



SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY

(DEEMED TO BE UNIVERSITY)

Accredited A++ Grade by NAAC | 12B Status by UGC | Approved by AICTE

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School of Electrical & Electronics

Department of Electrical & Electronics Engineering

1.1.3 Courses having focus on Employability / Entrepreneurship / Skill Development

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Employability

Entrepreneurship

Skill Development

SEEA7017	SIMULATION OF POWER ELECTRONIC SYSTEMS	L	T	P	Credits	Total Marks
		0	0	4	2	100

COURSE OBJECTIVES

- Understand the Need and Challenges of Simulation.
- Develop and Analyze Mathematical Models.
- Simulate Systems Using SIMULINK.

UNIT 1 INTRODUCTION 9 Hours

Need for simulation - Challenges in simulation - Powerful simulation tools. - Overview of Pspice, MATLAB and SIMULINK. Mathematical Modeling of Power Electronic Systems: Static and dynamic models of power electronic switches - Develop static and dynamic models for power electronic switches, and formulate static and dynamic equations. Represent power electronic systems using state space methods.

UNIT 2 PSPICE 9 Hours

File formats - Description of circuit elements - Circuit description - Output variables - Dot commands - SPICE models of Diode, Thyristors, Triac, BJT, Power MOSFET, IGBT and Power S-Functions - Converting S-Functions to blocks.

UNIT 3 MATLAB AND SIMULINK 9 Hours

MATLAB - Intro Variables - Matrix representation and operation, Trigonometric functions, Logical relations, Exponential Complex Numbers - m file - Function - For loop - While - If else. Create and customize 2D plots for data visualization. SIMULINK, including basic blocks, sources, and sinks. model analysis using SIMULINK - S-functions - converting S-functions to blocks.

UNIT 4 INTRODUCTION TO PSIM 9 Hours General

Information - Power Circuit Components - Control Circuit & Other Components - Analysis specification - Circuit Schematic Design - Waveform Processing - Error and Warning messages

UNIT 5 SIMULATION USING PSPICE, PSIM, MATLAB AND SIMULINK 9 Hours

Diode rectifiers - controlled rectifiers - AC voltage controllers - DC choppers - PWM inverters - voltage source and current source inverters - Resonant pulse inverters - Zero current switching and zero voltage switching inverters.

COURSE OUTCOMES :

On completion of the course, student will be able to

CO1 - Comprehend the Importance and Applications of Simulation:

CO2 - Develop proficiency in using these tools for mathematical modeling and simulation.

CO3 - Formulate static and dynamic models for power electronic switches

CO4 Utilize PSPICE for Circuit Simulation.

CO5 - Implement MATLAB for Numerical Computations.

CO6 - Perform comprehensive model analysis and convert S-functions into SIMULINK blocks.

REFERENCES

1. Rashid, M.H., - SPICE for Power Electronics and Electric Power II, 3rd Edition, CRC Press, 2012.
2. Ned Mohan, - Power Electronics, Computer Simulation Analysis and Education using Pspice, Minnesota Power Electronics Research and Education, USA, 1992.
3. Chee-Mun-Ong, - Dynamic simulation of Electric Machinery using MATLAB/SIMULINK II, Prentice Hall PTR, 2003.
4. - The Pspice User's Guide II, Microsim Corporation, California 5. MATLAB simulink - user manual 6. PSIM user manual

SEEA7016	Advanced Optimization Technique	L	T	P	Credits	Total Marks
		0	0	4	2	100

COURSE OBJECTIVES

- Formulate complex optimization problems and choose appropriate solution methods.
- Understand the theoretical foundations of various advanced optimization techniques.
- Implement optimization algorithms and apply them to real-world problems.
- Analyze the performance and convergence of optimization algorithms

UNIT 1 INTRODUCTION

9 Hours

Introduction to Optimization- Types of optimization problems Real-world applications Concept of System and State- Performance Measure- Design Constraints- Condition for Optimality- Formulation of Objective Function-Classification of Optimization Problem Review of linear programming- Formulation of linear program- Feasible regions and solutions Simplex method and duality

UNIT 2 NONLINEAR OPTIMIZATION TECHNIQUES

9 Hours

Optimization Techniques- Single Variable and Multi-Variable Optimization Techniques and Unconstrained Minimization- Golden section- Random Pattern and Gradient Search Methods- Interpolation Methods- Optimization with Equality and Inequality Constraints- Direct Methods- Indirect Methods using Penalty Functions- Lagrange Multiplier Geometric Programming and Stochastic Programming-KKT Conditions-Derivation and significance

UNIT 3 GENETIC ALGORITHM

9 Hours

Introduction to Evolutionary Computing- Genetic Algorithm- Biological Inspiration –Finer Evaluation- Selection methods- Reproduction- Genetic Operators- Cross Over- Mutation- Schema Processing- Fitness Scaling Advanced Genetic Operators and Techniques in Genetic Search Constrained Genetic Algorithms- Penalty Functions- Multi Objective Optimization- Applications in Pattern Recognition Computers, Communication and Signal Processing.

UNIT 4 IMULATED ANNEALING

9 Hours

Simulated Annealing- Algorithm- Initial Solution- Assess Solution Randomly Tweak Solution- Acceptance Criteria- Temperature Schedule Adjusting Algorithm Parameters-Application

ANT COLONY OPTIMIZATION AND TABU SEARCH

9 Hours Ant Colony

Optimization – Ant Algorithm- Natural Motivation- Initial Population- Ant Movement- Ant Town- Pheromone Evaporation – Adjusting Algorithm Parameters- α / β / ρ - Number of Ants- Applications- Routing- Shortest Term Problem. Tabu Search Principles- Short Term Memory- Long Term Memory- Tabu Thresholding- Special Dynamic Tabu Tenure Strategies- Hash Function.

COURSE OUTCOMES :

On completion of the course, student will be able to

CO1 - Comprehend the concepts of system and state, performance measures, design constraints, and conditions for optimality.

CO2 – Apply the simplex method and understand duality theory, including the dual simplex method, to solve linear programming problems.

CO3 – Solve optimization problems with equality and inequality constraints using direct methods and penalty functions.

CO4 - Utilize advanced genetic operators, fitness scaling, and techniques for genetic search, including constrained genetic algorithms and penalty functions.

CO5 - Adjust algorithm parameters to optimize performance and apply simulated annealing to practical optimization problem.

CO6 - Master the principles of tabu search, including short-term and long-term memory, tabu thresholding, special dynamic tabu tenure strategies, and hash functions.

