs
Chapter 7:BASIC OOP CONCEPTS: Base Class, Inheritance and protected members, Protected base class inheritance, Inheriting multiple base classes, Virtual function, Calling a Virtual function through a base class reference, Virtual attribute is inherited, and Virtual functions are hierarchical, Pure virtual functions, Abstract classes, Using virtual functions.	7hrs

Course Content

Course Code: 18EARC209	Course Title: Object Oriented Programming and Database Management Systems	
L-T-P: 3-0-0	Credits: 3	Contact Hrs: 40
ISA Marks: 80	ESA Marks: 20	Total Marks: 100
Teaching Hrs: 40		Exam Duration: 2 hrs

Content	Hrs
UNIT I	
Chapter 1. Introduction to Software Development Lifecycle Software Development Lifecycle, SDLC Models, Agile Software Development, Requirement Engineering, System Modelling, Architecture Design, Design and Implementation, Software Testing, Software Evolution	4
Chapter 2. Introduction to Object-Oriented Programming - I Structure vs. Class, Components of a Class, Encapsulation, Access Specifiers, Member Functions, Instance of a Class, Default Constructors, Destructors, Accessing Data Fields, Constructors with Parameters, Static Class Members - Data Members and Member Functions, Scope Resolution Operator, Nested Classes, Local Classes, Passing Objects to Functions, Return Objects, Object Assignment, Friend Function, Operator Overloading, Function Overloading, Copy Constructors	7
Chapter 3. UML Diagram UML Walkthrough, Class Diagram, Use Case Diagram, State Chart Diagram, Activity Diagram, Sequence Diagram	4
UNIT II	
Chapter 4. Introduction to Object-Oriented Programming – II Inheritance, Derived Class, Calling the Base Class Constructor, Overriding Member Functions, Polymorphism, Class Inheritance Hierarchies, Revisiting Class Diagrams, Abstract Classes, Run-Time Information, Early vs. Late Binding, Virtual Base Classes, Multiple Inheritance, Interfaces	7
Chapter 5. Entity Relationship (ER) Model High-Level Conceptual Data Models for Database Design, Entity Types, Entity Sets, Attributes and Keys, Relationship Types, Relationship Sets, Roles and Structural Constraints, Weak Entity Types, Relationship Types of Degree Higher than Two, ER Notations, Informal Design Guidelines for Relation Schemas, Functional Dependencies, Normal Forms Based on Primary Keys, First Normal Form (1NF), Second Normal Form (2NF) and Third Normal Form (3NF), Boyce-Codd Normal Form (BCNF)	8
UNIT III	
Chapter 6. Database Management System Introduction, Characteristics of Database Approach, Actors on the Scene, Workers Behind the	5

Scene, Advantages and Disadvantages of using DBMS Approach, Data models, Schemas and Instances, Three-Schema Architecture and Data Independence, Database Languages and Interfaces, Database System Environment	
Chapter 7. Cloud Computing Introduction to Cloud Computing, Virtualization Concepts, Main Players, Types of Cloud – Public, Private and Hybrid, Cloud Services – CaaS, SaaS, PaaS, and IaaS, Service Level Agreement, Cloud Security, Cloud Computing at Enterprise Systems Level, Hybrid Cloud Options	5

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Laboratory Plan FMTH0303-3.1

Semester: IV *Year: 2019-20*

Laboratory Title: Object-Oriented Programming and Database Management Systems Lab	*Lab. Code*: 18EARP209
Total Hours: 52	*Duration of Exam*: 2 hrs
Total Exam Marks: 100	*Total ISA. Marks*: 80

Experiment-wise plan

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

Category: Demonstration Total Weightage: 10 No. of lab sessions: 9

Learning Outcomes:
The students should be able to:
Demonstrate how to compile, debug and run a program in.NET environment.
Write programs using class, inheritance, and other fundamentals of OOP.
Design and model using UML diagrams.

