Course Content

Course Code: 15EEEC201 **Course Title: Circuit Analysis**

L-T-P: 4-0-0 **Credits: 4** **Contact Hrs: 50**

CIE Marks: 50 **SEE Marks: 50** **Total Marks: 100**

Teaching Hrs: 50 **Exam Duration: 3 hrs**

Content	Hrs
Unit - 1	
Chapter No. 1.Network Equations Source Transformation, Star Delta transformation, Nodal Analysis, Super node, Mesh Analysis, Super mesh, Duality, Network Topology, Tie Set and Cut Set matrix formulation, Dot convention.	8 hrs
Chapter No. 2.Network Theorems Homogeneity, Superposition and Linearity, Thevenin's & Norton's Theorems, Maximum Power Transfer Theorem, Milman's theorem, Reciprocity principle, Application of theorems to both ac and dc networks	8 hrs
Chapter No. 3.Sinusoidal Steady state analysis Characteristics of sinusoids, Forced response to sinusoidal functions, The complex forcing function, Phasors & Phasor diagrams.	4 hrs
Unit - 2	
Chapter No. 4.First order circuits Order of a system, Concept of Time constant, System Governing equation, System Characteristic equation, Basic RL & RC circuit, Transient response with initial conditions , Frequency response characteristics, R-C , R-L circuits as differentiator and integrator models, time and frequency domain responses R-C , R-L circuits as Low pass and high pass filters	8 hrs
Chapter No. 5.Higher order circuits Higher order R-C, R-L, and R-L-C networks, time domain and frequency domain representation, Series R-L-C circuit, Transient response, Damping factor, Quality factor, Frequency response curve , Peaking of frequency curve and its relation to damping factor, Resonance Parallel, R-L-C circuit, Tank circuit, Resonance, Quality factor and Bandwidth	12 hrs
Unit - 3	
Chapter No. 6.Two Port Networks Two port variables, Z,Y, H,G, A- Parameter representations, Input and output impedance calculation, Series, Parallel and Cascade network connections, and their (suitable) models.	5 hrs
Chapter No. 7.Polyphase Circuits Polyphase systems, Single Phase three wire system, Three phase Y-Y connection, Delta connection, Analysis of balanced & unbalanced three phase circuits.	5 hrs

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

1. W H Hayt, J E Kemmerly, S M Durban, Engineering Circuit Analysis, 6th, McGraw Hil, 2006
2. M E. Van Valkenburg, Network Analysis, 3rd, Pearson Ed, 2006

References

1. Joseph Edminister, Mahmood Nahavi, Electric Circuits, 3rd, Tata McGra, 1991
2. Bruce Carlson, Circuits, 3rd, Thomson Le, 2002
3. V. K. Aatre, Network Theory and Filter Design, 2nd, Wiley West, 2002
4. Anant Agarwal and Jeffrey H Lang, Foundations of Analog & Digital Electronics Circuits, 3rd, Morgan Kau, 2006
5. Muhammad H . Rashid, Introduction to PSPICE using OrCAD for circuits and Electronics, 3rd, Pearson Ed, 2005

Course Title: Analog Electronic Circuits **Course Code:15EEEC202**
L-T-P-SS: 4-0-0 **Credits: 4** **Contact Hours: 4Hrs/week**
CIE Marks: 50 **SEE Marks: 50** **Total Marks: 100**
Teaching Hours: 50Hrs **Examination Duration: 3Hrs**

Unit I **Chapter 1: Applications of a Junction diode:** Recap of piece-wise linear model, constant voltage drop model, ideal diode model, small signal model. Applications of diodes as a Clipping circuit and clamping circuits Voltage doubler.	06Hrs
Chapter 2: MOSFETs structure and physical operation: Device structure, operation with no gate voltage, creating a channel for current flow, applying small vds, operation as vds is increased, derivation of the id-vds relationship, the P-channel mosfet, complementary mos or cmos, operating the mos transistor in the sub threshold region. Current-voltage characteristics: circuit symbol, the id vs vds characteristics, finite output resistance in saturation, characteristics of the p-channel mosfet, the role of the substrate-the body effect, temperature effects, breakdown and input protection. MOSFET circuits at DC.	12 Hrs
Unit II **Chapter 3:Current mirrors** Basic current mirror, Widlar, Cascode and Wilson : Output impedance and Voltage swing.	08 Hrs
Chapter 4: MOSFET amplifiers : Biasing in MOS amplifier circuits, small signal operation and models, single stage mos amplifiers, the MOSFET internal capacitance and high frequency model, frequency response of CS amplifier.(CD and CG), Cascode Connection: Implications on gain and Bandwidth	12 Hrs
Unit III **Chapter 5: Feedback Amplifiers :** General feedback structure (Block schematic), Feedback desensitivity factor, positive and negative feedback Nyquist stability Criterion, RC phase shift oscillator, wein bridge oscillator, merits of negative feedback, feedback topologies: series-shunt feedback amplifier, series-series feedback amplifier, and shunt-shunt and shunt-series feedback amplifier with examples	06 Hrs
Chapter 6: Large Signal Amplifiers : Classification of amplifiers: (A, B, AB and C); Transformer coupled amplifier, push-pull amplifier Transistor case and heat sink.	06 Hrs

Text Books

1. A.S. Sedra & K.C. Smith, "Microelectronic Circuits", 5th Edition, Oxford Univ. Press, 1999.
2. Jacob Millman and Christos Halkias, “Integrated Electronics”, McGraw Hill,

References

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

Course Content

Course Code: 15EEEC203 **Course Title: Digital Electronics**

L-T-P : 4-0-0 **Credits: 4** **Contact Hrs: 40**

CIE Marks: 50 **SEE Marks: 50** **Total Marks: 100**

Teaching Hrs: 50 **Exam Duration: 3 hrs**

Content	
Unit I **Chapter 1:** Logic Families: Logic levels, output switching times, fan-in and fan-out, comparison of logic families	03Hrs
Chapter 2: Principles of Combinational Logic: Definition of combinational logic, canonical forms, Generation of switching equations from truth tables, Karnaugh maps-3,4 variables, Incompletely specified functions(Don't care terms),Simplifying Maxterm equations, Quine-McCluskey minimization technique- Quine-McCluskey using don't care terms, Decimal method, Reduced Prime Implicant Tables.	08 Hrs
Chapter 3: Analysis and design of combinational logic: General approach, Decoders-BCD decoders, Encoders, Digital multiplexers- Using multiplexers as Boolean function generators. Adders and subtractors-Cascading full adders, Look ahead carry adders, Binary comparators.	09 Hrs
Unit II **Chapter 4:** Flip Flops and its applications: Basic Bistable Element, Latches, A SR Latch, Application of SR Latch, A Switch De bouncer, The SR Latch, The gated SR Latch, The gated D Latch, The Master-Slave Flip-Flops (Pulse-Triggered Flip-Flops): The Master-Slave SR Flip-Flops, The Master-Slave JK Flip-Flop, Edge Triggered Flip-Flop: The Positive Edge-Triggered D Flip-Flop, Negative-Edge Triggered D Flip-Flop; Characteristic Equations.	10Hrs
Chapter 5: Analysis of Sequential Circuits: Registers and Counters, Binary Ripple Counters, Synchronous Binary counters, Ring and Johnson Counters, Design of a Synchronous counters, Design of a Synchronous Mod-n Counter using clocked JK Flip-Flops Design of a Synchronous Mod-n Counter using clocked D, T or SR Flip-Flops.	10Hrs
Unit – III **Chapter 6:** Introduction to Sequential Circuit: Introduction to Sequential Circuit Design, Mealy and Moore Models, State Machine notations, Synchronous Sequential Circuit Analysis, Construction of state Diagrams and counter design.	05Hrs
Chapter 7: Introduction to Memories: Introduction and role of memory in a computer system, memory types and terminology, Read Only memory, MROM, PROM, EPROM, EEPROM, Random access memory, SRAM, DRAM, NVRAM.	05Hrs

Text Book

1. Donald D Givone, Digital Principles and Design, Tata McGraw Hill Edition, 2002.
2. John M Yarbrough, Digital Logic Applications and Design, Thomson Learning, 2001.
3. M. Raffiquzzman&Rajan Chandra, Modern Computer Architecture, Galgotia Publications, 1990.
4. David Patterson and John Hennessy, Computer Organization and Design, Elsevier, 2007.

References

1. Charles H Roth, Jr; Fundamentals of Logic Design, Thomson Learning, 2004.
2. ZviKohavi, Switching and Finite Automata Theory, 2ed, TMH
3. Mono and Kim, Logic and Computer Design Fundamentals, Pearson, 2ed, 2001
4. David Harris Money and Sarah Harris, Digital Design and Computer Architecture, Morgan Kaufman, 2007.

Course Code: 15EEEC204 **Course Title: Electrical Machines -I**

L-T-P : 3-0-0 **Credits: 3** **Contact Hrs: 40**

CIE Marks: 50 **SEE Marks: 50** **Total Marks: 100**

Teaching Hrs: 40 **Exam Duration: 3 hrs**

Content	Hrs
Unit - 1	
Chapter No. 1 Magnetic Circuits and Induction Introduction, Magnetic circuits, Magnetic Materials and Their Properties, Magnetically Induced EMF and Force, AC Operation of Magnetic Circuits, Hysteresis and Eddy – Current Losses, Permanent Magnets, Application of Permanent Magnet Materials.	5 hrs
Chapter No. 2 Single Phase Transformers Introduction, Transformer Construction and Practical Considerations, Transformer on No-Load, Ideal Transformer, real Transformer and Equivalent Circuit, Transformer Losses, Transformer Testing, The Per Unit System, Efficiency and Voltage Regulation, Excitation Phenomenon in Transformers, transformer as a Magnetically Coupled Circuit. Autotransformers.	10 hrs
Unit - 2	
Chapter No. 3 Three Phase Transformer Three Phase transformers, Parallel operation of transformers, Three – Winding transformers, Phase Conversion, Tap Changing Transformers, Voltage and Current Transformers.	5 hrs
Chapter No. 4 Principles of Electromechanical Energy Conversion Introduction, Energy in Magnetic System, Field Energy and Mechanical Force, Multiply – Excited Magnetic Field Systems, Forces/Torques in Systems with Permanent Magnets, Energy Conversion via Electric Field.	6 hrs
Chapter No. 5 DC Generators Introduction, Armature Winding and Commutator, EMF and Torque, Circuit Model, Armature Reaction, Compensating Winding, Commutation, Methods of Excitation, Operating Characteristics of dc generator, Self – Excitation, Characteristics of dc generator, Shunt Generator – Predetermination of External Characteristic, Parallel Operation of dc generators,	4 hrs
Unit - 3	
Chapter No. 6 DC Motors Characteristics of dc Motors, Starting of dc Motors, Braking of dc Motors, Efficiency and Testing, Testing of dc Machines, Permanent Magnet dc (PMDC) Motors, DC Machine Applications, Starters.	5 hrs
Chapter No. 6 Speed Control Speed control by varying armature circuit resistance, varying field current, varying armature terminal voltage.	5 hrs

Text Book:

1. A E Fizgerald , Charles Kingsley, Jr Stephen D. Umans , Electric machinery , 6th edition, TMH, 2012.
2. D. P. Kothari and I. J. Nararath, Electrical Machines, 4, MGH, 2011
3. P. C. Sen, Principles of Electric Machines and Power Electronics, 2, John Wiley, 2001

References

1. Bhimbra, Principles of Electric machinery, 3, Khanna, 2006

Course Title: Microcontroller Architecture & Programming **Course Code: 15EEEP201**

L-T-P: 0-1-1 **Credits: 2** **Contact Hours: 4Hrs/week**

CIE Marks: 80 **SEE Marks:20** **Total Marks: 100**

Teaching + Lab. Hours: 48Hrs **Examination Duration:3 Hrs**

1.	**Overview of Architecture of 8051:** • Processor Core and Functional Block Diagram • Description of memory organization • Overview of ALL SFR's and their basic functionality	02+02 Hrs
2.	**Low Level programming Concepts:** • Addressing Modes • Instruction Set and Assembly Language programming(ALP) • Developing, Building, and Debugging ALP's	02+02 Hrs
3.	**Middle Level Programming Concepts:** • Cross Compiler • Embedded C language implementation, programming, & debugging • Differences from ANSI-C • Memory Models • Library reference • Use of directives • Functions, Parameter passing and return types	04+04Hrs
4.	**On-Chip Peripherals Study,Programming, and Application:** • Ports: Input/Output • Timers & Counters • UART • Interrupts	04+04Hrs
5.	**External Interfaces Study,Programming and Applications :** • LEDS • Switches(Momentary type, Toggle type) • Seven Segment Display: (Normal mode, BCD mode,Internal Multiplexing & External Multiplexing) • LCD (8bit, 4bit, Busy flag, custom character generation) • Keypad Matrix	04+04Hrs
6.	**Selective Discussion during Project Development** • A/D & D/A Converter • Stepper Motor, DC Motor • ZIGBEE • GSM/GPS • USB • MMC & SD • Ethernet MAC	08+08Hrs

Text Book*Text Books:*

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

References Books:

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

Course Title: Analog Electronics Laboratory **Course Code: 15EEEP202**

L-T-P: 0-0-1 **Credits: 1** **Contact Hours: 2Hrs/week**

CIE Marks: 80 **SEE Marks: 20** **Total Marks: 100**

Laboratory Hours: 28Hrs **Examination Duration: 3Hrs**

List of Experiments:

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

Reference Books

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

Course Title: Digital Electronics Laboratory **Course Code: 15EEEP203**

L-T-P: 0-0-1 **Credits: 1** **Contact Hours: 2Hrs/week**

CIE Marks: 80 **SEE Marks: 20** **Total Marks: 100**

Laboratory Hours: 28Hrs **Examination Duration: 3Hrs**

List of Experiments:

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

Reference Books

1. Books/References: 1. K.A.Krishnamurthy “Digital lab primer”, Pearson Education Asia Publications, 2003.
2. **“**Electronic Principles” by A.P. Malvino, TaTa MGH,5th ED

Course Code: 15EEEC205 **Course Title: Electrical machines-II**

L-T-P-SS: 3-0-0-0 **Credits: 3** **Contact Hrs: 40**

CIE Marks: 50 **SEE Marks: 50** **Total Marks: 100**

Teaching Hrs: 40 **Exam Duration: 3 hrs**

Content	Hrs
Unit - 1	
Chapter No. 1 Synchronous Machines Introduction, Basic Synchronous Machine Model, Circuit Model of Synchronous Machine, Determination of the Synchronous Reactance, MMF Method, Determination of Armature Reaction Ampere-Turns and Leakage Reactance of a Synchronous Machine – Potier Method, Nature of Armature Reaction, Synchronizing to Infinite Bus – Bars, Operating Characteristics, Efficiency of Synchronous Machines,	9 hrs
Chapter No. 2 Synchronous Machines - continued Power Flow (Transfer) Equations, Capability Curve of Synchronous Generator, Salient –Pole Synchronous Machine Two – Reaction Model, Staying in Synchronizm – The Synchronizing Power (Torque), Determination of X_D and X_Q – Slip Test, Parallel Operation of Synchronous Generators, Hunting in Synchronous Machines, Starting of Synchronous Motors, Short – Circuit transient in Synchronous Machine, Single – Phase Synchronous Generators, Brushless DC Motors	6 hrs
Unit - 2	
Chapter No. 3 Induction Machine Introduction, Construction, Flux and MMF Waves in Induction Motor – Principles of Operation, Development of Circuit Model (Equivalent Circuit), Power Across Air – Gap, Torque and Power Out Put, Tests to determine Circuit – Model Parameters, The Circle Diagram (Approximate),	09 hrs
Chapter No. 4 Speed Control of Induction Motors: Starting, Cogging and Crawling, Speed Control, Deep – bar/Double – Cage Rotor, Classes of Squirrel – Cage Motors, Induction Generator, Induction Machine Dynamics Acceleration Time, Inverted Induction machine, High Efficiency Induction Motors, Linear Induction Motor.	6 hrs
Unit - 3	
Chapter No. 5 Single Phase Induction Motor Introduction, Single Phase Induction Motors, Circuit Model of single – Phase Induction Motor, Types of single phase induction motors, Balanced 2-phase Motor Fed from Unbalanced Supply.	5 hrs
Chapter No. 6 Special Motors Stepper Motors, Series Motor (Universal Motor), Reluctance Motors, Hysteresis Motors, Speed Control.	5 hrs