Text Book

1. Kalyonmoy Deb, — Optimization for Engineering DesignII, 2 nd Edition, Prentice Hall of India, 2012.
2. Pierre. D.A., — Optimization Theory with ApplicationsII, John Wiley, 1969.
3. Rao.S.S. — Optimization Theory and ApplicationsII, Wiley Eastern Ltd., 1979.
4. David.E.Goldberg, — Genetic Algorithms in Search, Optimization and Machine LearningII, International Student Edition, Addison Wesley Ltd., 1999.
5. Fred Glover, Manuel Laguna, — Tabu SearchII, Kluwer Academic Publishers, 1997.
6. Tim Jones.M, — Artificial Intelligence Application ProgrammingII, Dreamtech Press, 2003, New Delhi.
7. Sin Giresu. S. Rao, — Engineering OptimizationII, John Wiley and Sons, 2009.

Employability

Entrepreneurship

Skill Development

SEEA1702	PRINCIPLES OF EMBEDDED SYSTEM DESIGN	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- 8 bit RISC microcontroller.
- ARDUINO
- ARM Processor
- Real time operating system.

UNIT 1 RISC EMBEDDED CONTROLLER

9 Hrs.

Comparison of CISC and RISC controllers - PIC 16F877 architecture - Memory organization - Addressing modes - Assembly language instructions.

UNIT 2 ARDUINO

9 Hrs.

Introduction to ARDUINO, Architecture, overview of its I/O Ports, Serial Ports, PWM, ADC, Interfacing with different type of Sensors and Communication modules, Hardware timers, watchdogs and interrupt handling in Arduino. Controlling embedded system based devices using Arduino.

UNIT 3 ARM PROCESSOR BASED SoC and SoM

9 Hrs.

Overview of ARM 7 Architecture- Overview of Intel ARM based hard processor System on Chip (SoC) with an on chip FPGA - Overview of System on Module (SoM) using ARM based SoC- Fundamentals of ARM instructions, Barrel shifter, Classification and explanation of instructions with examples-Data processing, Branch, Load-store, SWI and Program Status Register instruction.

UNIT 4 EMBEDDED NETWORKING

9 Hrs.

Embedded Networking: Introduction, I/O Device Ports & Buses- multiple interrupts and interrupt service mechanism – Serial Bus communication protocols -RS232 standard-RS485-USB-Inter Integrated Circuits (I2C)- Serial Peripheral Interface (SPI) -CAN Bus –Wireless protocol based on Wifi , Bluetooth, Zigbee – Introduction to Device Drivers-Distributed Embedded system

UNIT 5 EMBEDDED SOFTWARE DEVELOPMENT TOOLS and REAL TIME OPERATING SYSTEM

9Hrs.

Introduction to assembler - Compiler -Cross compilers -Linker/ Locators - Simulators - RTOS - Desktop OS versus RTOS - Software architectures - Round Robin, Round-Robin with Interrupts, Function Queue Scheduling architecture - ISRs and Scheduling -Task management - Task scheduling - Race conditions - Priority Inversion — Inter task Communication-Interprocess Communication – synchronization between processes-semaphores, Mailbox, pipes, priority inversion, priority inheritance, comparison of Real time Operating systems: VxWorks, uC/OS-II, RT Linux.

Max. 45 Hrs.

COURSE OUTCOMES :

On completion of the course, student will be able to

CO1 - Analyze the architecture, functionalities of PIC 16F877A Microcontroller and apply for addressing the Engineering problems.

CO2 – Develop knowledge and skills required to develop an real time embedded system using ARDUINO for addressing Engineering problems

CO3 – Analyze the architecture of ARM processor and concepts of SoC and SoM.

CO4 - Analyse the various standards and protocols used for embedded interfaces.

CO5 - Analyze various embedded software development tools.

CO6 - Evaluate the concept of RTOS in real time embedded system.

TEXT / REFERENCE BOOKS

1. Muhammed Ali Mazidi, Rolin D.Mckinlay, Dannycaskey, "PIC microcontrollers and embedded systems using assembly and C", 1st edition, Pearson, 2007.
2. Rajesh Singh, Anita Gehlot, Bhupendra Singh, and Sushabhan Choudhury," Arduino-Based Embedded Systems, CRC Press; 1 edition, November 2017.
3. Ashwin Pajankar, ARDUINO MADE SIMPLE: With Interactive Projects, BPB Publications, 2018.
4. Raj Kamal, "Embedded system-Architecture, Programming, Design", Tata McGraw Hill, 2011.
2. Sriram. V. Iyer, Pankaj Gupta, "Embedded Real Time Systems Programming", 2004 Tata McGraw Hill Publishing Company Limited, 2006.
3. Frank Vahid, Tony Givargis, 'Embedded system Design - A unified Hardware / software Introduction', John Wiley and Sons, 2002.
4. Todd D Morton, 'Embedded Microcontrollers', Reprint by 2005, Low Price Edition.
5. Muhammed Ali Mazidi, Janice Gillispie Mazidi, 'The 8051 Microcontroller and Embedded Systems', Low Price Edition, Second Impression 2006.
6. <https://www.intel.com/content/dam/www/programmable/us/en/pdfs/literature/wp/wp-01167-custom-arm-soc.pdf>

Employability

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7. <https://www.arm.com/resources/guide/designing-soc-with-cortex-m>
 8. <https://www.microchip.com/design-centers/32-bit-mpus/sip-som/system-on-module>

SEEA3004	FLEXIBLE AC TRANSMISSION SYSTEM	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To attain detailed knowledge in various reactive power compensators.
- To understand Thyristor Controlled Series Capacitor concepts.
- To attain the knowledge of series and shunt compensation.
- To analyze the behavior of STATCOM, UPFC and IPFC.
- To understand the implementation of FACTS controllers in improvement of power system performance.

UNIT 1 INTRODUCTION

9 Hrs.

Electrical Transmission Network, Emerging Transmission Network, Concept of Reactive Power, Load and System Compensation, Midpoint Voltage, Passive Compensation, Synchronous Condenser, Saturated Reactor, Classification of FACTS controllers.

UNIT 2 SHUNT COMPENSATION

9 Hrs.

Thyristor Controlled Reactor (TCR), Thyristor Switched Reactor (TSR), Thyristor Switched Capacitor (TSC), Fixed Capacitor- Thyristor Controlled Reactor (FC-TCR), Thyristor Switched Capacitor-Thyristor Controlled Reactor (TSC -TCR), V-I Characteristics of Static Var Compensator (SVC), Advantages of slope in dynamic Characteristic, Voltage control by SVC.

UNIT 3 THYRISTOR CONTROLLED SERIES CAPACITOR (TCSC)

9 Hrs.

Fixed Series Compensation, Need for Variable Series Compensation, TCSC: Basic principle, Modes of Operation, Advantages, Capability Characteristic, Variable Reactance Model, Application: Open loop & Closed loop Control.