Expt./Job No.	Experiment/job Details	No. of Lab. Session/s per batch (estimate)	Marks/ Experiment	Correlation of Experiment with the theory
1	Visual Studio IDE, Hello World Project, Project Properties, Programming, Compiling, Debugging, Input, Output and Formatted Output, Number Types, String, Arrays, Variable Definition, Assignments, Constants, Namespace	1	1	
2	*if* Statement, *switch* Statement, Nested *if* and *switch* Statements, ? Alternative, *while* Loop, *for* Loop, *do* Loop, Nested Loops, Predefined Functions, Functions, Return Values, Arguments, Parameters, Debugging, Default Function Arguments, Procedures, Friend Function, Inline Function, Variable Scope, Global Variable, Program Styles	1	1	
3	Pointers, Pointer Variables, Pointer Operators, Pointer Expressions, Array of Pointers, Pointers to Functions, Structures, Structure Members, Structure Assignments, Passing Structures to Functions, Structure Pointers	1	1	
4	Structure vs. Class, Components of a Class, Encapsulation, Access Specifiers, Member Functions, Instance of a Class, Default Constructors, Destructors, Accessing Data Fields	1	1	Introduction to Object-Oriented Programming - I
5	Passing Objects to Functions, Return Objects, Object Assignment, Friend Function	1	1	Introduction to Object-Oriented Programming - I

6	UML Class Diagram, Use Case Diagram, State Chart Diagram, Activity Diagram, Sequence Diagram	1	1	UML Diagram
7	Abstract Classes, Multiple Inheritance, Interfaces	1	1	Introduction to Object-Oriented Programming - II
8	File Handling, MVC, User Interface	1	2	
9	Connecting Database through C++ Programs	1	1	

Category: Exercise Total Weightage: 30 No. of lab sessions: 10

Learning Outcomes:
The students should be able to:
Design and model using ER models.
Write programs using class, inheritance, and other fundamentals of OOP.
Write SQL statements concerning data manipulation using retrieving, inserting, updating, and deleting commands.
Write packages/procedure for manipulating data and triggers to enhance data retrieval.
Design and model ER models for different scenarios.
Construct a database schema with data manipulation SQL statement, a proper procedure in place, and create triggers for fast data retrieval.

Expt./Job No.	Experiment/job Details	No. of Lab. Session/s per batch (estimate)	Marks/ Experiment	Correlation of Experiment with the theory
01	Exception Handling, Lists, Queues, Stack	1	3	
02	Constructors with Parameters, Static Class Members - Data Members and Member Functions, Scope Resolution Operator, Nested Classes, Local Classes	1	3	Introduction to Object-Oriented Programming - I
03	Function Overloading, Operator Overloading, Copy Constructors	1	3	Introduction to Object-Oriented Programming - I
04	Inheritance, Derived Class, Calling the Base Class Constructor	1	3	Introduction to Object-Oriented Programming - II
05	Overriding Member Functions, Polymorphism	1	3	Introduction to Object-Oriented Programming - II
06	Class Inheritance Hierarchies	1	3	Introduction to Object-Oriented Programming - II
07	ER Diagram	1	3	Entity Relationship (ER) Model
08	DDL (Data Definition Language), like CREATE, DROP, ALTER, TRUNCATE and RENAME commands, DML (Data Manipulation Language), like SELECT, INSERT, UPDATE and DELETE commands	1	3	Database Management System

09	DML (Data Manipulation Language), like SELECT, INSERT, UPDATE and DELETE commands, and TCL (Transaction Control Language), like COMMIT and ROLLBACK commands	1	3	Database Management System
10	Database Performance, Indexing, Views, Procedure	1	3	Database Management System

Category: Structured Enquiry Total Weightage: 20 No. of lab sessions: 2

Learning Outcomes:
The students should be able to:
Design, develop and implement application utilizing previously developed JAR/DLL files.
Store data from the application into the database.
Design, development and implement the user interface for visualization of data from the database.

Expt./Job No.	Experiment/job Details	No. of Lab. Session/s per batch (estimate)	Marks/ Experiment	Correlation of Experiment with the theory
1	Implement an application that utilizes previously learnt concepts to replicate an automation system using classes	2	10	
2	Implement a database schema that utilizes previously learnt concepts to capture the data to and from an automation system	2	10	

Category: Open Ended Total Weightage: 20 No. of lab sessions: 2

Learning Outcomes:
The students should be able to:
Use the OOP concepts to implement the project.
Use database concept to implement the project
Select the appropriate tool/software to implement the project.
Write a technical report using a predefined template.
Present the technical report of the implemented project.
Demonstrate the learning experiences of working in a team.