Text Book:

1. A E Fizgerald , Charles Kingsley, Jr Stephen D. Umans, Electric machinery , 6th edition, TMH, 2012.
2. D. P. Kothari and I. J. Nararath, Electrical Machines, 4, MGH, 2011
3. P. C. Sen, Principles of Electric Machines and Power Electronics, 2, John Wiley, 2001

References

1. Bhimbra, Principles of Electric machinery, 3, Khanna, 2006

Course code: 15EEEC206 **L-T-P: 4-0-0**
Course title: Linear Control Systems **CIE: 50**
Teaching hours: 50 **SEE: 50**

	Unit-I	
1	**Introduction to control systems**: Open loop and closed loop control systems-definitions, salient features and simple examples	3 Hours
2	**Transfer function Models and block diagram representation:** Definition of transfer function, assumptions and properties, Block diagram representation**,** symbols used. Block-diagram of negative and positive feedback systems. Electrical systems: Derivation of transfer functions for electrical circuits. Mechanical translation and rotational systems: Basic elements of mechanical systems, Transfer functions of mechanical translation systems. Models of dc servomotors-armature and field control, block-diagram representation. Bock diagram reduction rules, Examples. Signal flow graphs-definition of terms, Mason's gain formula.	13 Hrs
3	**Introduction to Time-domain Analysis** Poles and Zeros, Type and order, Standard test signals. First order system: unit step response, importance of time constant.	4 Hrs
	Unit-1I	
4	**Time Response Specifications** Second order system: Standard T.F of second order system. Unit step response of 2^{nd} order system Time response specifications-definition. Expressions for rise time, peak time, peak overshot and settling time, Static error constants and steady-state errors.	5 Hrs
5	**Stability Analysis of control systems:** Explanation of Routh-Hurwitz criterion-necessary and sufficient condition for stability, special cases, Absolute and Relative stability, relative stability analysis.	5 Hrs
6	**Controller design approaches:** Basic modes of controls and their features: On-Off, proportional, integral, PI, PD and PID, Controller design approaches- Zeigler Nichol's tuning method and Pole placement design method, design examples	5 Hrs
7	**Frequency response analysis:** Sinusoidal response: system response for sinusoidal inputs**,** sinusoidal transfer functions. Frequency response of a second order system, definitions and expressions of Frequency response specifications. Polar plot: method to draw approximate polar plot, definition of phase and gain margin.	5 Hrs
	Unit-III	
8	**Bode plot analysis of control systems:** Bode plots: asymptotic plots for basic factors, method to draw Bode asymptotic plot and phase plot, determination of gain and phase margins from Bode plot.	5 Hrs
9	**Root locus diagrams:** Basic principle – magnitude and angle criterion, Rules to construct root locus diagram (proof not required), method to construct root locus diagram.	5 Hrs

Text Books:

1. Nagarath and Gopal, *Control system Engineering*, Wiley Eastern Ltd., 1995, 2^{nd} edition.
2. Katsuhiko Ogata, *Modern Control Engineering*, PHI, 2002, 4^{th} edition

Reference Book:

1. M. Gopal, Control Systems-Principles and Design, TMH 2002, 2nd edition

Course Code: **15EEEC207** Course Title: **ARM Processor & Applications**
L-T-P-SS: **4-0-0-0** Credits: **4** Contact Hours:**4 Hrs/week**
CIE Marks: **50** SEE Marks:**50** Total Marks: **100**
Teaching Hours:**50Hrs** Examination Duration:**3Hrs**

Content	Hrs
Unit - 1	
Chapter No.1 Interrupt programming 8051-Interrupts and programming (both assembly and 'C'): Interrupts for timer and serial communication.	5 hrs
Chapter No.2 ARM Architecture The Acorn RISC machine, Architectural inheritance, Architecture of ARM7TDMI, ARM programmers model, ARM development tools, 3 stage pipeline ARM organization, ARM instruction execution.	5 hrs
Chapter No.3 Introduction to ARM instruction set Data processing instruction, Branch instruction, Load store instruction, Software interrupt instruction, Program status register instruction, Conditional execution, Example programs.	5 hrs
Unit - 2	
Chapter No.4 Introduction to THUMB instruction set The Thumb programmer model, ARM-Thumb interworking, other branch instructions, Data processing instructions, Single/Multiple register load store instruction, Stack operation, Software interrupt instructions, example programs.	2 hrs
Chapter No.5 Assembler rules and Directives Introduction, structure of assembly language modules, Predefined register names, frequently used directives, Macros, Miscellaneous assembler features. Example programs.	4 hrs
Chapter No.6 Exception handling Introduction, Interrupts, error conditions, processor exception sequence, the vector table, Exception handlers, Exception priorities, Procedures for handling exceptions.	4 hrs
Chapter No.7 Architectural support for high level languages Abstraction in software design, data types, floating point data types, The ARM floating point architecture, use of memory, run time environment.	5 hrs
Unit - 3	
Chapter No.8 LPC2148 Architecture and applications On-chip memory, GPIOs, Timers, UART, ADC, I2C, SPI , RTC, ARM interfacing techniques and programming: LED, LCD, Stepper Motor, Buzzer, Keypad, ADC and I2C	10 hrs

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

1.	Steve Furber, ARM System- on-Chip Architecture, 2nd, LPE, 2002
2.	William Hohl, ARM Assembly Language fundamentals and Techniques, 1st, CRC press, 2009

References

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

Course Content

Course code: 15EEEC208 **L-T-P: 3-0-0**
Course title: Electrical Power Generation, Transmission & Distribution **CIE: 50**
Teaching hours: 40 **SEE: 50**

Chapter 1 : Selection of site, Classification, General arrangement and operation of Hydro electric plant with Components, General arrangement and operation of Thermal power plant with Components, General arrangement and operation of Nuclear power plant with Components, Safety of Nuclear power reactor, Storing and processing spent fuel	**5hrs**
Chapter 2: Substations: Types, bus-bar arrangement, schemes, location, substation equipments. **Economics:** Important terms and curves commonly used in system operation, Effect of Voltage and frequency on Loads, Scheduling of Generators, Choice of size and number of generator units, Interconnection of power stations.	**5hrs**
Chapter3: Introduction, electrical supply system, comparison of AC & D.C. Systems, Standard Voltages of Transmission & Distribution, Advantages of High Voltage Power Transmission, (effect of increase in voltage on weight of conductor, Line Efficiency & Line Voltage Drop). Feeders, Distributors & Service Mains, Conductors types.	**2hrs**
Chapter4: Line supports & placing of the conductors, single phase and three phase systems. Single circuit and double circuit, Spacing of conductors, Length of span & Sag in OH lines. Sag calculation in conductors (a) Suspended on level supports (b) Supports at different levels, Effect of wind and ice. Tension and sag. Corona: Phenomena, expression for disruptive and visual critical voltages and corona power loss.	**3hrs**
Unit – II	
Chapter 5:Line parameters Introduction to transmission line constants i.e. Resistance, Inductance and capacitance, Inductance of the single phase & three phase lines, Inductance calculation with equilateral and unsymmetrical spacing of the lines, Transposition of line conductors. Capacitance for single phase & three phase lines, Effect of earth on capacitance of the line, Numerical solutions on resistance calculations.	**7hrs**
Chapter 6: **Characteristics & Performance of Power transmission lines:** Introduction to Short transmission lines, calculations for short lines, Medium transmission lines, Nominal-T and ∏ representation for transmission lines, Long transmission lines, Long line solutions by Rigorous method, equivalent models, ABCD constants,	**8hrs**
Unit – III	
Chapter 7: Insulators: Types, potential distribution over a string of suspension insulators. String efficiency and methods of increasing string efficiency and methods of increasing string efficiency, testing of insulators.	**5 hrs**
Chapter 8:Underground Cables: Types, material used. Insulation resistance, thermal rating of cables, charging current. Grading of cables, capacitance grading and inter sheath grading, testing of cables.	**5 hrs**

Text Book:

1. Power Station Engineering and Economics by Skrotzki and Wavopat, McGraw Hill, 1995

Reference Books:

1. Principles of Power system By: V.K. Mehta & Rohit Metha. S. Chand & Company, LTD. 2014
2. A course in Electrical Power By: Soni, Gupta & Bhatnagar. Dhanpat rai Publications .2014
3. Transmission & Distribution of Electrical Power By J.B.Gupta. SK Kataria, Publication
4. Electric Power Generation Transmission and Distribution by S. M. Singh, by Prentice Hall of India, Regd. Office: d 13/12, Model Town, Delhi

Course Title: Machines lab **Course Code: 15EEEP204**

L-T-P: 0-0-1 **Credits: 1** **Contact Hours: 2Hrs/week**

CIE Marks: 80 **SEE Marks: 20** **Total Marks: 100**

Laboratory Hours: 28Hrs **Examination Duration: 3Hrs**

Category: Demonstration	
Expt. No.	**Experiment**
1	Introduction to meters and machines
Category: Exercise	
Expt. No.	**Experiments**
2	No Load/Load characteristics of DC Generators
3	Speed control of DC motor by armature voltage control and flux control
4	Three Phase transformer Bank with STAR-STAR connection mode demonstration
5	To Conduct Open Circuit and Short Circuit test on given single phase transformer and a) Calculate Voltage regulation at different loads & power factors. b) To represent the transformer by its equivalent circuit.
6	Speed control of Induction motor by a) Stator Voltage control. b) Rotor resistance control.(SRIM)
7	To Conduct NO – LOAD & BLOCKED ROTOR test on a given Induction motor and a) Represent the motor by its equivalent circuit referred to Stator or Rotor. b) To find the performance parameters
8	Performance study of synchronous motor with change in its excitation (V and Inverted V curves)
9	Voltage regulation of an Alternator by EMF method
Category: Open Ended	
Expt. No.	**Experiment**
1	Open delta connection of a three phase transformer **OR** Voltage regulation of an alternator by direct loading **OR** Load test on DC series motor **OR** Determination of x_d and x_q of synchronous machines

Course Title: ARM Microcontroller Lab **Course Code: 15EEEP205**
L-T-P: 0-0-1 **Credits: 1** **Contact Hours: 2Hrs/week**
CIE Marks: 80 **SEE Marks: 20** **Total Marks: 100**
Teaching Hours: 25Hrs **Examination Duration: 2 Hrs**

Chapter No.	List of Experiments
1	Write an ALP to achieve the following arithmetic operations: i. 32 bit addition ii. 64 bit addition iii. Subtraction iv. Multiplication v. 32 bit binary divide
2	Write an ALP for the following using loops: i. Find the sum of 'N' 16 bit numbers ii. Find the maximum/minimum of N numbers iii. Find the factorial of a given number with and without look up table.
3	Write an ALP to i. Find the length of the carriage r1eturn terminated string. ii. Compare two strings for equality. ii.
4	Write an ALP to pass parameters to a subroutine to find the factorial of a number or prime number generation.
5	Write a 'C' program to test working of LED's using LPC2148.
6	Write a 'C' program & demonstrate an interfacing of Alphanumeric LCD 2X16 panel to LPC2148 Microcontroller.
7	Write an ALP to generate the following waveforms of different frequencies i. Square wave ii. Triangular iii. Sine wave II.Write a 'C' program & demonstrate interfacing of buzzer to LPC2148(using external interrupt)
8	Write a program to set up communication between 2 microcontrollers using I2C.
9	Write a 'C' program & demonstrate an interfacing of ADC.
Structured Enquiry	
1	Write a program that displays a value of 'Y' at port 0 and 'N' at port 2 and also generates a square wave of 10Khz with Timer 0 in mode 2 at port pin p1.2 XTAL =22MHz
2	Write a C program that continuously gets a single bit of data from P1.7 and sends it to P1.0 in main, while simultaneously i. creating a square wave of 200us period on pin P2.5. ii. Sending letter 'A' to serial port. Use Timer 0to create square wave.
Open Ended	
1	Develop an ARM based application using i. sensors ii. Actuators iii. displays

Course Code: 17EEEC203 **Course Title: Digital Circuits**

L-T-P-SS: 3-0-0 **Credits: 3** **Contact Hrs: 40**

CIE Marks: 50 **SEE Marks: 50** **Total Marks: 100**

Teaching Hrs: 50 **Exam Duration: 3 hrs**

Unit I	
Chapter 1: Logic Families: Logic levels, output switching times, fan-in and fan-out, comparison of logic families	03Hrs
Chapter 2: **Principles of Combinational Logic:** Definition of combinational logic, canonical forms, Generation of switching equations from truth tables, Karnaugh maps-3,4 variables, Incompletely specified functions(Don't care terms),Simplifying Maxterm equations, Quine-McCluskey minimization technique- Quine-McCluskey using don't care terms, Decimal method, Reduced Prime Implicant Tables.	08 Hrs
Chapter 3: **Analysis and design of combinational logic:** General approach, Decoders-BCD decoders, Encoders, Digital multiplexers- Using multiplexers as Boolean function generators. Adders and subtractors-Cascading full adders, Look ahead carry adders, Binary comparators.	09 Hrs
Unit II	
Chapter 4: **Introduction to Sequential Circuits** : Basic Bistable Element, Latches, A SR Latch, Application of SR Latch, A Switch De bouncer, The SR Latch, The gated SR Latch, The gated D Latch, The Master-Slave Flip-Flops (Pulse-Triggered Flip-Flops): The Master-Slave SR Flip-Flops, The Master-Slave JK Flip-Flop, Edge Triggered Flip-Flop: The Positive Edge-Triggered D Flip-Flop, Negative-Edge Triggered D Flip-Flop; Characteristic Equations.	10Hrs
Chapter 5: Analysis of Sequential Circuits: Registers and Counters, Binary Ripple Counters, Synchronous Binary counters, Ring and Johnson Counters, Design of a Synchronous counters, Design of a Synchronous Mod-n Counter using clocked JK Flip-Flops Design of a Synchronous Mod-n Counter using clocked D, T or SR Flip-Flops.	10Hrs
Unit – III	
Chapter No. 6 Sequential Circuit Design Introduction to Sequential Circuit Design, Mealy and Moore Models, State Machine notations, Synchronous Sequential Circuit Analysis, Construction of state Diagrams and counter design.	05Hrs
Chapter 7: Introduction to Memories: Introduction and role of memory in a computer system, memory types and terminology, Read Only memory, MROM, PROM, EPROM, EEPROM, Random access memory, SRAM, DRAM, NVRAM.	05Hrs

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

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

References

1. Charles H Roth, Fundamentals of Logic Design, Thomson Learning, 2004
2. Zvi Kohavi, Switching and Finite Automata Theory, 2nd, TMH
3. R.D. Sudhaker Samuel, Logic Design, Sanguine Technical Publishers, 2005
4. R P Jain, Modern Digital Electronics, 2nd, Tata McGraw Hill , 2000

Code: 17EEEC201 **L-T-P: 3-0-0**
Course Title: Electrical Machines. **CIE: 50**
Teaching Hours: 40 **SEE: 50**

Unit –I

Chapter 1 : Transformer : Transformer construction and principle of operation, Ideal Transformer, Practical Transformer, Transformer phasor diagrams, Equivalent circuit of transformers, Open circuit and short circuit tests, Voltage regulation, transformer losses and efficiency, Testing of transformers, Three phase transformers, Auto-transformers.	**10 hours**
Chapter 2: DC Machines: Construction of DC machine and DC machine as generator, EMF equation of DC machine, Operating characteristics of types of DC generators, Operating characteristics of DC motors, DC motor starting, Speed control of DC motors.	**05 hours**
Unit – II	
Chapter 3: Induction (Asynchronous) Machines: Induction motor as transformer, Principle of operation, Rotor frequency, e.m.f, current and power, Losses and Efficiency, Equivalent circuit, Torque slip and Power-slip characteristics, Determination of equivalent circuit parameters. Circle diagram, Starting of polyphase induction motors.	**10 hours**
Chapter 4 : **Synchronous Machines:** Cylindrical and salient pole machines, Phasor diagram of cylindrical rotor alternator. AC armature winding, Voltage regulation of alternator using e.m.f method.	**05 hours**
Unit – III	
Chapter 5 : **Synchronous Machines:** Synchronous motor phasor, Power angle characteristic of synchronous machine, Measurement of Xd and Xq, Capability curves of synchronous generators, Power factor correction by synchronous motors.	**5 hours**
Chapter 6:Single phase induction machines:: Double field revolving theory, Equivalent circuit, Resistance split phase motors, capacitor start motor, permanent capacitor motor, two-value capacitor motor, shaded-pole motor. Performance and cost comparison and choice of single phase induction motors.	**5 hours**

Text Book

1. P. C. Sen, “Principles of Electric Machines and Power Electronics”, John Wiley & Sons Publications, Canada, 2nd Edition, 2001.