UNIT 4 EMERGING FACTS CONTROLLER

9 Hrs.

Static Synchronous Compensator (STATCOM): Introduction, Principle of Operation, V-I Characteristic, Multilevel VSC based STATCOM, SSSC: Principle of Operation, Unified Power Flow Controller (UPFC): Principle of Operation, Interline Power Flow Controller (IPFC): Principle of Operation.

UNIT 5 SUB SYNCHRONOUS RESONANCE (SSR)

9 Hrs.

Concept of SSR, NGH-SSR Damping scheme: basic concept, design and operation aspect, Thyristor Controlled Braking Resistor (TCBR), Advanced Series Capacitor (ASC): Basic concept, Design and operation aspect.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Analyze different types of FACTS Controllers.
- CO2 - Examine the performance of various Shunt Compensators.
- CO3 - Analyze the impact of Thyristor Controlled Series Capacitor for open loop and closed loop applications.
- CO4 - Analyze the functional operation and control of Emerging FACTS controllers with voltage source and current source inverters.
- CO5 - Analyze the significance of SSR in Power System network.
- CO6 - Design Advanced Series Capacitor.

TEXT / REFERENCE BOOKS

1. R. Mohan Mathur and Rajiv K. Varma, "Thyristor based FACTS controllers for electrical transmission systems", IEEE Press John Wiley & Sons Inc. Publication, 2002.
2. Narin G. Hingorani and Laszlo Gyugi, "Understanding FACTS", IEEE Press Standard Publishers Distributors, 2001.
3. K.R. Padiyar, "FACTS controllers in power transmission and distribution", New Age International Publishers, 2009.

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4. Xiao-Ping Zhang, Chrysitan Rehtanz and Bikash Pal, "Flexible AC Transmission Systems Modelling and Control", Springer International Publishers, 2015.

5.

SEEA3001	POWER GENERATION AND UTILIZATION	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- To understand the general power generation concepts.
- To understand the general electrical utilization concepts.
- To study the performance and efficiency of power generation.

UNIT 1 CONVENTIONAL POWER PLANTS

10 Hrs.

Layout and working of diesel, steam, low and high head power plants-pumped storage plants-principle of nuclear power generation - types and layouts of nuclear reactors- boiling water reactor- advanced gas cooled reactor- fast breeder reactor - reactor control - waste disposal.

UNIT 2 ECONOMICS OF GENERATION

8 Hrs.

Introduction-Definitions-Load Duration Curve-Number and size of Generator Units-Base Load and Peak Load Plants-Cost of Electrical Energy-Fixed cost-Running Cost of Energy-Tariff or Charge to Consumer.

UNIT 3 ILLUMINATION

10 Hrs.

Nature of radiation - definition-laws-lighting calculations-polar curves-Rousseau construction- design of Illumination Systems-Flood Lighting and Calculations-Street Lighting-Classification of Light Sources-Incandescent lamps- gas discharge lamps- sodium vapour, mercury vapour, Fluorescent Lamps and LED lamps.

UNIT 4 HEATING AND WELDING

8 Hrs.

Introduction - methods of heating - design of heating element- resistance, inductance, arc furnaces- high freq. dielectric heating- welding - types- resistance, arc welding- construction and its characteristics.

UNIT 5 ELECTRIC TRACTION

9 Hrs.

Introduction - requirements of an ideal traction Train Movement-Speed-Time Curve- mechanics of train movement - tractive effort calculations- Power and energy output from driving axles-Traction motors and its Characteristics-Traction motor control-Current collection systems.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 – Apply the ideas of conventional power generation methods
- CO2 - Evaluate the number and size of generator units and base load and peak load
- CO3 - Design of Illumination systems and working of types of Lighting
- CO4 – examine various methods of Heating and Welding
- CO5 – Analyze the concept of Electric traction systems
- CO6 – Examine the principle of a Traction motor

TEXT / REFERENCE BOOKS

1. C.L.Wadhwa, "Generation, Distribution & Utilisation of Electrical Energy", New Age International Publishers, New Delhi, Reprint 2016.
2. Uppal.S.L. "Electrical Power", Khanna Publishers, 9th Edition, 2001.
3. J.B. Gupta, "Utilization of Electric Power and Electric Traction", Kataria & Sons publishers, Delhi, 9th Edition, 2004.
4. B.R.Gupta, "Generation of Electrical Energy", S. Chand Limited, 2009.
5. R.K.Rajput, "Utilization of Electrical power", Laxmi Publications, 2006.
6. Leonard L.Grigsby, "Electric power generation, transmission and Distribution", CRC Press, Taylor and Francis Group, 2012.
7. S.Sivanagaraju, M.Balasubba Reddy and D.Srilatha, "Electric Energy-Generation, Utilization and Conservation" Pearson, 2012.

SEEA1701	POWER SYSTEM PROTECTION AND SWITCHGEAR	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To discuss the cause and effect of abnormal operating conditions in a power system and the protective schemes along with the problems associated with circuit interruptions.
- To understand construction, operation and characteristics of various electromagnetic and static relays.
- To introduce apparatus protection for transformer, alternator, induction motor, transmission line and bus bar.
- To understand the arc quenching theories and operations of various types of circuit breakers and their ratings.

UNIT 1 INTRODUCTION DRIVES

8 Hrs.

Essential requirements of protection - Nature and causes of faults - Types of faults - Effects of faults - Zones of protection - Protection schemes - CTs and PTs and their applications - Basic relay terminology.

UNIT 2 PROTECTIVE RELAYS

10 Hrs.

Electromagnetic relays - Operating principle - Torque equation - Relay characteristics - Over current relay, Directional relay, Distance relay, Differential relay, Negative sequence relay, Amplitude and Phase comparator of over current static relays, Duality between comparators - Microprocessor based over current relay.

UNIT 3 APPARATUS PROTECTION

9 Hrs.

Protection of Generator - Stator & Rotor protection - Large Motor protection - Transformer protection - Bus bar Protection - Transmission line protection.

UNIT 4 THEORY OF ARC QUENCHING

9 Hrs.

Arcing phenomena - Theory and methods of arc quenching - Recovery voltage - Restriking voltage - RRRV - Resistance switching - Current chopping - Capacitive current breaking - Characteristics of fuses - HRC fuse.