Expt./Job No.	Experiment/job Details	No. of Lab. Slots per batch (estimate)	Marks/ Experiment	Correlation of Experiment with the theory
1	Implement an open-ended project using C++/DB concepts for an automation application	2	20	

Course Content

Course Code: 18EARC208	Course Title: Microcontrollers Programming & Interfacing	
L-T-P-**SS**: **4-0-0-0**	Credits:4	Contact Hrs: 4
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 50		Exam Duration: 100

No	Content	Hrs
	Unit I	
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 Microcontroller Architecture and assembly language programming** 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: Introduction to the STMicroelectronics Line of Microcontrollers** STM Nucleo Boards, STM32CubeMX Application: Pinout Tab, MCU Alternative Functions, Integrated Peripheral (IP) Tree Pane, Creating a Project using CubeMX, ARM Cortex Microcontroller Software Interface Standard, Memory-Mapped Peripherals, Core Memory Addresses, Peripheral Memory Addresses, HAL_GPIO Module	**5 Hrs**
8	**Chapter 8: Interrupts and Timers:** Interrupts, NVIC Specifications, Interrupt Process, External Interrupts, Interrupt Demonstration, STM Timer Peripherals STM Timer Configuration, Update Event Calculation, Polled or Non-interrupt Blink LED Timer Demonstration, Test Run: Interrupt-Driven Blink LED Timer Demonstration, Test Run: Multi-rate Interrupt-Driven Blink LED Timer Demonstration	**5 Hrs**

Course Content

Course Code: **18EARC207**	Course Title: **Control Systems**	
L-T-P : 4-0-0	Credits: 5	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. Introduction to Control Systems Introduction to Control Systems, Classification of Dynamic Systems, Closed Loop Control System with Feedback, Mathematical Preliminaries – Complex Variables, Laplace Transform.	**4**
Chapter No. 2. System Modeling in Frequency domain Standard Inputs, Free and Forced Response, Transfer Function, Poles and Zeros, Response to various Inputs, Effect of Poles, Notion of Bounded Input Bounded Output (BIBO) stability, Block diagram reduction and signal flow graphs	**8**
Chapter No. 3. Time Response Effect of Zeros, Closed Loop Transfer Function, Dynamic Performance Specification, First Order Systems, Second Order Systems, Unit Step Response of Underdamped Second Order Systems, Concepts of Rise Time, Peak Time, Maximum Peak Overshoot and Settling Time, Steady state errors and error constants	**8**
Unit - 2	
Chapter No. 4. Controllers Controllers – Proportional (P), Integral (I) and Derivative (D) Blocks, Examples of PID controller design, Problems	**4**
Chapter No. 5: Stability Analysis Routh's Stability Criterion, Use in Control Design, Incorporation of Performance Specifications in Controller Design, Analysis of Steady State Errors, Root Locus and its Application in Control Design.	**8**
Chapter No. 6 : Frequency Domain Analysis Stability analysis, Bode plot, Nyquist Stability Criterion, Relative Stability – Gain and Phase Margins.	**8**
Unit - 3	
Chapter No. 7 : Design Via Frequency Response Control System Design via Frequency Response – Lead, Lag and Lag-Lead Compensation	**5**
Chapter No. 8: Case Studies Plants for Pressure Control, Electromechanical Plants, Modeling and design of InvertedPendulum, Modeling and design of Aircraft.	**5**