References

1. Bhimbra, “Principles of Electrical machinery”, Khanna Publishers.2006.
2. D. P. Kothari and I. J. Nagrath, “Electrical Machines”, MGH Publishers. 4th Edition, 2011.
3. Fitzgerald, Kingsly & Stephen, “Electric Machinery”, 5ed., McGraw Hill, 1992

Course Code: 17EEEC204 **Course Title: Linear Control Systems**

L-T-P: 3-0-0 Credits: 3 Contact Hrs: 40

ISA Marks: 50 ESA Marks: 50 Total Marks: 100

Teaching Hrs: 50 Exam Duration: 3 hrs

Chapter No.	**Unit-I**	
1	**Introduction to control systems**: Open loop and closed loop control systems-definitions, salient features and simple examples	2 Hrs
2	**Transfer function Models and block diagram representation:** Definition of transfer function, assumptions and properties, Block diagram and signal flow graph representation**,** symbols used. Block-diagram of negative and positive feedback systems. Electrical systems: Derivation of transfer functions for electrical circuits, Models of dc servomotors-armature and field control, block-diagram representation. Block diagram reduction rules, Examples.	6 Hrs
3	**Time Response Analysis** Poles and Zeros, Type and order, Standard test signals. First order system: unit step response, importance of time constant, Second order system: Standard T.F of second order system. Unit step response of 2^{nd} order system Time response specifications-definition. Expressions for rise time, peak time, peak overshot and settling time, Static error constants and steady-state errors.	7 Hrs
	Unit-II	
4	**Stability Analysis of control systems:** Explanation of Routh-Hurwitz criterion-necessary and sufficient condition for stability, special cases, Absolute and Relative stability, relative stability analysis.	5 Hrs
5	**Controller design approaches:** Basic modes of controls and their features: On-Off, proportional, integral, PI, PD and PID, Controller design approaches- Zeigler Nichol's tuning method and Pole placement design method, design examples	5 Hrs
6	**Frequency response analysis:** Sinusoidal response: system response for sinusoidal inputs**,** sinusoidal transfer functions. Frequency response of a second order system, definitions and expressions of Frequency response specifications. Polar plot: method to draw approximate polar plot, definition of phase and gain margin.	5 Hrs
	Unit-III	
7	**Bode plot analysis of control systems:** Bode plots: asymptotic plots for basic factors, method to draw Bode asymptotic plot and phase plot, determination of gain and phase margins from Bode plot.	5 Hrs
8	**Root locus diagrams:** Basic principle – magnitude and angle criterion, Rules to construct root locus diagram (proof not required), method to construct root locus diagram.	5 Hrs

Text Books

1 Nagarath and Gopal, *Control system Engineering*, Wiley Eastern Ltd., 1995, 2^{nd} edition.

2 Katsuhiko Ogata, *Modern Control Engineering*, PHI, 2002, 4^{th} edition

Reference Books:

1 M.Gopal, Control Systems-Principles and Design, 2, TMH, 2002.

Course Content

Course Code: 17EEEC301 **L-T-P-S: 3-0-0**
Course Title: Power Electronics **CIE: 50**
Teaching Hours: 40 **SEE: 50**

Unit–I

1	**Introduction** Power Electronics, Converter Classification, Power Electronics Concepts, Electronic Switches: The Diode, Thyristor, Transistors, switch Selection.	2 Hrs
2	**Power Computations** Introduction, Power and Energy, Instantaneous Power, Energy, Average Power, Inductors and Capacitors, Energy Recovery, Effective Values: RMS, Apparent Power and real Power, Power Factor, Power Computations for Sinusoidal AC Circuits, Power Computations for non-sinusoidal periodic waveforms, Fourier Series, Average Power, Non-sinusoidal Source and linear load, Sinusoidal Source and Nonlinear load.	4 Hrs
3	**DC-DC Converters** Linear voltage regulators, a basic switching converter, the buck converter, Voltage and Current Relationships, output voltage ripple, capacitor resistance—The Effect on Ripple Voltage Synchronous Rectification for the buck converter, design considerations, the boost converter, Voltage and Current Relationships, Output Voltage Ripple, Inductor Resistance, the Buck-Boost Converter, Voltage and Current Relationships, Output Voltage Ripple, Cuk and SEPIC converters.	9 Hrs
	Unit–II	
4	**Inverters** Introduction, the full-bridge converter, the square-wave inverter, Fourier series analysis, total harmonic distortion, amplitude and harmonic control, the half-bridge inverter, pulse-width-modulated output: bipolar switching, unipolar switching, three-phase inverters, the Six-Step Inverter, PWM three-phase inverters.	8 Hrs
5	**Controlled Rectifiers** The controlled half-wave rectifier, resistive load, RL load, RL-source load, commutation, the effect of source inductance, controlled full-wave rectifiers, resistive load, RL load, discontinuous current, RL load, continuous current, controlled rectifier with RL-Source Load, controlled single-phase converter operating as an inverter.	7 Hrs
	Unit–III	
6	**AC Voltage Controllers** Introduction, The Single-Phase AC Voltage, Controller, Basic Operation, Single-Phase Controller with a Resistive Load, Single-Phase Controller with an RL Load, Static VAR Control, AC Voltage Controllers.	5 Hrs
7	**Drive Circuits, Snubber Circuits and Heat Sinks** Introduction, MOSFET and IGBT drive circuits, low-side drivers, high-side drivers, transistor snubber circuits, heat sinks and thermal management, steady-state temperatures, time-varying temperatures.	5 Hrs

Text Book:

1. Daniel W Hart, Power Electronics, Tata McGraw-Hill Edition, New-Delhi, 2011.

References:

1. Rashid M. H, Power Electronics: Circuits, Devices and Applications, 3rd edition, PHI, New Delhi, 2000.
2. P. S. Bhimbra, Power Electronics, Khanna Publishers, 2007.
3. Umanand, Power Electronics, 2nd edition, Wiley-India Publications, New –Delhi, 2009.

L-T-P: 3-0-0

Course code: 17EEEC302

Course title: Power System Analysis & Stability **CIE Marks: 50**

Teaching hours: 40 **SEE Marks: 50**

Course Content	Hrs
Unit - 1	
Chapter No. 1: Power system representation Standard symbols of power system components, one-line diagram, impedance and reactance diagrams, per-unit quantity-definition, per-unit impedance of 3-phase component, change of base, equivalent load impedance, p.u impedance of two-winding transformer referred to primary and secondary, method to draw p.u impedance diagram, advantages of p.u system calculations, examples on obtaining per-unit reactance diagram and per-unit calculations	6 hrs
Chapter No. 2: Symmetrical fault analysis 3-Phase short circuit at the terminals of unloaded generator, definitions of sub-transient, transient and steady-state reactance, internal emf's of loaded machines, examples on short circuit calculations, selection of circuit breaker ratings-momentary current and interrupting capacity, examples on symmetrical fault calculations.	5 hrs
Chapter No. 3: Introduction to Symmetrical components and sequence networks Definition of sequence components as applied to 3-phase unbalanced systems, expressions for sequence components, examples on computations of sequence components.	4 hrs
Unit - 2	
Chapter No. 4 Sequence Networks Sequence impedance and sequence network, sequence networks of 3-phase generator, zero-sequence networks of 3-phase loads and transformers, Sequence network of power systems	4 hrs
Chapter No. 5: Unsymmetrical Fault Analysis Single line to ground, line to line and double line to ground fault with fault impedance at the terminals of unloaded generator- derivation of connection of sequence networks, Unsymmetrical faults on unloaded power systems, examples on unsymmetrical fault calculation for unloaded power systems.	7 hrs
Chapter No. 6: Introduction to power system Stability Power angle equation of SMIB system, steady-state analysis, M&H constants-definitions and relation, swing equation, equal area criterion (EAC),	4 hrs
Unit - 3	
Chapter No. 7: Stability analysis by EAC: EAC applications to to-sudden change in mechanical power input, 3-phase fault on transmission line, expression for critical clearing angle, examples on EAC applications	5 hrs
Chapter No. 8: Numerical solution of swing equation for stability analysis Point by point method of solving swing equation, applications of Euler, modified Euler and R-K numerical techniques for stability analysis, methods to improve transient stability, examples on stability analysis	5 hrs

Text Books

1. W.D. Stevenson, Elements of Power System Analysis, 4th Edition, McGraw Hill, 1982
2. I.J. Nagarath and D.P. Kothari, Power System Engineering, 2nd Edition, Tata McGraw Hill, 2010

Reference Books

1. Hadi Sadat, Power System Analysis, First Edition, Tata McGraw Hill, 2002
2. Nagarath and Kothari, Modern Power System Analysis, 2nd Edition, Tata McGraw Hill, 1993
3. J.J. Grainger and W.D. Stevenson, Power System Analysis, McGraw Hill (New York), 1994

Course Code: 17EEEC303 **Course Title: OS and Embedded Systems**
L-T-P-SS: 3-0-0 **Credits: 3** **Contact Hrs: 3 hrs/week**
CIE Marks: 40 SEE Marks: 50 **Total Marks: 100**
Teaching Hrs: 40 hrs **Exam Duration: 3 hrs**

No	Content	Hrs
1	**Unit I** **Introduction and System structures** Operating system definition; Operating System operations; Different types of operating system – Mainframe systems, Multi programmed systems, Time sharing systems, Desktop systems, Parallel systems, Distributed systems, Real time systems. **Process Management** Process concept; Process scheduling; Operations on processes; Inter-process communication. Multi-Threaded Programming: Overview; Multi threading models; Thread Libraries; Threading issues. Process Scheduling: Basic concepts; Scheduling criteria; Scheduling algorithms; Multiple-Processor scheduling; Thread scheduling. **Memory Management** Memory Management Strategies: Background; Swapping; Contiguous memory allocation; Paging; Structure of page table; Segmentation. Virtual Memory Management: Background; Demand paging; Page replacement; Allocation of frames; Thrashing. **(Textbook: Galvin)**	03 Hrs 06 Hrs **06 Hrs**
	Unit II	
4	**Introduction To Real-Time Operating Systems** Introduction To Real-Time Operating Systems: Introduction to OS, Introduction to real time embedded system- real time systems, characteristics of real time systems , the future of embedded systems. Introduction to RTOS, key characteristics of RTOS, its kernel, components in RTOS kernel, objects, scheduler, services, context switch, Scheduling types: Preemptive priority-based scheduling, Round-robin and preemptive scheduling. **Tasks, Semaphores and Message Queues:** Tasks, Semaphores and Message Queues: A task, its structure, A typical finite state machine, Steps showing the how FSM works. A semaphore, its structure, binary semaphore, mutual exclusion (mutex) semaphore, Synchronization between two tasks and multiple tasks, Single shared-resource-access synchronization, Recursive shared-resource-access synchronization. A message queue, its structure, Message copying and memory use for sending and receiving messages, Sending messages in FIFO or LIFO order, broadcasting messages. ***(Textbook: Qing Li with Caroline Yao, Real-Time Concepts for Embedded Systems, 1E, Published, 2011)***	08 Hrs 07 Hrs
3	**Unit III** **Typical Embedded System:** Classification and purposes of embedded system, Characters and Quality attributes of embedded system, Core and Supporting components of embedded system, Embedded firmware **(Text book: Shibu KV)** Wired and Wireless Protocols: **Bus communication protocol (USB,I^2C,SPI), Wireless and mobile system protocol (Bluetooth, 802.11 and its variants, ZigBee), Embedded design cycle-case study-ACVM** (Text book: Rajkamal)	05 Hrs **05 Hrs**

Course Code: 17EEEC304 **Course Title: Digital Signal Processing**
L-T-P: 3-0-0 Credits: 3 **Contact Hrs: 3 hrs/week**
CIE Marks: 50 SEE Marks: 50 **Total Marks: 100**
Teaching Hrs: 40 hrs **Exam Duration: 3 hrs**

No	Content	Hrs
	Unit I	
1	**Introduction to Digital Signal Processing:** Signals, Systems, and Signal Processing, Classification of Signals, Basic operations on signals, Elementary signals.	07hrs
2	**Discrete Time Signals and Systems:** Properties of systems, representation of linear time in variant systems, Correlation of Discrete Time Signals.	08hrs
	Unit II	
4	**Discrete Fourier Series and Fourier Transform Representation :** Fourier Series representation of discrete time signals and properties, Fourier Transform representation of discrete time signals and properties, Applications	04hrs
5	**The Discrete Fourier Transforms:** Frequency Domain Sampling, Properties	06hrs
6	**Efficient Computation of DFT:** Fast Fourier Transform Algorithms, Applications of FFT Algorithms, A linear Filtering Approach to Computation of the DFT.	05hrs
	Unit – III	
7	**Design of Digital IIR Filters:** Introduction, Impulse Invariant & Bilinear Transformations, analog filters – Butterworth , design of digital Butterworth, Chebyshev	05hrs
8	**Design of FIR Filters:** Introduction, windowing, rectangular, modified rectangular, Hanning, Hamming,	05hrs
	Text Book: 1. Digital Signal Processing, by John G. proakis & Dimitris G. Manolakis, Third Edition, prentice-Hall of India Pvt. Ltd.,ISBN 81-203-1129-9. References: [1] Discrete-Time Signal Processing, by Alan V Oppenheim & Ronald W. Schfer, Prentice-Hall of India Pvt. Ltd., ISBN 0-87692-720-7 [2] Digital Signal Processing- A computer based approach by Sanjit K. Mitra, Tata McGraw-Hill Publishing Company Limited, New Delhi,ISBN 0-07-463723-1. [3] A Student's Guide to Fourier Transforms With Applications in Physics and Engineering by J. F. James, Third Edition, www.cambridge.org/9780521176835	

Course Code: 17EEEP301 **Title: Data Structure Using C Lab**
L-T-P: 0-0-2 Credits:2 **Contact Hrs: 4 hrs/week**
CIE Marks: 80 SEE Marks: 20 **Total Marks: 100**
Teaching Hrs: 48hrs **Exam Duration: 3 hrs**

1.	**Programming on pointer concepts**: Pointer concepts,1D and 2D arrays, pointers to functions, memory management functions	02+02 Hrs
2.	**Programming on string handling functions using pointers, structures, bit-fields**: Perform string handling functions like String length, String concatenate, Strings compare, String copy and Strings reverse, Implementing Structures, union and bit-field.	02+02 Hrs
3.	**Programming on files:** Open, Close, Read, Write and Append the file.	02+02 Hrs
4.	**Programming on stack data structures and applications:** Insert delete and display an integer in a stack, Conversion from Infix to postfix & Infix to Prefix, Recursion.	02+02 Hrs
5.	**Programming on queue data structures:** Insert at rear end ,delete at front end and display the integers in queue, Deque and circular queue.	02+02 Hrs
6.	**Programming on linked lists:** Insert, delete and display a node in Singly Linked List, Doubly Linked List and Circular Linked List.	06+03 Hrs
7.	**Programming on trees:** Perform various operations on binary trees, find max, min value in a binary search trees, find the height of a tree, count nodes in a tree, delete a node in a tree.	02+02 Hrs
8.	**Programming on sorting:** Merge sort, Quick sort, Heap sort, Shell sort, Radix sort**.**	02+02 Hrs
9.	**Programming on graphs:** Compare Breadth First Sort Sort, and Depth First Sort	02+02 Hrs
10.	**Programming on hashing tables:** Implement different methods of hash tables.	02+02 Hrs
11.	**Open ended experiment:** Implement given Data structures.	02+02 Hrs

NOTE: The pseudo codes for different data structures and algorithms to be based on standard problems from geeksforgeeks website.