UNIT 5 CIRCUIT BREAKERS

9 Hrs.

Classification of circuit breakers - Air circuit breakers - Oil circuit breakers - Vacuum circuit breaker - SF6 circuit Breakers - Selection of circuit breakers - Rating of circuit breakers - Testing of circuit breakers.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1- Categorize various faults, their effects on power system and need of protection.
- CO2 - Analyze the various electromagnetic and static relay used in power system.
- CO3 - Design appropriate relay for various power system apparatus.
- CO4 - Investigate various Arc quenching technique for power system protection.
- CO5 - Evaluate the effectiveness of various circuit breakers with respect to Arc quenching.
- CO6 - Examine the characteristics, rating and testing of circuit breakers.

TEXT / REFERENCE BOOKS

1. L.G.Hewitson, Mark Brown, Ben Ramesh and Ramesh Balakrishnan, "Practical Power System Protection", Newnes Publications, Oxford, 2005.
2. Sunil S.Rao "Switchgear and protection", Khanna Publishers, New Delhi, 2008.
3. Badri Ram and D.N.Vishwakarma "Power System Protection and Switchgear", Tata McGraw Hill Publishing, New Delhi, 2005.
4. Soni, Gupta and Bhatnagar "A Course in Electrical power", Dhanpat Rai & Sons, New Delhi, 2010.

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5. TSM Rao, "Digital Numerical Relays", Tata McGraw Hill publishing, New Delhi, 2005.
6. B.Ravindranath and N.Chander, "Power System Protection and Switchgear", New Age International (P) Ltd, 2005.

SEEA1601	ELECTRICAL MACHINE DESIGN	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- To impart knowledge about engineering materials, calculation of mmf for air and iron path for rotating machines.
- To impart knowledge in design of armature and field system of DC machines.
- To impart knowledge in design of core, yoke, windings and cooling systems of transformer.
- To impart knowledge in design of stator and rotor of induction machines.
- To impart knowledge in design of stator and rotor of synchronous machines.

UNIT 1 INTRODUCTION

9 Hrs.

Major considerations in Machine design - Limitations in design - Standard specifications - Electrical Engineering materials - High conductivity materials - Insulating materials - Magnetic circuit calculations - mmf for airgap and iron path - real and apparent flux densities in rotating machines - **Choice of specific electric and magnetic loadings.**

UNIT 2 DC MACHINES

9 Hrs.

Output equation - Main Dimensions - Choice of number of poles - Armature design - Estimation of number of conductors / turns - Coils armature slots- Conductor dimensions - Slot dimension - **Design of field poles and field coil (shunt field) - Design of Commutators and Brushes.**

UNIT 3 TRANSFORMERS

9 Hrs.

Output equation - Design of core and winding of single phase shell and core type transformer and three phase transformers - Temperature rise in transformers - **Design of tank, cooling tubes and Ducts.**

UNIT 4 INDUCTION MOTORS

9 Hrs.

Output equation, Main dimensions, Design of stator, Choice of L/D ratio - Air gap length - **Design of rotor - Squirrel cage and Slip ring rotor.**

UNIT 5 SYNCHRONOUS MACHINES

9 Hrs.

Output equation - Design of salient pole rotor machine - Dimensions - Short circuit ratio - Effect of Short Circuit ratio - Air gap length - **Armature design - Slot dimensions - Rotor design - Design of damper winding - Design of cylindrical rotors.**

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Analyze the mmf for rotating machines based on the major considerations.
- CO2 - Apply the design procedure for DC machines.
- CO3 - Analyze the design procedure for core, yoke, winding and cooling systems of transformer.
- CO4 - Analyze the design procedure for stator and rotor of induction machines.
- CO5 - Analyze the design procedure for stator and rotor of synchronous machines.
- CO6 - Design various machine components for specific application.

TEXT / REFERENCE BOOKS

1. A.K.Sawhney, A.Chakrabarti, "A course in Electrical machine Design", Dhanpat Rai and Sons, New Delhi, 6th Edition, 2010.
2. Albert E. Clayton and NN Hancock, "The performance and Design of Direct Current Machines", Oxford and IBH Publishing Co. Pvt.Ltd., New Delhi, Edition 2004.
3. A.Nagoorkani, "Electrical Machine Design", RBA Publications, 2nd Edition, 2014.
4. R.K.Agarwal, "Principles of Electrical Machine Design", 5th Edition, S.K.Kataria & Sons. 2014.

SEEA1501	POWER SYSTEM ANALYSIS	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- To impart knowledge in modelling of power system elements.
- To implement Numerical methods in power flow problem.
- To analyze the system in various fault conditions.
- To have a knowledge in stability of power systems.

UNIT 1 POWER SYSTEM MODELING**9 Hrs.**

Need for system analysis in planning and operation of power system - per phase analysis of symmetrical three-phase system. General aspects relating to power flow, short circuit and stability analysis - Modeling of generator, load, shunt capacitor, transmission line, shunt reactor for short circuit, power flow and stability studies -per unit representation - bus admittance by analytical method and direct inspection method.

UNIT 2 POWER FLOW ANALYSIS**9 Hrs.**

Problem definition - bus classification - derivation of power flow equation - solution by Gauss Seidel and Newton Raphson methods by polar form - P V bus adjustments for both methods - computation of slack bus power, line flow and transmission loss.

UNIT 3 SYMMETRICAL SHORT CIRCUIT ANALYSIS**9 Hrs.**

Need for short circuit study - Bus impedance matrix formation - Symmetrical short circuit analysis using Z-bus. - computations of short circuit capacity, post fault voltage and current.

UNIT 4 UNSYMMETRICAL SHORT CIRCUIT ANALYSIS**9 Hrs.**

Symmetrical component transformation - sequence impedances.- Sequence Networks - unsymmetrical short circuit analysis for single line fault, line to line fault and double line to ground fault using Z-bus - computations of short circuit capacity, post fault voltage and current.

UNIT 5 STABILITY & SECURITY ANALYSIS**9 Hrs.**

Distinction between steady state and transient state - Concepts of Stability & Security - Swing equation-solution to swing equation - step by step method - power angle equation - equal area criterion - critical clearing angle and time. Stability analysis of single machine connected to infinite bus by modified Euler's method - Multi-machine stability analysis using Runge Kutta method.

Max. 45 Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1 - Model Impedance and Reactance networks for the given power system Network and formulate bus admittance matrix.
- CO2 - Apply Y Bus in load flow analysis and examine the power flows and voltages in a power grid.
- CO3 - Formulate bus impedance matrix and apply Z Bus in symmetrical short circuit analysis and evaluate the fault currents and post fault voltages.
- CO4 - Model sequence networks and apply Z Bus in unsymmetrical short circuit analysis and evaluate the fault currents and post fault voltages.
- CO5 - Analyze the transient and steady state stability conditions.
- CO6 - Solve transient stability problems.