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Laboratory Plan

Laboratory Course Plan: B E in A&R

Semester: **4th Semester** Year:2019-2020

Laboratory Title: **Microcontroller Lab**	Lab. Code: 18EARP208
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:20 No. of lab sessions: 2				
Expt./ Job No.	Experiment/job Details	No. of Lab. Session/s per batch (estimate)	Marks/Experiment	Marks obtained	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.	1	5		Chap1
	Learning Objectives : The students should be able to: Study the data sheets and make a comparative study of the Architectures, resources, tools and applications of different microcontroller Compare and contrast different microcontrollers. Connect microcontroller to LED and blink LED with proper delay. Apply suitable method or logic to solve given problem. Pre-lab: Download the data sheets of PIC16F877a, ATMEGA328, 8051 microcontrollers from the following websites http://www.atmel.com/images/Atmel-8271-8-bit-AVR-Microcontroller-ATmega48A-48PA-88A-88PA-168A-168PA-328-328P_datasheet_Complete.pdf http://ww1.microchip.com/downloads/en/DeviceDoc/39582b.pdf http://ww1.microchip.com/downloads/en/devicedoc/41159d.pdf http://www.atmel.com/images/doc8161.pdf http://www.farnell.com/datasheets/46220.pdf http://www.nxp.com/documents/data_sheet/LPC2921_23_25.pdf Draw the architectural layout of the following microcontrollers with pin out diagrams.				

	PIC16F877a ATMEGA328 8051 Make a comparative study and fill up the table 1 given in lab manual. Download the application notes. Prepare flowcharts and develop the code to demonstrate the use of the microcontroller as a simple digital output device. Study Proteus 8 Professional Study different ports and understand the basic LED program In lab: Must be able to explain difference between various types of Microcontrollers and its architectures. Setup the hardware platform and deploy the code on the hardware. If any errors debug the code until it works. Make a note of the number and types of errors. Simulate LED blink program on Proteus 8 Professional Post-lab: Analyze the cause for errors and make a note.				
2	Write a program to demonstrate a counting machine which count from 0000 to 9999 and display on 7 segment LED display using PIC16F877A and Arduino board.	1	5		Chap2
	Learning Objectives : The students should be able to: Use 7Segment LED for counting numbers. Use appropriate logic or method for counting. Pre-lab Study the application notes of Arduino and PIC16F877a Study advantages and disadvantages of Arduino and PIC16F877a microcontrollers Understand 7segment LED. Prepare flowcharts and develop the code to demonstrate the use of the microcontroller as a simple digital input and output device Study different segments of LED In-lab Write program for both Arduino and PIC If any errors debug the code until it works. Make a note of the number and types of errors. Simulate in Proteus Setup the hardware platform and deploy the code on the hardware. Execute the code and note the output. Post-lab Record the results and experience you got in lab Analyze the cause for errors and make a note				
3.	Write a program to read the values from the temperature sensor (LM35) and display the temperature in degree Celsius on LCD display	1	5		Chap2,3

	using PIC16F877A and Arduino board.				
	Learning Objectives : The students should be able to: Connect LM35, LCD and microcontroller. Write function to read values from LM35 and display it on LCD. Pre-lab Study the application notes of Arduino and PIC for interfacing LM35 and LCD. Prepare flowcharts and develop the code to demonstrate the use of the microcontroller as a simple digital input and output device. Study what is 16*2 LCD and how it works. Analyze the driver required for LCD. In-lab Write program for both Arduino and PIC Execute the code and note the output. If any errors debug the code until it works. Simulate LCD display in Proteus. Setup the hardware platform and deploy the code on the hardware. Make a note of the number and types of errors. Post-lab Analyze the cause for errors and make a note. List down different types of LCDs and sensors.				
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.	1	5		Chap2,3
	Learning Objectives : The students should be able to: Connect Keypad, LCD with microcontroller. Write logic to read key press event from keypad. Pre-lab Study the application notes of Arduino and PIC for interfacing keypad and LCD. Prepare flowcharts and develop the code to demonstrate the use of the microcontroller as a simple digital input and output device. List down different types of keypads Analyze the driver required for 4*3 keypad. In-lab Write programs for both Arduino and PIC Execute the code and note the output. If any errors debug the code until it works. Make a note of the number and types of errors. Simulate both in Proteus Setup the hardware platform and deploy the code on the hardware Post-lab				