Text Book

1. Horowitz, Sahani, Anderson-Feed, "Fundamentals of Data Structures in C", 2ed,Universities Press, 2008
2. Aaron M. Tenenbaum , "Data Structures Using C", Pearson Education India, 2003
3. Richard F. Gilberg, Behrouz A. Forouzan "Data Structures: A Pseudocode Approach With C", 2nd Edition , Course Technology, Oct 2009.

References

1. E Balaguruswamy, "The ANSI C programming Language", 2ed., PHI, 2010.
2. Yashavant Kanetkar, "Data Structures through C", BPB publications 2010

Course Code: 17EEEP302 **Title: Linear Integrated Circuits Lab**
L-T-P: 0-0-2 Credits:2 **Contact Hrs: 4 hrs/week**
CIE Marks: 80 SEE Marks: 20 **Total Marks: 100**
Teaching Hrs: 48hrs **Exam Duration: 3 hrs**

1.	Inverting & Noninverting summer	02+02 Hrs
2.	Conductance & Tansconductance Amplifier	02+02 Hrs
3.	Instrumentation Amplifier	02+02 Hrs
4.	High gain high input impedance amplifier	02+02 Hrs
5.	Op-amp Phase shifter	02+02 Hrs
6.	Non Inverting Integrator	06+03 Hrs
7.	Active Low pass filter	02+02 Hrs
8.	RC Phase shift Oscillator	02+02 Hrs
11.	**Open ended experiment:** Implement given LIC Circuit To design and implement Analog PI controller for single time constant system	02+02 Hrs

Text Book

1. Jacob Milman, "Microelectronics: Digital and Analog Circuits and Systems", 6th edition McGrawhill,1984

Course Code: 17EEEP303	Course Title: Embedded and IOT Lab	
L-T-P: 0-0-1	Credits: 1	Contact Hrs: 32
CIE Marks: 20	SEE Marks: 80	Total Marks: 100
Teaching Hrs: 32		Exam Duration: 2 hrs

Chapter No.	List of Experiments
1	Write a C program to use on chip Timers in LPC2148 and generate required delay
2	Write a C program to demonstrate the concept of basic RTOS programming by using RTX RTOS
3	Write a 'C' program & demonstrate concept of Round Robin Task Scheduling.
	Write a C program to demonstrate the concept of basic preemptive scheduling algorithm by using RTX RTOS
4	Write a 'C' program & demonstrate concept of Events and Flags for inter task communication using RTX RTOS
5	Write a 'C' program & demonstrate concept of Mailbox.
6	Write a 'C' program & demonstrate concept of Semaphore.
7	Write a 'C' program & demonstrate concept of interrupts(hardware and software)
	Write a C program to interface I2C-RTC with LPC2148
8	Write a C program to interface SPI-EEPROM with LPC2148
	Structured Enquiry
	Real-Time OS Application which successfully demonstrates the use of various RTOS concepts

Course Code: 17EEEW301 **Title: Mini Project**
L-T-P: 0-0-3 Credits:3 **Contact Hrs: 3 hrs/week**
CIE Marks: 50 SEE Marks: 50 **Total Marks: 100**

Students are supposed to carry out the mini project based on the theme and guidelines as given below.

(I) Theme: A Computer Aided Solution to Electrical Engineering Problems

1. The work must involve designing and developing a computer solution to an electrical engineering problem with the help of a computer program written in C/C++.
2. Computer program must make use of data structures /algorithms suitable to the problem being solved.
3. The solution must involve mathematical modeling, mathematical solution and numerical methods.
4. Computer program design must be well documented through flowcharts.
5. Computer program must have a user manual and source code documentation.
6. Computer program must generate a clear, concise report that is useful for other users.
7. The solution must be documented in a report consisting of problem definition, methodology, modeling, solution, results and discussion and conclusions.

(II) Project batches and Guide:
Each project batch consists of 3 or 4 students. Students are informed to form their own batch based on the kind of project work and their interest. Each batch is supposed to give four faculty names as guides in the order of their preference. Guides will be allocated based on the preference given by the batch. The primary role of the guide is to supervise the work, provide appropriate guidance in successfully carrying out the project work.

(III) Project implementation
The principle steps in carrying out the project work are summarized below:
Step-1: Literature survey:
A literature survey with regard to the given theme is to be carried out in order to understand the state of the current research. Further, a critical review of the collected literature will facilitate to summarize key observations. Key observations will lead to identifying a specific problem for the project work in terms of alternate/new solution techniques, possible improvements, new formulations or models, hardware implementations etc.

Step-2: Prepare a synopsis:
A synopsis highlights the definition of identified problem and its significance. The synopsis will also contain detailed literature review giving the state of the current research on the selected specialized area.

It will also brief the problem formulation, solution methodology, tools employed and possible outcomes.

Step-3: Project implementation:

The work is to be carried out in phase wise manner, testing or analyzing the partial results obtained. Guide will periodically monitor the progress of the work done giving suitable suggestions as required.

(IV) Schedule:

Sl. No.	Activity	Week No.	Evaluation Objectives
1	Announcement for the formation of batches	At the end of the previous semester	NA
2	Allotment of guides	1^{st} - 2^{nd}	NA
3	Submission of Synopsis	3^{rd} - 5^{th}	Literature review, problem formulation, solution methodology, tools employed
4	Review-I	6^{th} - 8^{th}	Literature review, problem formulation, solution methodology, tools employed
5	Review-II	9^{th} -10^{th}	Analysis and implementation (partial)
6	Review-III	12^{th} - 14^{th}	Analysis, complete implementation and results.

Evaluation:

Evaluation of the project work carried out by each batch will be reviewed periodically by a review committee. Review committee consists of guide and two other faculty members who are guiding other batches. Generally, two to three reviews will be held during a semester. However, each project batch will be supervised by the guide on a weekly basis. Review committee will evaluate for 40% and guide will evaluate for 60% of the total marks.

Continuous Internal Evaluation (50%)	**Assessment**	**Weightage in Marks**
	Evaluation by Project Guide	30
	Project Review committee	20
Semester End Examination (50%)	Using SEE Rubrics	50
	Total	**100**

Passing: 40% both in CIE and SEE

Course Code: 17EEEC305 **Course Title: Electric Drives and Control**
L-T-P-S: 3-0-0 **CIE:50**
Teaching Hours: 40 **SEE:50**

Chapter 1. An introduction to Electrical Drives & its Dynamics: Electrical drives. Advantages of electrical drives. Parts of electrical drives, Choice of electrical drives, status of dc and ac drives, dynamics of electrical drives, fundamental torque equation, speed torque conventions and multi quadrant operation. Nature and classification of load torques, calculation of time and energy loss in transient operations..	**5 Hrs**
Chapter 2. D C Motor Drives: Starting braking, single phase fully controlled rectifier control of dc separately excited motor, Single-phase half controlled rectifier control of dc separately excited motor. Three phase fully controlled rectifier control of dc separately excited motor, three phase half controlled rectifier control of dc separately excited motor, multiquadrant operation of dc separately excited motor fed from fully controlled rectifier. Rectifier control of dc series motor, chopper controlled dc drives, chopper control of separately excited dc motor. Chopper control of series motor.	**10 Hrs**
Unit – II	
Chapter 3. Induction Motor Drives: Operation with unbalanced source voltage and single phasing, operation with unbalanced rotor impedances, analysis of induction motor fed from non-sinusoidal voltage supply, starting, braking, Stator voltage control, variable frequency control from voltage sources, voltage source inverter control, current source inverter control, current regulated voltage source inverter control, rotor resistance control, slip power recovery.	**10 Hrs**
Chapter 4. Synchronous Motor and Brushless dc Motor Drives: Operation from fixed frequency supply, synchronous motor variable speed drives, variable frequency control of multiple synchronous motors, self controlled synchronous motor drive, PMAC motor drives, brushless dc motor drives	**05 Hrs**
Unit – III	
Chapter 5. Stepper Motor and Swiched Reluctance Motor Drives: Stepper Motor: variable reluctance, permanent magnet, torque versus stepping rate characteristics drive circuits for stepper motors Switched Reluctance Motor: Operation and control requirements, converter circuits, modes of operation	**5 Hrs**
Chapter 6. Solar and Battery Powered Drives: Solar panels, motors suitable for pump drives, battery powered vehicles, solar powered electrical vehicles	**5 Hrs**

Text Book :

1. G. K Dubey, *"Fundamentals of Electrical Drives"*, 2nd ed., Narosa Publishing House, Chennai, 2002.

References:

Course code: 17EEEC306 **L-T-P: 3-0-0**
Course title: Power System Modeling, Operation & Control **CIE Marks: 50**
Teaching hours: 50 **SEE Marks: 50**

Unit - 1	Hrs
Chapter No. 1: Formation of network matrices : Multi-port power system representation, performance equations in bus frame of reference, definitions of Network models Ybus and Zbus, Primitive element representations, primitive performance equations,. Formation of Ybus by method of Inspection, Introduction to graph theory- definitions of terms, Bus incidence matrix, Ybus by the method of singular transformation, Examples on Ybus formation by singular transformation (with no mutual coupling) and Inspection method, Zbus building algorithm-addition of uncoupled branches and links, modification of Zbus for changes in elements not mutually coupled, Examples on Zbus formation	8 hrs
Chapter No. 2: Optimal load dispatch : Importance and objective of economic load dispatch, Fuel cost and Incremental fuel cost, Optimal load allocation between plants neglecting transmission losses, Examples on optimal load allocation with and without generation constraints, Optimal load allocation considering transmission losses, General transmission loss formula, Examples.	7 hrs
Unit - 2	
Chapter No. 3: Load flow analysis : Importance of Power flow, Classification of busses, General steps in load flow analysis, Off-nominal ratio tap changing ratio transformer representation. Bus voltage solution by Gauss and Gauss-Seidel methods without PV buses, Handling PV buses in Gauss-Seidel method, N-R load flow model in polar coordinates, formation of NR Jacobian, Introduction to FDLF load flow model, Comparison of Gauss-Seidel, NR and FDLF load flow methods, Examples on one iteration of load flow solution.	8 hrs
Chapter No. 4: Load frequency control : Introduction to load frequency control problem, Working principle of speed governor, Model of isolated power system area –block diagram representation, Expression for steady-state frequency deviation, Parallel operation of generators – expression for operating frequency and load sharing,, two area load frequency control, steady-state operation of multi-area system under free governor operation, Examples on load sharing between areas.	7 hrs
Unit - 3	
Chapter No. 5: Reactive power and voltage control : Power flow through a line, Relation between voltage, power and reactive power at a node, Brief descriptions of methods of voltage control-by injection of reactive power and tap changing transformer. Generator reactive power control by AVR-simplified AVR system model, AVR response.	5 hrs
Chapter No. 6:Power System Simulations: Simulation of automatic generation control, simulation of small signal stability of a SMIB power system, Transient stability simulation of SMIB power system using trapezoidal integration, simulation of classical economic load dispatch Algorithm	5 hrs

Text Books

1. Stagg and El-Abid, Computer Methods in power system analysis, First Edition, Mc-Graw Hill, 1968
2. Kothari and Nagarath, Modern power system analysis, 3rd Edition, Tata McGraw Hill, 2004

References :

1. P. Kundur, Power system stability and control, First Edition, Tata McGraw Hill, 2007
2. Hadi Sadat, Power System analysis, Ed. First Edition, Tata McGraw Hill, 2002
3. A.R. Bergen and Vijay Vittal, Power system analysis, Ed. First Edition, Pearson Ed, 2009

Course Code: 17EEEC307 **Course Title: Automotive Electronics**
L-T-P-SS: 3-0-0 Credits:3 **Contact Hrs: 3 hrs/week**
CIE Marks: 50 SEE Marks: 50 **Total Marks: 100**
Teaching Hrs: 40hrs **Exam Duration: 3 hrs**

No	Content	Hrs
	Unit I	
1	**Automotive Systems, Design cycle and Automotive industry overview** Overview of Automotive industry, Vehicle functional domains and their requirements, automotive supply chain, global challenges. Role of technology in Automotive Electronics and interdisciplinary design. Introduction to modern automotive systems and need for electronics in automobiles and application areas of electronic systems in modern automobiles, Introduction to power train, Automotive transmissions system ,Vehicle braking fundamentals, Steering Control, Overview of Hybrid Vehicles **ECU Design Cycle :** Types of model development cycles(V and A) , Components of ECU, Examples of ECU on Chassis, Infotainment, Body Electronics and cluster	8
2	**Automotive Sensors and Actuators:** Sensor characteristics, Sensor response, Sensor error, Redundancy of sensors in ECUs, Avoiding redundancy, Smart Nodes , Examples of sensors : Accelerometer (knock sensors),wheel speed sensors, Engine speed sensor, Vehicle speed sensor, Throttle position sensor, Temperature sensor, Mass air flow (MAF) rate sensor, Exhaust gas oxygen concentration sensor, Throttle plate angular position sensor, Crankshaft angular position/RPM sensor, Manifold Absolute Pressure (MAP) sensor. **Actuators**: Engine Control Actuators, Solenoid actuator, Exhaust Gas Recirculation Actuator.	7
	Unit II	
3	**Embedded system in Automotive Applications & Automotive safety systems:** Review of microprocessor, microcontroller and digital signal processor within the automotive context. Criteria to choose the right microcontroller/processor for various automotive applications, Architectural attributes relevant to automotive applications Automotive grade processors ex: Renesas, Quorivva, Infineon. **EMS:** Engine control functions, Fuel control, Electronic systems in Engines , Development of control algorithm for EMS, Look-up tables and maps, Need of maps, Procedure to generate maps, Fuel maps/tables, Ignition maps/tables, Engine calibration, Torque table, Dynamometer testing **Safety Systems in Automobiles: Active and Passive safety systems:** ABS, TCS, ESP, Brake assist, Airbag systems etc.	10
4	**Automotive communication protocols :** Overview of Automotive communication protocols : CAN, LIN , Flex Ray, MOST	5
	Unit – III	
5	**Advanced Driver Assistance Systems (ADAS) and Functional safety standards:** Advanced Driver Assistance Systems (ADAS):Examples of assistance applications: Lane Departure Warning, Collision Warning, Automatic Cruise Control, Pedestrian Protection, Headlights Control, Connected Cars technology and trends towards Autonomous vehicles. **Functional Safety:** Need for safety standard-ISO 26262, safety concept, safety process for product life cycle, safety by design, validation	5

6	**Diagnostics:** Fundamentals of Diagnostics: Basic wiring system and Multiplex wiring system, Preliminary checks and adjustments, Self-diagnostic system. Fault finding and corrective measures, Electronic transmission checks and Diagnosis, Diagnostic procedures and sequence, On board and off board diagnostics in Automobiles, OBDII, Concept of DTCs, DLC, MIL, Freeze Frames, History memory, Diagnostic tools, Diagnostic protocols : KWP2000 and UDS	**5**

Text Book:

1. Ribbens – Understanding of Automotive electronics
2. Denton.T – Automobile Electrical and Electronic Systems.
3. Denton.T – Advanced automotive fault diagnosis

References:

1. Ronald K Jurgen: "Automotive Electronics Handbook, 2nd Edition, McGraw-Hill, 1999
2. James D Halderman: -Automotive electricity and Electronics", PHI Publication
3. Terence Rybak. Mark Stefika: Automotive Electromagnetic Compatibility (EMC), Springer. 2004
4. Allan Bonnick.: “Automotive Computer Controlled Systems” Diagnostic Tools and Techniques". Elsevier Science, 2001
5. William T.M – Automotive Electronic Systems.
6. Nicholas Navet – Automotive Embedded System Handbook 2009.
7. BOSCH Automotive Handbook, 6th Edition.