TEXT / REFERENCE BOOKS

1. John J. Grainger and Stevenson Jr. W.D., "Power System Analysis", Tata McGraw Hill, 2017.
2. Kothari .D.P and Nagarath.I.J., "Power system Engineering", 2nd Edition, Tata McGraw Hill, 2011.
3. Pai. M.A," Computer Techniques in Power System Analysis", Tata McGraw-Hill Publishing Company Limited, New Delhi, 2006.
4. Nagarath, I.J. and Kothari, D.P., "Modern Power System Analysis", 4th Edition, Tata McGraw Hill Publishing Company, 2011.
5. Hadi Saadat, "Power system Analysis", Tata McGraw Hill Publishing Company, 3rd Edition, 2011.

SEEA1502	CONTROL SYSTEMS	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- To impart knowledge regarding the various types of system and different transfer function analyzing techniques associated with control systems.
- To analyze the response and error of various types of system in time domain.
- To understand the stability analysis of frequency domain systems.
- To analyze the open loop system in frequency domain.
- To implement the design of controllers and compensators.

UNIT 1 SYSTEM CONCEPTS

10 Hrs.

Types of System - Open Loop Systems, Closed Loop Systems, Basic Elements in Control System - Mathematical Models of Physical System: Differential Equation- Transfer Functions of Single Input, Single Output and Multi Variable Systems - Simple Electrical Networks, **Electrical Analogous of Mechanical Translational and Rotational System** - D.C and AC Servomotor - Mechanical System- Translational and Rotational System - Block Diagram Reduction Techniques - Signal Flow Graphs - Mason's Gain Formula.

UNIT 2 TIME RESPONSE ANALYSIS OF CONTROL SYSTEMS

9 Hrs.

Standard Test Signals - Time Response of First and Second Order System, Time Domain- Specifications - Generalized Error Series - Steady State Error - Static and Dynamic Error Constants.

UNIT 3 STABILITY OF CONTROL SYSTEM

9 Hrs.

Characteristics Equation - Location of Roots in S Plane for Stability - Routh Hurwitz Criterion - Root Locus Analysis - Effect of Pole Zero Additions on Root Locus - Nyquist Stability Criterion.

UNIT 4 FREQUENCY RESPONSE ANALYSIS

9 Hrs.

Frequency Response of the System - Correlation between Time and Frequency Response - Gain and Phase Margin - Bode Plot - Nyquist Plot (Polar Plot).

UNIT 5 COMPENSATION AND CONTROLLERS

8 Hrs.

Introduction to compensation networks - Lag, Lead and Lag Lead networks - Effect of providing Lag, Lead and Lag-Lead compensation on system performance and design using bode plot - **P, PI, PID Controllers design**.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Determine the transfer function for an electrical and mechanical system.
- CO2 - Analyze the response of any linear time invariant system.
- CO3 - Examine the stability of a system using Routh Hurwitz and root locus criterion.
- CO4 - Analyze the frequency response for linear time invariant system using bode plot and Nyquist plot.
- CO5 - Design a PI, PID controller in existing world problem.
- CO6 - Design lag, lead and lag-lead compensator network for real world problem.

TEXT / REFERENCE BOOKS

1. I.J.Nagarath and M.Gopal, "Control System Engineering" New Age International (p) Limited Publishers, 2nd Edition, 2009.
2. Kausuhio Ogata, "Modern Control Engineering", Prentice Hall of India PVT. Ltd, 5th Edition, 2010.
3. Richard Dorf, "Modern Control Systems", Pearson Education Ltd, 11th Edition 2009.
4. M.N. Bandyopadhyay, "Control Engineering, Theory and Practice" PHI, 4th print, 2006.
5. N.K.Sinha, "Control Systems", New Age International Private Limited Publishers, 3rd Edition, Reprint, 2008.
6. A.Nagoorkani, "Control System", RBA Publications, 3rd Edition, reprint 2012.
7. U.A.Bakshi and S.C.Goyal, "Control System Engineering", Technical Publication, 2nd Revised Reprint 2007.

SECA1502	ANALOG INTEGRATED CIRCUITS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To have thorough understanding of Op-Amp.
- To be able to design circuits using op amp for various applications.
- To acquire knowledge about ADC and DAC.
- To study the basic principles of PLL and Timer Circuit.
- To understand the concept of Special function ICs.

UNIT 1 INTRODUCTION TO OP- AMP AND ITS APPLICATIONS.**9 Hrs.**

OP-AMP- DC and AC Characteristics- Input offset voltage- Input bias current-Input offset current- Total output offset voltage- Thermal drift- Slew rate- CMRR -Inverting amplifier- Non-inverting amplifier- Voltage follower- Summing and differential amplifier- Integrator- Differentiator- Logarithmic and Anti logarithmic amplifiers-Comparator and Schmitt trigger.

UNIT 2 FILTERS AND SIGNAL GENERATORS**9 Hrs.**

First order and Second order Butterworth filters- low pass, high pass, band pass and band reject filters -RC phase shift, Wein's bridge oscillator- Astable and Monostable multivibrator-Precision half wave and full wave rectifiers.

UNIT 3 A/D AND D/A CONVERTERS**9 Hrs.**

Sample and Hold circuit - Digital to analog converters: R-2R ladder network and Binary weighted - Characteristics of D/A converters - Analog to digital converters: Flash converter - Successive approximation converter - Dual slope ADC-Weighted-Capacitor DACs- Oversampling Converters.

UNIT 4 PLL AND TIMER CIRCUITS.**9 Hrs.**

Phase Locked Loop IC 565- Block schematic - Applications of PLL: FM demodulator and Frequency synthesizers Demodulator- VCO IC LM 566 - Timer IC LM 555 and its applications: Astable and Monostable multivibrator.

UNIT 5 SPECIAL FUNCTION ICs**9 Hrs.**

Integrated circuit Tuned amplifier, Instrumentation Amplifier, Monolithic voltage regulators 78XX,79XX Series ,Opto coupler, CMOS Operational Amplifier- Dc analysis- small signal analysis- specifications of IC MC 14573.

Max. 45 Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1 - Design Summer, Subtractor, Multiplier and Divider circuits using op-amp.
- CO2 - Design filter circuits using analog IC's.
- CO3 - Design the op-amp based ADC and DAC converters.
- CO4 - Design suitable op-amp based circuits for the generation of sine, square and triangular waveforms..
- CO5 - Able to use OP Amp to generate sine waveform, Square wave form, Triangular wave forms.
- CO6 - Able to use OP Amp as analog to digital and digital to analog converter.