	Record the results and experience in manual List down the different applications of Keypad in real world.(eg. In Security applications)				
	Category: Exercises Total Weightage: 20			No. of lab sessions:4	
Expt./ Job No.	Experiment/job Details	No. of Lab. Session/s per batch (estimate)	Marks/Experiment	Marks obtained	Correlation of Experiment with the theory
5	Write a program to measure the distance of an object using ultrasonic Sensors and display the distance in terms of centimeters and inches. Make the connections as per the schematic and develop the flowchart and the code to perform the required operation.	1	5		Chapter 4
	Learning Objectives : The students should be able to: Connect Ultrasonic Distance Sensor and microcontroller Logic to find distance in CM and Meters. Pre-lab Study the application notes of Arduino and PIC for interfacing Ultrasonic Sensors. Understand different types of sensors. List the advantages and disadvantages of different sensors. Prepare flowchart and develop the code to demonstrate the use of the microcontroller as a simple analog input sensor and convertor. In-lab Write programs for both arduino and PIC Execute the code and note the output. If any errors debug the code until it works. Make a note of the number and types of errors Setup the hardware platform and deploy the code on the hardware. Post-lab Record the results and experience in manual Try interfacing at least two other sensors and note down the readings. List real world applications of sensors.				
6	Write a program to control the speed and direction of DC, stepper and servo motors.	1	5		Chapter 4,5
	Learning Objectives : The students should be able to: Understand the connections from microcontroller to DC motor using drives. Discuss how motor driver helps in controlling the speed on a DC motor. Pre-lab: Study the application notes of Arduino and PIC for interfacing DC motor. Study the working principle of DC motor. Study in detail about different types of DC motors and list out them List advantages and disadvantages of DC motors				

	List the applications in the real world In lab: Write programs for both Arduino and PIC Simulate in Proteus Demonstrate the hardware for both Arduino and PIC. Post-lab Record the results and experience in manual Measure the speed of the DC motor w.r.t voltage.				
7	Design and develop an interconnected connection of controllers to communicate and transfer data between them. Use Bluetooth modulecontroller.	1	5		Chapter 4,5
	Learning Objectives : The students should be able to: Establish connection between different controllers and transfer the data. Pre-lab: Get familiar with Bluetooth module Sketch circuit diagram on paper. In lab: Design circuit. Simulate in Proteus Demonstrate the hardware for both Arduino and PIC. Post-lab Record the results and experience in manual Measure the speed of the stepper motor w.r.t step angle.				
8	Design and develop an IOT (Internet of Things) system to collect data from NPK or pH sensor and store the data in the cloud. Use Wi-Fi-module and controller.	1	5		Chap 6
	Learning Objectives : The students should be able to: Develop an IOT system that must be able to record and store the data on cloud. Pre-lab: Get familiar with IOT and Wi-Fi module. In lab: Wire-up the circuit and place the sensor in the farm field/garden and collect the data . Store the collected data on cloud for analysis. Demonstrate the hardware for STM MCU. Post-lab Record the results and experience in manual				
	Category: Structured Enquiry Total Weightage: 20			No. of lab sessions:4	
Expt./Job No.	Experiment/job Details	No. of Lab. Session/s per batch (estimate)	Marks/Experiment	Marks obtained	Correlation of Experiment with the theory
9	Write Timer and interrupt programs on STM MCU.	1	10		Chapter 6,7

	Learning Objectives : The students should be able to: Differentiate between polling and interrupt. Control the flow of program using timers. Pre-lab: Understand types of timers and interrupts Applications and working principles of timers and interrupts. In lab: i. Simulate the working of timers and interrupts ii. Demonstrate the hardware for STM. Post-lab Record the results and experience in manual Measure the speed of the stepper motor w.r.t step angle.				
10	Develop an applications using STM MCU to predict the data using the existing trained module.	1	10		Chapter 6,7
	Learning Objectives : The students should be able to: Demonstrate the knowledge of data analysis. Pre-lab: Understand different trained modules that can be used on STM MCU. In lab: Analyze and predict data for the selected trained module. Demonstrate the hardware for STM MCU. Post-lab Record the results and experience in manual				
	Category: Open Ended	Total Weightage: 20		No. of lab session:2	
Expt./ Job No.	Experiment/job Details	No. of Lab. Slots per batch (estimate)	Marks/Experiment	Marks obtained	Correlation of Experiment with the theory
11	Develop an IOT system using NPK and existing prediction module to suggest the crop to be grown in the field considering weather forecasting.	2	20		Chapter 1 to 7
	Learning Objectives : The students should be able to: Identify the problem and solve. Apply the knowledge of electronics, data science and programming.				