Course code: 17EEEC308 **L-T-P: 2-0-1**

Course title: Machine Learning **CIE Marks: 50**

Teaching hours: 40 **SEE Marks: 50**

Chapter No.	**Unit-I**	
1	**Introduction** Introduction to Machine Learning, Applications of Machine Learning, Types of Machine Learning: Supervised, Unsupervised and Reinforcement learning, Dataset formats, Basic terminologies.	5 hrs
2	**Supervised Learning** Linear Regression, Logistic Regression Linear Regression: Single and Multiple variables, Sum of squares error function, The Gradient descent algorithm, Application, Logistic Regression, The cost function, Classification using logistic regression, one-vs-all classification using logistic regression, Regularization.	10 hrs
	Unit-II	
3	**Supervised Learning: Neural Network** Introduction to perception learning, Implementing simple gates XOR, AND, OR using neural network. Model representation, Gradient checking, Back propagation algorithm, Multi-class classification, Application- classifying digits, SVM.	10 hrs
4	**Unsupervised Learning: Clustering** Introduction, K means Clustering, Algorithm, Cost function, Application.	5 hrs
	Unit-III	
5	**Unsupervised Learning: Dimensionality Reduction** Dimensionality reduction, PCA- Principal Component Analysis. Applications, Clustering data and PCA.	4 hrs
6	**Introduction to Deep Learning** What is deep learning?, Difference between machine learning and deep learning, Convolution Neural Networks (CNN), Recurrent Neural Networks(RNN), When to use deep learning?	8 hrs

Text Books

1 Tom Mitchell, Machine Learning, 1, McGraw-Hill. , 1997

2 Christopher Bishop, Pattern Recognition and Machine Learning, 1, Springer, 2007

Reference Books:

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

Laboratory Title: Power Electronics & Drives Lab **Lab. Code: 17EEEP304**
Total Hours: 36 Hrs **Duration of Exam: 03 Hrs**
Total Exam Marks: 100 **Total CIE. Marks: 80**

S No	Experiment list
	Demonstration
1	Forward and Flyback DC-DC Converter
2	Single phase full bridge inverter
3	Half controlled Rectifier feeding R and RL load
4	Fully controlled bridge rectifier feeding R and RL load
	Exercises
1	Three phase full bridge controlled rectifier fed DC motor drive.
2	Class AB chopper fed DC Motor drive.
3	Four Quadrant Closed loop control of DC motor drive
4	VSI based open loop volts/hertz control of three phase induction motor drive.
	Structured Enquiry
1	Title: Each batch (consisting of 4 students) will work on one hard ware circuit out of the below mentioned circuits, obtain the simulation results, and experimentally verify the working principle and prepare a report. To design and implement closed loop DC motor/Induction motor drive to meet defined specifications.

Laboratory Title: Automotive Electronics Lab **Lab. Code: 17EEEP305**
Total Hours: 36 Hrs **Duration of Exam: 03 Hrs**
Total Exam Marks: 100 **Total CIE. Marks: 80**

Sl. No.	Name of Experiment
	Demonstration Experiment
1	Electronic engine control system: Injection and Ignition control system, Transmission trainer modules
	Exercise Experiment
2	Simulation of an automobile engine
3	Modeling a vehicle motion on a flat surface during hard acceleration, deceleration and steady acceleration.(ABS and suspension system)
4	Basic gate logic simulation and modeling using Simulink and realization on the hardware platform.
5	Modeling Seat belt warning system, and Vehicle speed control based on the gear input.
6	EGAS modeling and simulation using Simulink and realization on the hardware platform.
7	Interior lighting control modeling with state flow
8	Gear input transmission over CAN bus using ARM Cortex m3 and signal analysis using CANalyzer/BusMaster software. Code driven and Model driven integration for Vehicle speed control function based on the gear input.
	Structured Enquiry
1	Develop Matlab code for stepper motor control and convert it to Simulink model and port it on to an embedded hardware
2	Develop a C code for LCD display device and convert it to Simulink model and port it to embedded hardware/FPGA

Laboratory Title: Minor Project **Lab. Code: 17EEEW302**

Total Hours: 36 **Duration of SEE Hours: 3**

SEE Marks: 50 **CIE Marks: 50**

Students are supposed to carry out the minor project based on the theme and guidelines as given below.

(I) Theme:

Hardware Design and Implementation of Electrical and / or Electronics System for application in Controls, Measurement and Instrumentation, Power Electronics and Drives, Relays, Renewable Energy Systems etc using specialized ICs /Microcontrollers /DSPs.

(II) Project batches and Guide:

Each project batch consists of 3 or 4 students. Students are informed to form their own batch based on the kind of project work and their interest. Each batch is supposed to give four faculty names as guides in the order of their preference. Guides will be allocated based on the preference given by the batch. The primary role of the guide is to supervise the work, provide appropriate guidance in successfully carrying out the project work.

(III) Project implementation

The principle steps in carrying out the project work are summarized below:

Step-1: Literature survey:

A literature survey with regard to the given theme is to be carried out in order to understand the state of the current research. Further, a critical review of the collected literature will facilitate to summarize key observations. Key observations will lead to identifying a specific problem for the project work in terms of alternate/new solution techniques, possible improvements, new formulations or models, hardware implementations etc.

Step-2: Prepare a synopsis:

A synopsis highlights the definition of identified problem and its significance. The synopsis will also contain detailed literature review giving the state of the current research on the selected specialized area. It will also brief the problem formulation, solution methodology, tools employed and possible outcomes.

Step-3: Project implementation:

The work is to be carried out in phase wise manner, testing or analyzing the partial results obtained. Guide will periodically monitor the progress of the work done giving suitable suggestions as required.

(IV) Schedule:

Sl. No.	Activity	Week No.	Evaluation Objectives
1	Announcement for the formation of batches	At the end of the previous semester	NA
2	Allotment of guides	1st - 2nd	NA
3	Submission of Synopsis	3rd - 5th	Literature review, problem formulation, solution methodology, tools employed
4	Review-I	6th - 8th	Literature review, problem formulation, solution methodology, tools employed
5	Review-II	9th -10th	Analysis and implementation (partial)
6	Review-III	12th - 14th	Analysis, complete implementation and results.

Evaluation:

Evaluation of the project work carried out by each batch will be reviewed periodically by a review committee. Review committee consists of guide and two other faculty members who are guiding other batches. Generally, two to three reviews will be held during a semester. However, each project batch will be supervised by the guide on a weekly basis. Review committee will evaluate for 40% and guide will evaluate for 60% of the total marks.

	Assessment	Marks
Continuous Internal Evaluation (50%)	Evaluation by Project Guide	30
	Project Review committee	20
Semester End Examination (50%)	Using SEE Rubrics	50
	Total	**100**

Passing: 40% both in CIE and SEE

Course Code: 18EEEP201 **Title: Data Structure Using C Lab**
L-T-P: 0-0-3 **Credits:3** **Contact Hrs: 4 hrs/week**
CIE Marks: 80 SEE Marks: 20 **Total Marks: 100**
Teaching Hrs: 48hrs **Exam Duration: 3 hrs**

Chapter No.	**Unit-I**	
1	**Programming on pointer concepts**: Pointer concepts,1D and 2D arrays, pointers to functions, memory management functions	02+02 Hrs
2	**Programming on string handling functions using pointers, structures, bit-fields**: Perform string handling functions like String length, String concatenate, Strings compare, String copy and Strings reverse, Implementing Structures, union and bit-field.	02+02 Hrs
3	**Programming on files:** Open, Close, Read, Write and Append the file.	02+02 Hrs
4	**Programming on stack data structures and applications:** Insert delete and display an integer in a stack, Conversion from Infix to postfix & Infix to Prefix, Recursion.	02+02 Hrs
5	**Programming on queue data structures:** Insert at rear end ,delete at front end and display the integers in queue, Deque and circular queue.	02+02 Hrs
6	**Programming on linked lists:** Insert, delete and display a node in Singly Linked List, Doubly Linked List and Circular Linked List.	06+03 Hrs
7	**Programming on trees:** Perform various operations on binary trees, find max, min value in a binary search trees, find the height of a tree, count nodes in a tree, delete a node in a tree.	02+02 Hrs
8	**Programming on sorting:** Merge sort, Quick sort, Heap sort, Shell sort, Radix sort**.**	02+02 Hrs
9	**Programming on graphs:** Compare Breadth First Sort Sort, and Depth First Sort	02+02 Hrs
10	**Programming on hashing tables:** Implement different methods of hash tables.	02+02 Hrs
11	**Open ended experiment:** Implement given Data structures.	02+02 Hrs

Text Books

1 Horowitz, Sahani, Anderson-Feed, "Fundamentals of Data Structures in C", 2ed,Universities Press, 2008
2 Aaron M. Tenenbaum , "Data Structures Using C", Pearson Education India, 2003
3 Richard F. Gilberg, Behrouz A. Forouzan "Data Structures: A Pseudocode Approach With C", 2nd Edition , Course Technology, Oct 2009.

Reference Books:

1 E Balaguruswamy, "The ANSI C programming Language", 2ed., PHI, 2010.
2 Yashavant Kanetkar, "Data Structures through C", BPB publications 2010

Course Code: 18EEEC201 **Course Title: Electrical Machines**

L-T-P : 3-0-0 Credits: 3 Contact Hrs: 40

ISA Marks: 50 ESA Marks: 50 Total Marks: 100

Teaching Hrs: 40 Exam Duration: 3Hrs

Chapter No.	**Unit-I**	
1	Transformer : Transformer construction and principle of operation, Ideal Transformer, Practical Transformer, Transformer phasor diagrams, Equivalent circuit of transformers, Open circuit and short circuit tests, Voltage regulation, transformer losses and efficiency, Testing of transformers, Three phase transformers, Auto-transformers.	10 hrs
2	DC Machines: Construction of DC machine and DC machine as generator, EMF equation of DC machine, Operating characteristics of types of DC generators, Operating characteristics of DC motors, DC motor starting, Speed control of DC motors.	05 hrs
	Unit-II	
3	Induction (Asynchronous) Machines: Induction motor as transformer, Principle of operation, Rotor frequency, e.m.f, current and power, Losses and Efficiency, Equivalent circuit, Torque slip and Power-slip characteristics, Determination of equivalent circuit parameters. Circle diagram, Starting of polyphase induction motors.	10 hrs
4	Synchronous Machines: Cylindrical and salient pole machines, Phasor diagram of cylindrical rotor alternator. AC armature winding, Voltage regulation of alternator using e.m.f method.	05 hrs
	Unit-III	
5	Synchronous Machines: Synchronous motor phasor, Power angle characteristic of synchronous machine, Measurement of Xd and Xq, Capability curves of synchronous generators, Power factor correction by synchronous motors.	5 hrs
6	Single phase induction machines: Double field revolving theory, Equivalent circuit, Resistance split phase motors, capacitor start motor, permanent capacitor motor, two-value capacitor motor, shaded-pole motor. Performance and cost comparison and choice of single phase induction motors.	5 hrs

Text Books

1 P. C. Sen, “Principles of Electric Machines and Power Electronics”, John Wiley & Sons Publications, Canada, 2nd Edition, 2001.

Reference Books:

1 Bhimbra, “Principles of Electrical machinery”, Khanna Publishers.2006.
2 D. P. Kothari and I. J. Nagrath, “Electrical Machines”, MGH Publishers. 4th Edition, 2011.
3 Fitzgerald, Kingsly & Stephen, “Electric Machinery”, 5ed., McGraw Hill, 1992

Laboratory Title: Control System Lab **Lab. Code: 18EEEP202**

Total Hours: 32 **Duration of Exam: 02**

Total Exam Marks: 20 **Total ISA. Marks: 80**

Category: Demonstration	**Total Weightage: 10.00**	**No. of lab sessions: 2.00**
Expt./ Job No.	**Experiment/job Details**	
1	Demonstration of heat tank simulator without controller using Labview Interactive learning model	
2	Demonstration of temperature control of liquid tank simulator using Labview Interactive learning model	
Category: Exercises	**Total Weightage: 40.00**	**No. of lab sessions: 5.00**
Expt./ Job No.	**Experiment/job Details**	
1	Time response specifications of second order system	
2	Frequency response of second order system	
3	P,PI and PID controllers-effect on plant step response	
4	Lag and Lead Compensators- determination of frequency response	
5	Determination of Phase and Gain margin	
Category: Structured Enquiry	**Total Weightage: 30.00**	**No. of lab sessions: 4.00**
Expt./ Job No.	**Experiment/job Details**	
1.	Each batch consisting of 4 students work on a given design problem- To employ MATLAB to design compensator/controller for a system to meet given specifications and analyze the performance by simulating the time and frequency responses. To submit a technical report (consisting of objectives, specifications set, list of assumptions, design formulation, design calculations, simulation results, design validation)	

Course Title: Digital System Design using Verilog **Course Code: 18EEEP203**
L-T-P: 0-0-2 **Credits: 2** **Contact Hours: 4Hrs/week**
ISA Marks: 80 **SEA Marks:20** **Total Marks: 100**
Teaching + Lab. Hours: 48 Hrs **Examination Duration: 2 Hrs**

1.	Chapter No. 1. Architecture of FPGA Architecture of FPGS: Spartan 3, What Is HDL, Verilog HDL Data Types and Operators.	4hrs
2.	Chapter No. 2. Data Flow Descriptions Highlights of Data-Flow Descriptions, Structure of Data-Flow Description, Data Type – Vectors, Testbench.	6 hrs
3.	Chapter No. 3. Behavioral Descriptions Behavioral Description highlights, structure of HDL behavioral Description, The VHDL variable –Assignment Statement, sequential statements, Tasks and Functions	10 hrs
4.	Chapter No. 4. Structural Descriptions Highlights of structural Description, Organization of the structural Descriptions, Binding, state Machines, Generate, Generic, and Parameter statements	10 hrs
5.	Chapter No. 5:Finite State Machine: Moore Machines, Mealy Machines	4hrs
6.	Chapter No. 6:Timing Issues in Digital Circuits: Setup Time Constraints, Hold Time Constraints, Static Time analysis, Critical Path, Clock Skew.	6hrs
7.	Chapter No. 7. Advanced HDL Descriptions File operations in Verilog, Memories: RAM, ROM, Block Memories(Xilinx IP)	8hrs

Course Code: 18EEEC301 **Course Title: Linear Integrated Circuits**

L-T-P: 3-0-0 Credits: 3 Contact Hrs: 40

CIE Marks: 50 SEE Marks: 50 Total Marks: 100

Teaching Hrs: 40 Exam Duration: 3 hrs

Chapter No.	Unit-I	
1	**Current Mirrors** Current Mirror circuits and Modeling, Figures of merit (output impedance, voltage swing), Widlar, Cascode and Wilson current Mirrors, Current source and current sink.	05 Hrs
2	**Basic OPAMP architecture** Basic differential amplifier, Common mode and difference mode gain, CMRR, 5-pack differential amplifier, 7-pack operational amplifier, Slew rate limitation, Instability and Compensation, Bandwidth and frequency response curve	06 Hrs
3	**OPAMP characteristics** Ideal and non-ideal OPAMP terminal characteristics, Input and output impedance, output Offset voltage, Small signal and Large signal bandwidth.	04 Hrs
	Unit-II	
4	**OPAMP with Feedback** OPAMP under Positive and Negative feedback, Impact Negative feedback on linearity, Offset voltage, Bandwidth, Input and Output impedances,Follower property, Inversion property	05Hrs
5	**Linear applications of OPAMP** DC and AC Amplifiers, Voltage Follower, Summing, Scaling and Averagingamplifiers (Inverting, Non-inverting and Differential configuration), Integrator, Differentiator, , Currentamplifiers, Instrumentation amplifier,Phase shifters, Voltage to current converter, Phase shift oscillator, Weinbridge oscillator, Active Filters –First and second order Low pass & High pass filters.	10 Hrs
	Unit-III	
6	**Nonlinear applications of OPAMP** Crossing detectors (ZCD. Comparator),Schmitt trigger circuits, Monostable & Astable multivibrator, Triangular/rectangular wave generators, Waveform generator, Voltage controlled Oscillator,Precisionrectifiers, Limiting circuits.Clamping circuits, Peak detectors, sample and hold circuits, Log and antilog amplifiers, Multiplier and divider Amplifiers, Voltage Regulators.	10 Hrs

Text Books

1 Sedra and Smith, “Microelectronics ”, 5th edition , Oxford University Press.

2 Ramakant A. Gayakwad, “Op - Amps and Linear Integrated Circuits”, 4th edition, PHI.

Reference Books:

1 Robert. F. Coughlin &Fredrick F. Driscoll, “Operational Amplifiers and Linear Integrated Circuits”, PHI/Pearson, 2006.

2 James M. Fiore, “Op - Amps and Linear Integrated Circuits”, Thomson Learning, 2001

3 Sergio Franco, “Design with Operational Amplifiers and Analog Integrated Circuits”, TMH, 3e, 2005

4 David A. Bell, “Operational Amplifiers and Linear IC’s”, 2nd edition, PHI/Pearson, 2004

Course Code: 18EEEP301 **Course Title: Data Structure Using C Lab**

L-T-P: 0-0-3 Credits: 3 Contact Hrs: 48

CIE Marks: 20 SEE Marks: 80 Total Marks: 100

Teaching Hrs: 48 Exam Duration: 2 hrs

Chapter No.	**Unit-I**	
1	**Programming on pointer concepts**: Pointer concepts,1D and 2D arrays, pointers to functions, memory management functions	02+02 Hrs
2	**Programming on string handling functions using pointers, structures, bit-fields**: Perform string handling functions like String length, String concatenate, Strings compare, String copy and Strings reverse, Implementing Structures, union and bit-field.	02+02 Hrs
3	**Programming on files:** Open, Close, Read, Write and Append the file.	02+02 Hrs
4	**Programming on stack data structures and applications:** Insert delete and display an integer in a stack, Conversion from Infix to postfix & Infix to Prefix, Recursion.	02+02 Hrs
5	**Programming on queue data structures:** Insert at rear end ,delete at front end and display the integers in queue, Deque and circular queue.	02+02 Hrs
6	**Programming on linked lists:** Insert, delete and display a node in Singly Linked List, Doubly Linked List and Circular Linked List.	06+03 Hrs
7	**Programming on trees:** Perform various operations on binary trees, find max, min value in a binary search trees, find the height of a tree, count nodes in a tree, delete a node in a tree.	02+02 Hrs
8	**Programming on sorting:** Merge sort, Quick sort, Heap sort, Shell sort, Radix sort**.**	02+02 Hrs
9	**Programming on graphs:** Compare Breadth First Sort Sort, and Depth First Sort	02+02 Hrs
10	**Programming on hashing tables:** Implement different methods of hash tables.	02+02 Hrs
11	**Open ended experiment:** Implement given Data structures.	02+02 Hrs

NOTE: The pseudo codes for different data structures and algorithms to be based on standard problems from geeksforgeeks website.

Laboratory Title: Control System Lab **Lab. Code: 18EEEP302**

Total Hours: 32 **Duration of Exam: 02**

Total Exam Marks: 20 **Total ISA. Marks: 80**

Category: Demonstration	**Total Weightage: 10.00**	**No. of lab sessions: 2.00**
Expt./ Job No.	**Experiment/job Details**	
1	Demonstration of heat tank simulator without controller using Labview Interactive learning model	
2	Demonstration of temperature control of liquid tank simulator using Labview Interactive learning model	
Category: Exercises	**Total Weightage: 40.00**	**No. of lab sessions: 5.00**
Expt./ Job No.	**Experiment/job Details**	
1	Time response specifications of second order system	
2	Frequency response of second order system	
3	P,PI and PID controllers-effect on plant step response	
4	Lag and Lead Compensators- determination of frequency response	
5	Determination of Phase and Gain margin	
Category: Structured Enquiry	**Total Weightage: 30.00**	**No. of lab sessions: 4.00**
Expt./ Job No.	**Experiment/job Details**	
1.	Each batch consisting of 4 students work on a given design problem- To employ MATLAB to design compensator/controller for a system to meet given specifications and analyze the performance by simulating the time and frequency responses. To submit a technical report (consisting of objectives, specifications set, list of assumptions, design formulation, design calculations, simulation results, design validation)	

Course Code: 17EEEP306 **Course Title: RTOS Lab**

L-T-P: 0-0-1 **Credits: 1** **Contact Hrs: 32**

CIE Marks: 20 **SEE Marks: 80** **Total Marks: 100**

Teaching Hrs: 32 **Exam Duration: 2 hrs**

Expt No.	List of Experiments
1	Write a C program to use on chip Timers in LPC2148 and generate required delay
2	Write a C program to demonstrate the concept of basic RTOS programming by using RTX RTOS
3	Write a 'C' program & demonstrate concept of Round Robin Task Scheduling.
	Write a C program to demonstrate the concept of basic preemptive scheduling algorithm by using RTX RTOS
4	Write a 'C' program & demonstrate concept of Events and Flags for inter task communication using RTX RTOS
5	Write a 'C' program & demonstrate concept of Mailbox.
6	Write a 'C' program & demonstrate concept of Semaphore.
7	Write a 'C' program & demonstrate concept of interrupts(hardware and software)
	Write a C program to interface I2C-RTC with LPC2148
8	Write a C program to interface SPI-EEPROM with LPC2148
	Structured Enquiry
9	Real-Time OS Application which successfully demonstrates the use of various RTOS concepts

Course Code: 18EEEC302 **Course Title: Electric Drives & Control**

L-T-P: 2-0-1 **Credits: 3** **Contact Hrs: 30**

ISA Marks: 50 **ESA Marks: 50** **Total Marks: 100**

Teaching Hrs: 30 **Exam Duration: 3 hrs**

Content	Hrs
Unit 1	
Chapter 1: Introduction to electric drives: Fundamental torque equation, speed toque conventions and multi-quadrant operation, components of load torque, nature and classification of load torques **Control of electric drives:** Closed loop control of drives: current limit control, closed loop torque control, closed loop speed control.	04Hrs
Chapter 2: **DC motor drives:** DC motor and their performance: shunt and separately excited motors, series motors, permanent magnet motors. Braking: regenerative braking, dynamic braking, plugging. Speed control, methods of armature control, chopper controlled dc drives, chopper control of separately excited dc motors, chopper control of series motor.	06 hrs
Unit 2	
Chapter 3: Induction motor drives: Three phase induction motor: analysis and performance, Braking: regenerative braking, Plugging or reverse voltage braking, speed control, variable frequency control from voltage sources, Voltage Source Inverter (VSI) Control: VSI induction motor drives, braking and multi-quadrant operation of VSI induction motor drives. Closed loop speed control and converter rating of VSI induction motor drives.	10 hrs
Unit 3	
Chapter 4: Permanent magnet synchronous machines and BLDC drives: Permanent magnet synchronous motors, Electromotive force EMF (voltage induced), Electromagnetic (developed) torque, Vector control concepts, drive system schematics, control strategies, Permanent magnet DC brushless motors and its working principle.	05 hrs
Chapter 5: Switched Reluctance Motor drives: What is a switched reluctance machine, Aligned and unaligned positions, Electromagnetic torque, Power electronics converters for SRMs: Current hysteresis control, Voltage PWM control.	05 hrs

Text Book

1. G. K Dubey, “Fundamentals of Electrical Drives”, 2, Narosa Publishing House, Chennai, 2002
2. R. Krishnan, Permanent Magnet Synchronous and Brushless DC Motor Drives, CRC Press, Taylor & Francis Group, 2010.

References

1. T. J. E.Miller, “Brushless Permanent-Magnet and Reluctance Motor Drives”, Oxford Science Publications, 1989.
2. Jacek F. Gieras, “Electrical Machines: Fundamentals of Electromechanical Energy Conversion”, CRC Press, Taylor & Francis Group, 2017.

Course Title: Digital System Design using Verilog **Course Code: 18EEEP303**
L-T-P: 0-0-2 **Credits: 2** **Contact Hours: 4Hrs/week**
ISA Marks: 80 **SEA Marks:20** **Total Marks: 100**
Teaching + Lab. Hours: 48 Hrs **Examination Duration: 2Hrs**

1.	Chapter No. 1. Architecture of FPGA Architecture of FPGS: Spartan 3, What Is HDL, Verilog HDL Data Types and Operators.	4hrs
2.	Chapter No. 2. Data Flow Descriptions Highlights of Data-Flow Descriptions, Structure of Data-Flow Description, Data Type – Vectors, Testbench.	6 hrs
3.	Chapter No. 3. Behavioral Descriptions Behavioral Description highlights, structure of HDL behavioral Description, The VHDL variable –Assignment Statement, sequential statements, Tasks and Functions	10 hrs
4.	Chapter No. 4. Structural Descriptions Highlights of structural Description, Organization of the structural Descriptions, Binding, state Machines, Generate, Generic, and Parameter statements	10 hrs
5.	Chapter No. 5:Finite State Machine: Moore Machines, Mealy Machines	4hrs
6.	Chapter No. 6:Timing Issues in Digital Circuits: Setup Time Constraints, Hold Time Constraints, Static Time analysis, Critical Path, Clock Skew.	6hrs
7.	Chapter No. 7. Advanced HDL Descriptions File operations in Verilog, Memories: RAM, ROM, Block Memories(Xilinx IP)	8hrs

Course Code:17EEEC401 **Course Title: Switched Mode Power Converters**

L-T-P-SS: 3-0-0 Credits: 3 Contact Hrs: 40

CIE Marks: 50 SEE Marks: 50 Total Marks: 100

Teaching Hrs: 40 Exam Duration: 3 hrs

Chapter No.	Unit-I	
1	**Chapter No. 1.DC Power Supplies:** Introduction, transformer models, the flyback converter: Continuous Current Mode, Discontinuous Current Mode, Summary of flyback converter operation, the forward converter, summary of forward converter, operation, the doubly ended (two switch)forward converter, the push-pull converter, summary of push-pull converter operation, full-bridge and half-bridge DC-DC converters, multiple outputs, converter selection, power factor correction, simulation of DC power supplies, pwm control circuits, the Ac line filter, the complete DC power supply .	15 hrs
	Unit-II	
2	**Chapter No. 2. DC-AC Switched Mode Inverters** Introduction, basic concepts of switch-mode inverters, single phase inverters, three phase inverters, effect of blanking time on output voltage in inverters, other inverter switching schemes, rectifier mode of operation.	15 hrs
	Unit-III	
3	**Chapter No. 3. Multilevel Converters:** Introduction, Generalized topology with a Common DC Bus, Converters Derived from the Generalized Topology, Diode Clamped Topology, Flying Capacitor Topology,	05 hrs
4	**Diode Clamped Multilevel Converters:** Introduction, Converters structure and Functional description: voltage clamping, switching logic, Modulation of multilevel converters, Multilevel space vector modulation	05 hrs

Text Books

1 Ned Mohan, T. M. Undeland and W. Robbins, Power Electronics: Converters, Applications and Design, 2, John Wiley and Sons, 1995

2 Daniel W Hart, Power Electronics, 1, Tata McGRAW-HILL, 2011

3 YorkSergio Alberto González, Santiago Andrés Verne, María Inés Valla, Multilevel converters for Industrial Applications, CRC Press, 2014 .

Reference Books:

1 Rashid M. H, Power Electronics: Circuits, Devices and Applications, 3, PHI, 2005

2 Bose B. K., , Power Electronics and AC Drives, 5, PHI, 2003

3 Rashid M. H, Digital Power Electronics and Applications, 1, Elsevier, 2005

4 V. Ramanarayanan, Switched Mode Power Converters Notes, IISC, Bangalore, 2008

Laboratory Title: **Soft Computing Lab** Lab. Code: 17EEEP401

Total Hours: **32** Credits: L-T-P**: 0-0-1** Credits: **1** Duration of SEE Hours: 2

SEE Marks: **20** CIE Marks: **80**

Category: Demonstration	
Expt./ Job No.	**Experiment / Job Details**
1	Demonstration of Fuzzy, Genetic and PSO programs/tool-box of MATLAB
Category: Exercise	
2	Fuzzy based Automatic Generation controllers for isolated and two-area power system.
3	GA, DE and PSO optimization of PI/PID controllers for AGC
4	GA, DE and PSO based optimal load dispatch for multi-machine power systems.
Category: Structured Enquiry	
1.	Formulation and Simulation of Fuzzy logic based PSS for SMIB power system
2.	PSS Design for SMIB power system using GA/ PSO/ DE algorithms

Laboratory Title: **Relay & High Voltage Engineering Lab** Lab. Code: 17EEEP402
Total Hours: **32** Credits: L-T-P**: 0-0-2** Credits: 2 Duration of SEE Hours: 2
SEE Marks: **20** CIE Marks: **80**

Expt./ Job No.	**Experiment / Job Details**	
Category: Exercise		
1	Introduction Session	2 hrs
2	To obtain the inverse time characteristics of a given fuse wire and wires of different lengths.	2hrs
3	To obtain the inverse time characteristics of an electromagnetic over current relay	2hrs
4	To obtain the operating characteristics of microprocessor based differential relay.	2hrs
5	To obtain the operating characteristics of microprocessor based directional over current relay.	2hrs
6	To obtain the breakdown strength of air using Copper sphere gap with HVAC and HVDC.	2hrs
7	a) To obtain the breakdown strength of air using different pairs of electrode gap with HVAC and HVDC. b) To obtain the breakdown voltage of a solid dielectric. c) To obtain the breakdown voltage of a liquid dielectric.	2hrs
Category: Structured Enquiry		
1.	To develop microcontroller based overcurrent, over voltage and impedance relay using CT /PT giving details of program and demonstrate it's working output.	4hrs

Laboratory Title: **Capstone Project** Lab. Code: 18EEEW401

Credits: L-T-P**: 0-0-14** Credits: 14 Duration of SEE Hours: 3

SEE Marks: **50** CIE Marks: **50**

Capstone Project Guidelines

(I) Preamble

A project work essentially gives the students a platform to integrate the concepts studied during the study, enhance their analytical capabilities and develop abilities to effectively communicate technical information in multiple formats. During the course of projects, students are asked to follow the research methodology in identifying a problem of their interest though literature survey, carry-out feasibility study, formulate the problem, develop mathematical models, select suitable solution technique etc. Students are also encouraged to develop new formulations, alternate solution techniques, study and apply new optimization algorithms, develop new simulation models and use modern engineering/simulation tools.

(II) Project batch and Guide

Each project batch consists of 3 or 4 students. Students will be informed to form their own batch based on the kind of project work and their interest. Each batch is supposed to give four faculty names as guides based on faculty expertise in the order of their preference. Guides will be allocated based on the preference given by the batch. The primary role of the guide is to supervise the work, give appropriate guidance in successfully carrying out the project work.

(III) Project implementation

The principal steps in carrying out the project work are summarized below:

Step-1: Selection of a specialized area for the project work

A specialized area in which the project work is to be carried out depends on the interest and specialized skills acquired by the project team. This includes areas such as power system analysis, power system dynamics, renewable energy, electric drives, VLSI & Embedded system, Power quality issues etc. The proposed work may include simulation studies, hardware implementation or both.

Step-2: Selection of topic based on literature survey

A literature survey in the selected specialized area is to be carried out in order to understand the state of the current research. Further, a critical review of the collected literature will facilitate to summarize key observations. Key observations will lead to identifying a specific problem for the project work in terms of alternate/new solution techniques, possible improvements, new formulations or models, hardware implementations etc.

Step-3: Prepare a synopsis

A synopsis highlights the definition of identified problem and its significance. The synopsis will also contain detailed literature review giving the state of the current research on the selected specialized area. It will also brief the problem formulation, solution methodology, tools employed and possible outcomes.

Step-4: Project implementation

The work is to be carried out in phase wise manner, testing or analyzing the partial results obtained. Guide will periodically monitor the progress of the work done giving suitable suggestions as required.

(IV) Schedule

Sl. No.	Activity	Week No.	Evaluation Objectives
1	Announcement to form the batches	At the end of the previous 7th sem	NA
2	Allotment of guides	1st - 2nd	NA
3	Submission of Synopsis	4th- 5th	Literature review, problem formulation, methodology by respective Guides
4	Review-I	6th - 8th	Literature review, problem formulation, methodology, tools used in the presence Review Committee
5	Review-II	9th -10th	Implementation and analysis done
6	Review-III	12th - 14th	Completion along with Hardware/ Software/ Report. Results and Conclusions.