TEXT / REFERENCE BOOKS

1. Ramakant A.Gayakwad, "OP-AMP and Linear ICs", 4th Edition, Prentice Hall / Pearson Education, 2015.
2. D.RoyChoudary, Shail Jain, "Linear Integrated Circuits", New Age International Pvt. Ltd., 2000.
3. Grey and Meyer, "Analysis and Design of Analog Integrated Circuits", 4th Edition, Wiley International, 2001.
4. Michael Jacob, "Applications and Design with Analog Integrated Circuits", 2nd Edition, Prentice Hall of India, 1993.
5. S. Salivahanan, V.S. Kanchana Bhaaskaran, "Linear integrated circuits", 3rd Edition, McGraw-Hill, 2011.
6. William D.Stanely, "Operational Amplifiers with Linear Integrated Circuits", 4th Edition, Pearson Education, 2004.
7. Sergio Franco "Design with Operational Amplifiers and Analog Integrated Circuits" 4th edition, McGraw-Hill Education, 2015.

SECA1508	MICROPROCESSOR, INTERFACING AND ITS APPLICATIONS	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- To impart the knowledge of 8085 and 8086 processor.
- To develop assembly language program in 8085/8086 processor.
- To introduce the peripheral devices.
- To acquire the knowledge of interfacing and hardware implementation.

UNIT 1 8085 MICROPROCESSOR

9 Hrs.

8085 Architecture-Timing Diagram-Interrupts-Addressing Modes-Instruction Formats-Instruction Set-Programming of 8085.

UNIT 2 8086 MICROPROCESSOR

9 Hrs.

8086 Architecture-Maximum and Minimum Mode-Memory Banks-Memory Segmentation-Programming Model -Instruction Set-Programming of 8086.

UNIT 3 PERIPHERALS INTERFACING USING 8085/8086

9 Hrs.

Introduction, memory and I/O interfacing, data transfer schemes, programmable peripheral interface (8255), programmable DMA controller (8257), programmable interrupt controller (8259), Universal synchronous asynchronous receiver transmitter (USART) (8251), programmable counter/interval timer (8254).

UNIT 4 INTERFACING CONCEPTS WITH 8085/8086

9 Hrs.

Switches-Matrix Keyboard-interfacing LED, 7 segment LED, LCD, Analog to Digital Converter (ADC), Digital to Analog Converter (DAC), Memory Interfacing (RAM and ROM).

UNIT 5 APPLICATIONS USING 8085/8086

9 Hrs.

Stepper motor interfacing with ULN2003-specific angle rotation, Motor speed control, Temperature control system, Traffic light control-6V relay to control AC Bulb-PWM generation for Single phase- controlled rectifier with specific firing angle.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Apply the basics of 8-bit processor to do real time automation programming.
- CO2 - Analyze the 16-bit processors with memory segmentation technique for better programming technique.
- CO3 - Examine the performance enhancement of microprocessor with various peripheral interfacing IC's.
- CO4 - Investigate the operation of various peripheral devices to implement in real time applications.
- CO5 - Design the interfacing circuits for real time applications.
- CO6 - Develop the control circuits for various motor controlled by 8085/8086.

TEXT / REFERENCE BOOKS

2. Ramesh Gaonkar, "Microprocessor Architecture, Programming and applications with 8085", 6th Edition, Penram International Publishing Pvt. Ltd., 2014.
3. Douglas V. Hall, "Microprocessor and its Interfacing", Tata McGraw Hill, Edited second Version, 2006.
4. Nagoor Kani A, "Microprocessor (8085) and its Applications", 2nd Edition, RBA publications, 2013.
5. Mathur A.P, "Introduction to Microprocessor", Tata McGraw Hill, 3rd Edition 2002.

SEEA3016	Embedded Systems and IoT	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To understand fundamentals of IoT and embedded system including essence, basic design strategy and process modeling.
- To develop comprehensive approach towards building small low cost embedded IoT system.
- To learn real world application scenarios of IoT along with its societal and economic impact using case studies

UNIT 1 INTRODUCTION TO EMBEDDED SYSTEM AND IOT

9 Hrs.

Introduction to embedded systems, Application Areas ,Categories of embedded systems, Overview of embedded system architecture, Specialties of embedded systems, recent trends in embedded systems, Introduction to ARM processor and its architecture. Internet Of Things Promises–Definition– Scope–Sensors, IoT Applications–Structure of IoT– IoT Map Device ; IoT Sensors-Characteristics-types. IoT Issues and Challenges, Applications.

UNIT 2 EMBEDDED IoT PLATFORM DESIGN METHODOLOGY

9 Hrs.

Purpose and requirement specification, Process specification, Domain model specification, information model specification, Service specifications, IoT level specification, Functional view specification, Operational view specification, Device and component integration, Application development.

UNIT 3 PILLARS OF EMBEDDED IoT AND PHYSICAL DEVICES

9 Hrs.

The internet of devices, The internet of objects, The internet of transducer, o The internet of controllers, Device to Connect and Manage, talk, Connect. Network, Basic building blocks of and IoT device, Exemplary device: Raspberry Pi, Raspberry Pi interfaces, Programming Raspberry Pi with Python, ▪ Beagle board and other IoT Devices.

UNIT 4 WEB OF THINGS AND CLOUD OF THINGS

9 Hrs.

Web of Things versus Internet of Things, Two Pillars of the Web, Architecture Standardization for WoT, Cloud of Things: Grid/SOA and Cloud Computing, Cloud Middleware, Cloud Standards – Cloud Providers and Systems, Mobile Cloud Computing, The Cloud of Things Architecture.

UNIT 5 IoT CLOUD OFFERINGS AND IoT CASE STUDIES

9 Hrs.

Introduction to Cloud Storage Models, Communication API, Amazon Web Services for IoT, Skynet IoT Messaging Platform. Case Studies: Home Intrusion Detection, Weather Monitoring System, Air Pollution Monitoring, Smart Irrigation, Energy Harvesting.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Apply the basic concepts of embedded systems and IoT.
- CO2 - Apply the design methodology for embedded IoT Platform.
- CO3 - Develop programs using Python for Raspberry Pi.
- CO4 - Analyze the significance of real world problems of web of things and cloud of things.
- CO5 - Implement IoT Cloud Offerings for real world problems.
- CO6 - Develop the solutions to solve the given societal challenge using IoT.

TEXT / REFERENCE BOOKS

- 1.Adrian McEwen and Hakim Cassimally, —Designing the Internet of ThingsII, John Wiley and Sons Ltd, UK, 2014.
- 2.Vijay Madiseti, Arshdeep Bahga, —Internet of Things (A Hands-on Approach), Universities Press, 2015.
- 3.Dieter Uckelmann, Mark Harrison, Florian Michahelles, —Architecting the Internet of ThingsII, Springer, New York, 2011.
- 4.John H. Davies, —MSP430 Microcontroller BasicsII, First Edition, Newnes Publication. 2010.