(V) Evaluation

Evaluation of the project work carried out by each batch will be reviewed periodically by a review committee. Review committee consists of guide and two/ three other faculty members who are guiding other batches. Generally, two to three reviews will be held during a semester. However, each project batch will be supervised by the guide on a weekly basis. Review committee will evaluate for 40% and guide will evaluate for 60% of the total marks.

Activity	Assessment	Marks
ISA (50%)	Project Review committee	20
	Evaluation by Project Guide	30
ESA (50%)	Using ESA Rubrics	50
	Total	**100**

Passing: 40% both in ISA and ESA

Review Committee Evaluation Schedule

Activity	Week	Marks
Review I: Problem Definition	6th	05
Review II: Progress	8th	05
Review III: Results & Conclusions	12th	10
Guide Evaluation	12th	30
Total		**50**

In Semester Assessment (ISA)

Review	Phases of the project	PI	Marks
1	Identification of problem, Literature survey, Methodology	2.4.1	10 Marks
	Relevance of project topic literature review	2..4.1	
	Tools/ Software/ Hardware using	2.2.3	
	Team and Individual Work	9.2.1	
2	Develop models and simulate power/ energy/ electronics systems using appropriate engineering tools	13.1.1	10 Marks
	Presentation and communication skills	10.3.2	
	Design/ Development of solutions	3.4.1	
	Investigation of complex problems	4.3.4	
	Work done	2.2.3	
	Team and Individual Work	9.2.1	
3	Develop models and simulate power/ energy/ electronics systems using appropriate engineering tools	13.1.1	30 Marks
	Work done	2.2.3	
	Design/ Development of solutions	3.4.1	
	Investigation of complex problems	4.3.4	
	Analysis and Results	3.4.1	
	Team and Individual Work	9.2.1	
Total (Average of three reviews)			50 Marks

End Semester Assessment (ESA)

CAPSTONE PROJECT					
End Semester Assessment (ESA)	**Group Evaluation**		**PO Assessed**	**PI Assessed**	**Weightage**
	Relevance of project topic and Literature review	• Problem identification • Problem objectives and scope	2	2.2.3 2.4.1	30%
	Quality and Quantity of work reported	• Problem formulation • Contribution to the field of knowledge • Experimentation/simulation • Analysis of results • Drawing conclusions • Assumptions and justifications	2 3 4 13	2.4.2 13.1.1 3.4.1 4.3.4	40%
	Quality of presentation and report	• Organization of the report/presentation • Clarity of language • Clarity of illustrations and Tables	10	10.3.2	20%
	Individual Evaluation				
	Presentation/ Communication skills	• Clarity of language • Technical Knowled	10	10.3.2	5%
	Viva Voce	• Demonstration of clear understanding of the concept	10	10.3.2	5%

Course Code: 19EEEC202

Course Title: Electrical Power Generation, Transmission & Distribution

L-T-P-Self Study: 3-0-0-0 **Credits: 3** **Contact Hrs: 40**

ISA Marks: 50 **ESA Marks: 50** **Total Marks: 100**

Teaching Hrs: 40 **Exam Duration: 3 hrs**

Content	Hrs
Unit - 1	
Chapter No. 1. Generating Stations. selection of Site, Classification, General arrangement and operation of Hydroelectric plant with components, General arrangement and operation of Thermal power plant with components, General arrangement and operation of Nuclear power plant with components, Safety of Nuclear power reactor, storing and processing of spent fuel.	5 hrs
Chapter No. 2. Substations and Economic operations Sub stations : Types, Bus-bar arrangement Schemes, location and substation equipment's Economics :Important terms and curves commonly used in system operation, effect of Voltage and frequency on loads , Scheduling of generators, Choice of size and number of generator units, Interconnection of power stations	5 hrs
Chapter No. 3.Typical Transmission & distribution systems Introduction, electric supply system, comparison of AC and DC systems, Standard Voltages of Transmission & Distribution. . Advantages of High Voltage Power Transmission. (effect of increase in voltage on weight of conductor, Line Efficiency & Line Voltage Drop) Feeders, Distributors & Service Mains. Conductor types.	2 hrs
Chapter No. 4. Overhead Transmission Line (Mechanical Design) Overhead transmission lines: introduction, components of a typical OH system. Line supports & placing of the conductors, single phase and three phase systems. Single circuit and double circuit.. Spacing of conductors, Length of span & Sag in OH lines. Sag calculation in conductors. (a) Suspended on level supports. (b) Supports at different levels. Effect of wind and ice. Tension and sag at erection. Corona Phenomena & Factors affecting corona in OH lines Expressions for Critical disruptive & visual critical voltage. and corona power loss	3 hrs
Unit - 2	
Chapter No. 5. Line parameters (Electrical Design) Introduction to transmission line constants i.e. Resistance, Inductance and capacitance . Distributed resistance of the transmission line, skin effect and proximity effect. Inductance of the single phase & three phase lines. Inductance calculation with equilateral and unsymmetrical spacing of the lines. Transposition of line conductors. Capacitance for single phase & three phase lines. Effect of earth on capacitance of the line. Numerical solutions on resistance calculations. Inductance & Capacitance calculations.	7 hrs
Chapter No. 6. Characteristics & Performance of Power transmission lines:	8 hrs

Introduction to Short transmission lines, calculations for short lines. Medium transmission lines. Nominal-T and □ representation for transmission lines Long transmission lines. Long line solutions by Rigorous method, equivalent models, ABCD constants. .	
Unit - 3	
Chapter No. 7. Insulators Materials of insulators. Different types of insulators. Potential distribution over a string of suspension insulators. String efficiency and methods of increasing string efficiency. Testing of insulators.	5 hrs
Chapter No. 8. Underground Cables Underground Cables: Types of cables & material used for Insulation. Resistance, thermal rating of cables & charging current, Grading of cables Capacitance grading and inter sheath grading, testing of cables.	5 hrs

Text Books

1. Skrotzki and Wavopat, Power station Engineering and economics ., McGraw Hill, 1995

References

1. Soni, Gupta and Bhatnagar, A Course in Electrical Power, Dhanpatrai, 2014
2. S M Singh, Electric Power generation , transmission and Distribution., Prentice Hall of India., 2012
3. J B Gupta., Transmission and Distribution of Electrical power., Kataria, 2012

V K Metha and Rohit Metha., Principles of Power System., S Chand & Company Ltd.,

Course Code: 19EEEC201 **Course Title: Circuit Analysis**

L-T-P-SS: 4-0-0 **Credits: 4** **Contact Hrs: 50**

CIE Marks: 50 **SEE Marks: 50** **Total Marks: 100**

Teaching Hrs: 50 **Exam Duration: 3 hrs**

Chapter No.	Unit-I	Hrs
1	**Network Equations :**Source Transformation, Star Delta transformation, Nodal Analysis, Super node, Mesh Analysis, Super mesh, Duality, Network Topology, Tie Set and Cut Set matrix formulation, Dot convention.	8 hrs
2	**Network Theorems :**Homogeneity, Superposition and Linearity, Thevenin's & Norton's Theorems, Maximum Power Transfer Theorem, Milman's theorem, Reciprocity principle, Application of theorems to both ac and dc networks	8 hrs
3	**Two Port Networks :**Two port variables, Z,Y, H,G, A- Parameter representations, Input and output impedance calculation, Series, Parallel and Cascade network connections, and their (suitable) models.	4 hrs
	Unit-II	
4	**First order circuits :**Order of a system, Concept of Time constant, System Governing equation, System Characteristic equation, Basic RL & RC circuit, Transient response with initial conditions , Frequency response characteristics, R-C , R-L circuits as differentiator and integrator models, time and frequency domain responses R-C , R-L circuits as Low pass and high pass filters	8 hrs
5	**Higher order circuits:** Higher order R-C, R-L, and R-L-C networks, time domain and frequency domain representation, Series R-L-C circuit, Transient response, Damping factor, Quality factor, Frequency response curve , Peaking of frequency curve and its relation to damping factor, Resonance Parallel, R-L-C circuit, Tank circuit, Resonance, Quality factor and Bandwidth	12 hrs
	Unit-III	
6	**Sinusoidal Steady state analysis :** Characteristics of sinusoids, Forced response to sinusoidal functions, The complex forcing function, Phasors & Phasor diagrams.	5 hrs
7	**Polyphase Circuits :** Polyphase systems, Single Phase three wire system, Three phase Y-Y connection, Delta connection, Analysis of balanced & unbalanced three phase circuits.	5 hrs

Text Books

1 W H Hayt, J E Kemmerly, S M Durban, Engineering Circuit Analysis, 6th, McGraw Hil, 2006
2 M E. Van Valkenburg, Network Analysis, 3rd, Pearson Ed, 2006

Reference Books:

1 Joseph Edminister, Mahmood Nahavi, Electric Circuits, 3rd, Tata McGra, 1991
2 Bruce Carlson, Circuits, 3rd, Thomson Le, 2002
3 V. K. Aatre, Network Theory and Filter Design, 2nd, Wiley West, 2002
4 Anant Agarwal and Jeffrey H Lang, Foundations of Analog & Digital Electronics Circuits, 3rd, Morgan Kau, 2006
5 Muhammad H . Rashid, Introduction to PSPICE using OrCAD for circuits and Electronics, 3rd, Pearson Ed, 2005

Course Code: 19EEEC203 **Course Title: Digital Circuits**

L-T-P-Self Study: 4-0-0 **Credits: 4** **Contact Hrs: 50**

ISA Marks: 50 **ESA Marks: 50** **Total Marks: 100**

Teaching Hrs: 50 **Exam Duration: 3 hrs**

Content	Hrs
Unit – 1	
Chapter No. 1. Logic Families Logic levels, output switching times, fan-in and fan-out, comparison of logic families	2 hrs
Chapter No. 2.Principles of Combinational Logic Definition of combinational logic, canonical forms, Generation of switching equations from truth tables, Karnaugh maps-3,4 variables, Incompletely specified functions(Don't care terms),Simplifying Maxterm equations, Quine-McCluskey minimization technique- QuineMcCluskey using don't care terms, Reduced Prime Implicant Tables.	8 hrs
Chapter No. 3.Analysis and design of combinational logic General approach, Decoders-BCD decoders, Encoders, Digital multiplexers- Using multiplexers as Boolean function generators. Adders and subtractors-Cascading full adders, Look ahead carry adders, Binary comparators.	10 hrs
Unit – 2	
Chapter No. 4.Introduction to Sequential Circuits Basic Bistable Element, Latches, A SR Latch, Application of SR Latch, A Switch De bouncer, The SR Latch, The gated SR Latch, The gated D Latch, The Master-Slave FlipFlops (Pulse-Triggered Flip-Flops): The Master-Slave SR Flip-Flops, The Master-Slave JK Flip-Flop, Edge Triggered Flip-Flop: The Positive Edge-Triggered D Flip-Flop, Negative- Edge Triggered D Flip-Flop; Characteristic Equations	10 hrs
Chapter No. 5. Analysis of Sequential Circuits Registers and Counters, Binary Ripple Counters, Synchronous Binary counters, Ring and Johnson Counters, Design of a Synchronous counters, Design of a Synchronous Mod-n Counter using clocked JK Flip-Flops Design of a Synchronous Mod-n Counter using clocked D, T or SR Flip-Flops.	10 hrs
Unit – 3	
Chapter No. 6. Sequential Circuit Design Introduction to Sequential Circuit Design, Mealy and Moore Models, State Machine notations, Synchronous Sequential Circuit Analysis, Construction of state Diagrams and counter design.	5 hrs

Chapter No. 7. Introduction to memories Introduction and role of memory in a computer system, memory types and terminology, Read Only memory, MROM, PROM, EPROM, EEPROM, Random access memory, SRAM, DRAM, NVRAM.	5 hrs

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

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

References

1. Charles H Roth, Fundamentals pf Logic Design, Thomson Learning, 2004
2. R.D.Sudhaker Samuel, Logic Design, Sanguine Technical Publishers, 2005
3. R P Jain, Modern Digital Electronics, Tata McGraw, 2000

Course Code: 19EEEC204 **Course Title: Electrical Machines**
L-T-P : 4-0-0 **Credits: 3** **Contact Hrs: 50**
ISA Marks: 50 **ESA Marks: 50** **Total Marks: 100**
Teaching Hrs: 50 **Exam Duration: 3Hrs**

Content	Hrs
Unit – 1	
Chapter 1: Transformers: Single phase transformer- Principle of operation and construction, Ideal transformer, Real transformer, Phasor diagrams, Equivalent circuit, Open-circuit test, Short-circuit test, Voltage regulation, Efficiency, Three phase transformers.	**09 hours**
Chapter 2: Three Phase Induction Machines: Principle of energy conversion in machines, Construction, Fundamental relationships- Slip, Rotor speed, Input power, Electromagnetic power, Electromagnetic (developed) torque, Mechanical power, Efficiency, Shaft torque. , Equivalent circuit, Analogies between induction machine and transformer, No-load and locked-rotor tests, Torque-speed characteristics, Starting, Speed control. Inverter fed induction motor.	**11 hours**
Unit – 2	
Chapter 3: DC Machines: Principle of operation, Construction of DC machine, Fundamental equations, Armature reaction, Classification of DC machines, DC generators, DC motors, Starting, Speed control of DC motors ,Braking, Switched Reluctance Machines-Construction, principle of operation , Aligned and unaligned positions, Electromagnetic torque, Advantages, disadvantages and Applications of SRMs, Steady state analysis of SRM. BLDC motor Construction and operation.	**12 hours**
Chapter 4: **Synchronous Machines:** Construction, Classification of synchronous machines, Electromotive force induced in armature winding, Generator and motor operation, Phasor diagrams of synchronous machine with Non-salient pole rotor and salient pole rotor, Voltage regulation calculation by EMF and MMF method, Synchronous motor, Synchronous motor as a synchronous condenser, Study of V and inverted V curves.	**08 hours**
Unit – 3	
Chapter 5: **Synchronous Machines:** Permanent magnet synchronous motors, Air gap magnetic flux density, Equivalent circuit of PM synchronous machine, Phasor diagram, Performance Characteristics of PM synchronous machine, Starting.	**05 hours**
Chapter 6: Single phase induction motors: Double revolving field theory, Equivalent circuit, Split-phase induction motor, Capacitor-start induction motor, Permanent split capacitor induction motor, Capacitor start capacitor-run induction motor, and Shaded pole induction motor.	**05 hours**

Text Book

1. Jacek F. Gieras, “Electrical Machines: Fundamentals of Electromechanical Energy Conversion”, CRC Press, Taylor & Francis Group, 2017.

References

1. P. C. Sen, “Principles of Electric Machines and Power Electronics”, John Wiley & Sons Publications, Canada, 2nd Edition, 2001.

2. Bhimbra, “Principles of Electrical machinery”, Khanna Publishers.2006.
3. Mehrdad Ehsani…[et al.],“Modern electric, Hybrid electric, and Fuel Cell Vehicles: fundamentals, theory, and design.”, CRC Press, 2005.
4. T. J. E.Miller, “Brushless Permanent-Magnet and Reluctance Motor Drives”, Oxford Science Publications, 1989.

Course Title: Signals and Systems

Course Code: 19EEEC205

Teaching Hrs.

L-T-P: 3-0-0 **Credits:3** **Contact Hours: 3Hrs/week**

ISA Marks: 50 **SEA Marks:50** **Total Marks: 100**

Teaching Hours: 40 Hrs **Examination Duration: 3 Hrs**

1.	**Chapter No. 1. Introduction and Classification of signals:** Definition of signal and systems. Sampling of analog signals, Continuous time and discrete time signal, Classification of signals as even, odd, periodic and non-periodic, deterministic and non-deterministic, energy and power. Elementary signals/Functions: exponential, sine, impulse, step and its properties, ramp, rectangular, triangular. Operations on signals: Amplitude scaling, addition, multiplication, differentiation, integration, time scaling, time shifting and time folding. Systems: Definition, Classification: linear and nonlinear, time variant and invariant, causal and non-causal, static and dynamic, stable and unstable, invertible.	8hrs
2.	**Chapter No. 2. Time domain representation of LTI System:** Definition of impulse response, convolution sum, convolution integral ,computation of convolution sum using graphical method for unit step to unit step, unit step to exponential, exponential to exponential, unit step to rectangular and rectangular to rectangular only. Properties of convolution.	7hrs
3.	**Chapter No. 3. Fourier Representation of Periodic Signals:** Fourier Representation of Periodic Signals: Introduction to CTFS and DTFS, definition, properties and basic problems.	5hrs
4.	**Chapter No. 4. Fourier Representation of aperiodic Signals:** FT representation of aperiodic CT signals, definition, FT of standard CT signals, Properties and their significance. FT representation of aperiodic discrete signals DTFT, definition, DTFT of standard discrete signals, Properties and their significance, Impulse sampling and reconstruction: Sampling theorem and reconstruction of signals.	10hrs
5.	**Chapter No. 5: Z-Transforms:** Introduction, the Z-transform, properties of the Region of convergence, Properties of the Z-Transform, Inversion of the Z-Transform, Implementation of discrete time of LTI systems.	10hrs

Text Book

Simon Haykin and Barry Van Veen, Signals and Systems –2nd Edition, John Wiley, 2004 .

Course code: 19EEEC301 **L-T-P: 2-0-1**
Course title: Machine Learning **CIE Marks: 50**
Teaching hours: 40 **ESA Marks: 50**

Chapter No.	Unit-I	
1	**Introduction** Introduction to Machine Learning, Applications of Machine Learning, Types of Machine Learning: Supervised, Unsupervised and Reinforcement learning, Dataset formats, Basic terminologies.	5 hrs
2	**Supervised Learning** Linear Regression, Logistic Regression Linear Regression: Single and Multiple variables, Sum of squares error function, The Gradient descent algorithm, Application, Logistic Regression, The cost function, Classification using logistic regression, one-vs-all classification using logistic regression, Regularization.	10 hrs
	Unit-II	
3	**Supervised Learning: Neural Network** Introduction to perception learning, Implementing simple gates XOR, AND, OR using neural network. Model representation, Gradient checking, Back propagation algorithm, Multi-class classification, Application- classifying digits, SVM.	10 hrs
4	**Unsupervised Learning: Clustering** Introduction, K means Clustering, Algorithm, Cost function, Application.	5 hrs
	Unit-III	
5	**Unsupervised Learning: Dimensionality Reduction** Dimensionality reduction, PCA- Principal Component Analysis. Applications, Clustering data and PCA.	4 hrs
6	**Introduction to Deep Learning** What is deep learning?, Difference between machine learning and deep learning, Convolution Neural Networks (CNN), Recurrent Neural Networks(RNN), When to use deep learning?	8 hrs

Text Books

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

Reference Books:

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

Course Title: Machines lab **Course Code: 19EEEP301**

L-T-P: 0-0-1 **Credits: 1** **Contact Hours: 2Hrs/week**

CIE Marks: 80 **SEE Marks: 20** **Total Marks: 100**

Laboratory Hours: 28Hrs **Examination Duration: 3Hrs**

Category: Demonstration	
Expt./ Job No.	**Experiment / Job Details**
1	Star and Delta Connected Lighting Loads
2	Open circuit characteristics of DC machine
3	Speed control of separately excited DC motor by armature voltage control and flux control
4	Synchronization of Alternator with Bus bar/ Parallel operation of Alternator
Category: Exercise	
Expt./ Job No.	**Experiment / Job Details**
1	To Conduct NO – LOAD & BLOCKED ROTOR test on a given Induction motor to a) Find the performance parameters b) Represent the motor by its equivalent circuit model referred to Stator or Rotor.
2	To Conduct Open Circuit and Short Circuit test on given single phase transformer to a) Calculate efficiency and voltage regulation at different loads & power factors. b) Draw the transformer equivalent circuit model.
3	Load test on 3Ø Induction motor
4	Three phase Transformer bank using three single phase transformers with different configurations of primary and secondary windings.
5	Speed control of Induction motor by V/f method
6	Performance study of synchronous motor with change in its excitation (V and Inverted V curves)
7	Voltage regulation of an Alternator by EMF and MMF method
Category: Structured Enquiry	
Expt./ Job No.	**Experiment / Job Details**
1	To develop the second order response surface methodology (RSM) based speed prediction model of DC shunt motor by conducting experiments as per Design of Experiments.(DOE)

Course Content Course Code: 19EEEC302 **Course Title: Electric Drives and Control**
L-T-P-S: 3-0-0 **CIE:50**
Teaching Hours: 40 **SEE:50**

Chapter 1. An introduction to Electrical Drives & its Dynamics: Electrical drives. Advantages of electrical drives. Parts of electrical drives, Choice of electrical drives, status of dc and ac drives, dynamics of electrical drives, fundamental torque equation, speed torque conventions and multi quadrant operation. Nature and classification of load torques, calculation of time and energy loss in transient operations..	**5 Hrs**
Chapter 2. D C Motor Drives: Starting braking, single phase fully controlled rectifier control of dc separately excited motor, Single-phase half controlled rectifier control of dc separately excited motor. Three phase fully controlled rectifier control of dc separately excited motor, three phase half controlled rectifier control of dc separately excited motor, multiquadrant operation of dc separately excited motor fed from fully controlled rectifier. Rectifier control of dc series motor, chopper controlled dc drives, chopper control of separately excited dc motor. Chopper control of series motor.	**10 Hrs**
Unit – II	
Chapter 3. Induction Motor Drives: Operation with unbalanced source voltage and single phasing, operation with unbalanced rotor impedances, analysis of induction motor fed from non-sinusoidal voltage supply, starting, braking, Stator voltage control, variable frequency control from voltage sources, voltage source inverter control, current source inverter control, current regulated voltage source inverter control, rotor resistance control, slip power recovery.	**10 Hrs**
Chapter 4. Synchronous Motor and Brushless dc Motor Drives: Operation from fixed frequency supply, synchronous motor variable speed drives, variable frequency control of multiple synchronous motors, self controlled synchronous motor drive, PMAC motor drives, brushless dc motor drives	**05 Hrs**
Unit – III	
Chapter 5. Stepper Motor and Swiched Reluctance Motor Drives: Stepper Motor: variable reluctance, permanent magnet, torque versus stepping rate characteristics drive circuits for stepper motors Switched Reluctance Motor: Operation and control requirements, converter circuits, modes of operation	**5 Hrs**
Chapter 6. Solar and Battery Powered Drives: Solar panels, motors suitable for pump drives, battery powered vehicles, solar powered electrical vehicles	**5 Hrs**

Text Book :

1. G. K Dubey, *"Fundamentals of Electrical Drives"*, 2nd ed., Narosa Publishing House, Chennai, 2002.

References

1. N. K. De and P. K. Sen, Electrical Drives, PHI, 2007
2. S. K. Pillai, A First Course On Electric Drives, Wiley Eastern Ltd, 1990
3. V. R. Moorthi, Power Electronics, Devices, Circuits & Industrial Applications, Oxford University Press, 2005

Course Code: 19EEEC303 **Course Title: Object Oriented Programming using C++**

L-T-P: 2-0-1 Credits: 3 Contact Hrs: 3

ISA Marks: 50 ESA Marks: 50 Total Marks: 100

Teaching Hrs: 40 Exam Duration: 03 hrs

Content	Hrs
Unit - 1	
Chapter 01: Introduction Principles of Object Oriented Programming, Procedure oriented and Object oriented Programming, Basic Concepts of OOP, Benefits and Applications of OOP, Beginning with C++, Simple C++ program, C++ with classes, Structure of C++ program, Creating, compiling and linking C++ programs.	4 hrs
Chapter 02: Classes and Objects Structures and Classes, Specifying a Class, Defining Member functions, C++ program with class, Access Specifiers, Scope Resolution Operators, Inline functions, Static Data Members, Static Member Functions, Friend Functions.	7 hrs
Chapter 03: Constructors and Destructors Introduction, Parameterized Constructors, Multiple Constructors, Copy Constructor, Dynamic Constructor, Destructors, Dynamic allocation of objects - new and delete operators.	4 hrs
Unit - 2	
Chapter 04: Inheritance Introduction, Defining Derived Classes, Types of Inheritance, Virtual Base Classes, Abstract Classes, Constructors in Derived Classes, Nesting of Classes.	6 hrs
Chapter 05: Virtual Functions and Polymorphism Pointers to objects, this pointer, Pointers to Derived classes, Virtual Functions. Pure Virtual Functions.	5 hrs
Chapter 06: Exception Handling Basics, Exception Handling Mechanism, Throwing, Catching and Rethrowing Exceptions.	4 hrs
Unit - 3	
Chapter 07: Function Overloading, Operator Overloading Function Overloading, Overloading Constructors, Defining operator Overloading, Unary and Binary operator overloading, Rules for overloading operators.	5 hrs
Chapter 08: Templates, STL Class Templates, Function Templates, Overloading of Template functions, Components of STL, Containers, Iterators, Application of Container Classes.	5 hrs

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

1. E.Balagurusamy, Object Oriented Programming with C++, 4th edition, Tata McGrawHill, 2008
2. Herbert Schildt, C++ The Complete Reference, Fourth Edition, Tata McGrawHill, 2003

References

1. Yashavant P. Kanetkar, Let Us C++, 1st, BPB Publications,
2. Stanley B.Lippmann, Josee Lajore, Barbara E. Moo, C++ Primer, 4th Edition, Pearson Education, 2005

Laboratory Title: **Power Electronics & Drives Laboratory** Lab. Code: **19EEEP302**
Total Hours: **24** Duration of SEE Hours: 3
SEE Marks: **20** CIE Marks: **80**

Category: Demonstration	
Expt./ Job No.	**Experiment / Job Details**
1	Forward and Flyback DC-DC Converter
2	Single phase full bridge inverter
3	Half controlled Rectifier feeding R and RL load
4	Introduction to STEmbed Model based design and C-code generation for Power Electronics & Drives Application using TI's DSPs.
Category: Exercise	
Expt./ Job No.	**Experiment / Job Details**
1	Three phase full bridge controlled rectifier fed DC motor drive.
2	Fully controlled bridge rectifier feeding R and RL load
3	VSI based open loop volts/hertz control of three phase induction motor drive.
4	ADC, PWM pulse Generation and PI Controller design for PE and Drives application using STEmbed and TI's DSPs.
Category: Structured Enquiry	
Expt./ Job No.	**Experiment / Job Details**
1	To design, simulate and experimentally verify given drive system to meet defined specifications.

Course Code: 19EEEC401 **Course Title: Power System Modeling, Operation & Control**

L-T-P: 3-0-0 Credits: 3 Contact Hrs: 40

CIE Marks: 50 SEE Marks: 50 Total Marks: 100

Teaching Hrs: 40 Exam Duration: 3 hrs

Chapter No.	**Unit-I**	
1	**Formation of network matrices :**Multi-port power system representation, performance equations in bus frame of reference, definitions of Network models Y_{bus} and Z_{bus}, Primitive element representations, primitive performance equations,. Formation of Ybus by method of Inspection, Introduction to graph theory-definitions of terms, Bus incidence matrix, Ybus by the method of singular transformation, Examples on Ybus formation by singular transformation (with no mutual coupling) and Inspection method, Zbus building algorithm-addition of uncoupled branches and links, modification of Zbus for changes in elements not mutually coupled, Examples on Zbus formation	8 hrs
2	**Optimal load dispatch :** Importance and objective of economic load dispatch, Fuel cost and Incremental fuel cost, Optimal load allocation between plants neglecting transmission losses, Examples on optimal load allocation with and without generation constraints, Optimal load allocation considering transmission losses, General transmission loss formula, Examples.	7 hrs
	Unit-II	
3	**Load flow analysis :**Importance of Power flow, Classification of busses, General steps in load flow analysis, Off-nominal ratio tap changing ratio transformer representation. Bus voltage solution by Gauss and Gauss-Seidel methods without PV buses, Handling PV buses in Gauss-Seidel method, N-R load flow model in polar coordinates, formation of NR Jacobian, Introduction to FDLF load flow model, Comparison of Gauss-Seidel, NR and FDLF load flow methods, Examples on one iteration of load flow solution.	8 hrs
4	**Load frequency control :**Introduction to load frequency control problem, Working principle of speed governor, Model of isolated power system area –block diagram representation, Expression for steady-state frequency deviation, Parallel operation of generators –expression for operating frequency and load sharing,, two area load frequency control, steady-state operation of multi-area system under free governor operation, Examples on load sharing between areas.	7 hrs
	Unit-III	
5	**Reactive power and voltage control :** Power flow through a line, Relation between voltage, power and reactive power at a node, Brief descriptions of methods of voltage control-by injection of reactive power and tap changing transformer. Generator reactive power control by AVR-simplified AVR system model, AVR response.	5 hrs
6	**Power System Simulations:** Simulation of automatic generation control, simulation of small signal stability of a SMIB power system, Transient stability simulation of SMIB power system using trapezoidal integration, simulation of classical economic load dispatch Algorithm	5 hrs

Text Books

1 Stagg and El-Abid, Computer Methods in power system analysis, First Edition, Mc-Graw Hill, 1968

2 Kothari and Nagarath, Modern power system analysis, 3rd Edition, Tata McGraw Hill, 2004

Reference Books:

1 P. Kundur, Power system stability and control, First Edition, Tata McGraw Hill, 2007

2 Hadi Sadat, Power System analysis, Ed. First Edition, Tata McGraw Hill, 2002

3 A.R. Bergen and Vijay Vittal, Power system analysis, Ed. First Edition, Pearson Ed, 2009

Laboratory Title: Power System Simulation Lab **Lab. Code: 19EEEP401**

Credits: L-T-P: 0-0-1 **Credits: 1** **Duration of SEE Hours: 2**

SEE Marks: 20 **CIE Marks: 80**

Experiment wise Plan

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

Category: Demonstration	
Expt./ Job No.	Experiment / Job Details
1	To use interactive simulation software “SofTCAPS” for the simulation of (i)Load flow analysis by Gauss-Seidel and NR models (ii) Voltage control analysis by shunt capacitor and tap changing transformer (iii) P-V Curve at a load bus
2	To use interactive software "SofTCAPS" for the simulation of Economic load dispatch problem with and without coordinating the transmission losses
Category: Exercise	
Expt./ Job No.	Experiment / Job Details
3	To form bus admittance matrix [Ybus] by singular transformation.
4	To form [Ybus] by the method of inspection
5	ABCD constants and line performance using short and medium π/T models
Category: Structured Enquiry	
Expt./ Job No.	Experiment / Job Details
6	Each batch (consisting of 4 students) will work on one problem from the below mentioned sets, obtain the simulation results, carry out the analysis, interpret the results, draw practical conclusions from them and prepare a report. (a) To formulate and develop MATLAB/Scilab program/ SIMULINK model on one of the power problem which include, but not limited to - Load frequency control method, Study to determine the effect of excitation on dynamic stability, Comparison of various numerical techniques for stability study, Multimachine transient stability study, Load flow model development, (b) To employ an interactive power system software to simulate a given problem such as multimachine transient stability, multimachine small signal stability, contingency analysis, performance comparison of various load flow models, economic load dispatch etc.

Laboratory Title: Relay and High Voltage Engineering lab **Lab. Code: 19EEEP402**

Total Hours: **32** **Credits: L-T-P: 0-0-1** **Credits: 1** **Duration of SEE Hours: 2**

SEE Marks: 20 **CIE Marks: 80**

Expt./ Job No.	Experiment / Job Details	
Category: Exercise		
1	Introduction Session	2 hrs
2	To obtain the inverse time characteristics of a given fuse wire and wires of different lengths.	2hrs
3	To obtain the inverse time characteristics of an electromagnetic over current relay	2hrs
4	To obtain the operating characteristics of microprocessor based differential relay.	2hrs
5	To obtain the operating characteristics of microprocessor based directional over current relay.	2hrs
6	To obtain the breakdown strength of air using Copper sphere gap with HVAC and HVDC.	2hrs
7	a) To obtain the breakdown strength of air using different pairs of electrode gap with HVAC and HVDC. b) To obtain the breakdown voltage of a solid dielectric. c) To obtain the breakdown voltage of a liquid dielectric.	2hrs
Category: Structured Enquiry		
1.	To develop microcontroller based overcurrent, over voltage and impedance relay using CT /PT giving details of program and demonstrate it's working output.	4hrs