Employability

Entrepreneurship

Skill Development

SEEA3028	Electric Vehicle	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To understand the concept of conventional vehicle
- To acquire the knowledge about the electric vehicle
- Apply the control of control techniques for motors
- To understand the transmission system used in electric vehicle
- To acquire the knowledge about the battery charging system

UNIT 1 VEHICLE FUNDAMENTALS

9 Hrs.

General Description of Vehicle Movement, Vehicle Resistance, Dynamic Equation, Tire–Ground Adhesion and Maximum Tractive Effort, Power Train Tractive Effort and Vehicle Speed-Vehicle Power Plant and Transmission Characteristics-Vehicle Performance-Braking Performance-Performance of Electric Vehicles.

UNIT 2 ELECTRIC VEHICLE FUNDAMENTALS

8 Hrs.

EV Types, EV Configurations, Energy Sources, Motors Used, Charging Systems, Power Conversion Techniques, Technological Problems, Control Algorithms, Trends and Future Developments

UNIT 3 ELECTRIC TRAIN

9 Hrs.

Series Hybrid Electric Drive Train Design-Sizing of the Major Components- The Hybrid Electric Vehicle-Energy Use in Conventional Vehicles-Energy Savings Potential of Hybrid Drive trains-HEV Configurations-Series Hybrid System-Parallel Hybrid System-Series-Parallel System-Complex Hybrid System.

UNIT 4 ELECTRIC PROPULSION SYSTEM

10 Hrs.

DC motor drive-Chopper control of DC motor drive- multi-quadrant control of Chopper fed drive Induction motor drive-constant v/f control-power electronics control-FOC-VSI for FOC. PMBLDC motor drive-basic principle – construction-classification-performance and control of PMBLDC machine. SRM drive-basic magnetic structure-SRM drive converter-modes of operation-generating modes of operation.

UNIT 5 BATTERY STORAGE AND CHARGING

9 Hrs.

Batteries-Overview-Types of battery-Fuel Cell-Super capacitor -Flywheel. Charging, standards and infrastructure-Wireless power transfer-Solar charging case study. Case studies-General motor EV-1 and Tesla roadster

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Apply Vehicle concept to electric vehicle
- CO2 - Analyze the power conversion technique of electric vehicle
- CO3 - Examine the performance of different electric drive train
- CO4 - Select the appropriate electric motor for electric propulsion system
- CO5 - Select a suitable battery for electric vehicle
- CO6 - Develop a solar charging technique for electric vehicle.

TEXT / REFERENCE BOOKS

- 1.M. Ehsani, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2005
Suggested Reading.
- 2.Tom Denton, Electric and Hybrid vehicle routledge,2016.
- 3.Husain, Electric and Hybrid Electric Vehicles, CRC Press, 2003
4. Un-Noor, F., Padmanaban, S., Mihet-Popa, L., Mollah, M.N. and Hossain, E., 2017. A comprehensive study of key electric vehicle (EV) components, technologies, challenges, impacts, and future direction of development. Energies, 10(8), p.1217.

Employability

Entrepreneurship

Skill Development

SEEB5101	ANALYSIS OF RECTIFIERS AND CHOPPERS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To have in-depth knowledge on single and three phase rectifiers
- Understand the operation and to analyse AC and DC choppers
- To learn the operation of cycloconverter and special converters

UNIT 1 SINGLE PHASE RECTIFIERS

9 Hrs.

Introduction – Principle of phase controlled converter operation – Single phase full converter with R, RL and RLE loads – Effect of Freewheeling diodes – Effect of source inductance – Single phase semi converter – Single phase dual converter – Single phase series converter.

UNIT 2 THREE PHASE RECTIFIERS

9 Hrs.

Three phase half wave converter – Three phase semi converter – Three phase full converter with R, RL and RLE loads. – Effect of source and load inductance - Three phase dual converter – Power factor improvements

UNIT 3 DC CHOPPERS

9 Hrs.

Introduction – Principles of step-down operation, step-down chopper with RL load – Principle of step-up operation with resistive load – Converter classification – Switching mode regulators – Analysis of buck, boost, buck boost and CUK converter – Comparison of regulators – Multi output boost converter.

UNIT 4 AC CHOPPERS

9 Hrs.

Introduction – Principle of ON-OFF control – Principle of phase control – Single phase bidirectional controllers with resistive loads – Single phase controllers with Inductive loads – Three phase half wave and full wave controllers – Three phase bi-directional delta connected controllers. AC voltage controllers with PWM control.

UNIT 5 CYCLOCONVERTER AND SPECIAL CONVERTERS

9 Hrs.

Cycloconverters – Single phase step up and step down cycloconverter – Single phase to three phase cycloconverter – Three phase to single phase cycloconverter - Study of Harmonics- Introduction to Matrix converter.

Max. 45 Hrs.

COURSE OUTCOMES

On the completion of the course, student will be able to

- CO1 - Comprehend single phase rectifiers with various loads
- CO2 - Examine three phase rectifiers with various loads
- CO3 - Analyze DC chopper for a particular load
- CO4 - Design AC voltage controllers
- CO5 - Design various power converters
- CO6 - Develop new converters to meet industrial requirements

TEXT / REFERENCE BOOKS

1. Rashid M.H., "Power Electronics Circuits, Devices & Applications", Pearson Education, 4th Edition, 2017.
2. P.S.Bimbra, "Power Electronics", Khanna Publishers, 5th Edition, 2014.
3. Mohan N., Undeland & Robbins, "Power Electronics Converters, Application & Design", John Wiley & Sons, Inc, 3rd Edition, Reprint, 2009.
4. P.C.Sen, "Modern Power Electronics", S.Chand Ltd., 2005.

SEEB5102	ANALYSIS OF INVERTERS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- Understand the basic inverter circuit operation.
- Understand the three phase inverter types VSI, CSI and Z source inverter.
- Understand the Purpose and need of multilevel inverter.
- Design an inverter for electrical drive, photovoltaic application etc.
- Able to analyze the inverter output using Fourier analysis for harmonics.

UNIT 1 SINGLE PHASE INVERTER

9 Hrs.

Introduction – Principle of operation – Performance parameters – Single phase half bridge Inverters – Single phase full bridge Inverter – Single phase Series Inverter – Single phase parallel Inverter - Modified McMurray Inverter – McMurray Bedford half bridge and full Inverter Voltage control of single phase Inverters

UNIT 2 VOLTAGE SOURCE AND CURRENT SOURCE INVERTER

9 Hrs.

Three phase bridge Inverter with 180° and 120° mode of operation – Voltage control of three phase Inverters -Analysis of single phase and three phase auto sequential current source Inverter - Current source bridge Inverter– Harmonic Elimination Techniques.

UNIT 3 Z-SOURCES INVERTER

9 Hrs.

Single phase and three phase z source inverter -Comparison with VSI and CSI-Equivalent circuit and operation –Circuit analysis and calculation-Introduction to Quasi Z- source inverter-basic topology-Extended boost quasi Z- source inverter topologies.

UNIT 4 RESONANT PULSE INVERTERS

9 Hrs.

Introduction – Series resonant Inverters with unidirectional and Bidirectional switches – Parallel resonant Inverters– Class E resonant Inverter - Zero current switching resonant converter – Zero voltage switching resonant converter– Two quadrant ZVS resonant converter – Resonant DC link Inverter.

UNIT 5 MULTILEVEL INVERTER

9 Hrs.

Multilevel concept – Diode clamped – Flying capacitor – Cascade type multilevel Inverters - Comparison of multi-level Inverters - Application of multilevel Inverters.

Max. 45 Hrs.

COURSE OUTCOMES

On the completion of the course, student will be able to

- CO1 - Comprehend the Operation of inverter for single phase and three phase circuits
- CO2 - Examine how to do the analysis for the inverter for harmonics.
- CO3 - Develop controller using modulation techniques to control the inverter output voltage.
- CO4 - Design an inverter for a particular application and power level.
- CO5 - Examine the need for multi-level inverter and its operation.
- CO6 - Evaluate the efficiency by performing the soft switching in the inverter circuit.

Employability

Entrepreneurship

Skill Development

TEXT / REFERENCE BOOKS

1. Rashid M.H., "Power Electronics – Circuits, Devices & Applications", Pearson Education, 2013.
2. P.S.Bimbra, "Power Electronics", Khanna Publishers, 5th Edition, 2014.
3. Fang Lin luo, Hong Ye, "Advanced DC/AC Inverters:Applications in Renewable Enegy", CRC Press, Taylor and Francis Group, 2013.
4. Mohan N., Undeland & Robbins, "Power Electronics – Converters, Application & Design", John Wiley & Sons Inc., 2nd Edition, Newyork, 2001.
5. P.C. Sen, "Modern Power Electronics", S.Chand Ltd., 2005.
6. Rashid M.H., "Hand book on Power Electronics", Nihar Kularatna, Newnes, 1998.
7. M.D. Singh & K.B. Khanchandani, "Power Electronics", Tata McGraw Hill Publishing Company Limited, 2nd Edition, 3rd Reprint, 2008.

SEEB7001	POWER ELECTRONICS IN POWER SYSTEMS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To understand the concepts of Reactive power requirement and load compensation.
- To impart knowledge on FACTS devices and power factor improvement.
- To provide a chance for the students to learn about the different power converter and its methods of commutation.
- To impart more knowledge about Tap changing transformer, UPS, HVDC, etc which helps in energy storage and effective utilization.

UNIT 1 LOAD COMPENSATION**9 Hrs.**

Introduction – Need for Compensation – Objectives in load compensation – Specifications of load compensator – Ferranti Effect - Classification of compensation – Shunt & Series Compensation – Voltage Sag, Swell, Surges - Effects of Voltage Collapse

UNIT 2 INTRODUCTION TO FACTS DEVICES**9 Hrs.**

Thyristor Controlled Reactor (TCR) – Thyristor Switched Capacitor (TSC) – Saturable Reactor – Saturated Reactor Compensator – Static VAR Compensator (SVC) – Thyristor Controlled Series Capacitor (TCSC) – Unified Power Flow Controller (UPFC) - STATCOM – Dynamic Voltage Restorer (DVR)

UNIT 3 HARMONICS CONTROL AND POWER FACTOR IMPROVEMENT**9 Hrs.**

Reactive power variation for fully controlled converter – Half controlled converter – Fully controlled converter with controlled freewheeling – Methods of employing natural commutation – Methods of employing forced commutation – Implementation of forced commutation

UNIT 4 VOLTAGE CONTROL USING STATIC TAP CHANGER**9 Hrs.**

Introduction to voltage regulators – Single Phase voltage controllers – Sequence control of AC voltage controllers – Manually controlled voltage regulator (Conventional Methods) – Static Tap changer using thyristors - Application of Tap-Changing Transformers to Transmission Systems.

UNIT 5 UNINTERRUPTIBLE POWER SUPPLY SYSTEMS**9 Hrs.**

Switched mode power supply (SMPS) – Parallel UPS – Rotating UPS – Static UPS types – UPS using resonant power converters – High voltage DC transmission – Static circuit breakers

Max. 45 Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1 - Comprehend reactive power compensation and power factor improvement.
- CO2 - Examine the various FACTS devices and its role in compensation.
- CO3 - Analyse various methods of commutation for converters.
- CO4 - Examine different tap changing transformer and its applications.
- CO5 - Analyse the importance of UPS and SMPS.
- CO6 - Design and construct HVDC transmission, static circuit breakers.

TEXT / REFERENCE BOOKS

1. Miller.T.J.E., "Reactive Power Control in Electric Systems", Wiley-Interscience, New York, 1982.
2. G.K.Dubey, "Thyristorised Power Controllers", New Age International Publishers, 2nd Edition (2012).
3. P.S.Bimbhra, "Power Electronics", Khanna Publishers, 5th Edition, 2014.
4. R. Mohan Mathur, Rajiv K. Varma, "Thyristor-based Facts Controllers for Electrical Transmission systems", Wiley-IEEE, 2002.
5. P.C.Sen, "Power Electronics", Tata Mc Graw Hill, 2008.

Employability

Entrepreneurship

Skill Development

6. "Static compensator for AC power systems", Proc.IEE Vol.128, pt.c, Nov 1981, pp362-406.
7. "A static alternative to the Transformers on Load tap Changing", IEEE Trans. on PAS, Vol.101, Sep.982, pp3091-3095.
8. K.R. Padiyar, "FACTS Controllers in Power Transmission and Distribution", New Age International, 2007(Reprint 2013).
9. Narain G.Hingorani and Laszlo Gyugyi, "Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems", Wiley-IEEE Press, 1999.

SEEB7007	INTELLIGENT CONTROL	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To impart knowledge on intelligent control techniques and implementation in electric drives using power converters.
- To apply artificial neural networks and fuzzy methods in various electrical and electronics engineering applications.
- To discriminate the importance of exploration and exploitation swarm intelligent system to attain near global optimal solution.

UNIT 1 INTRODUCTION

9 Hrs.

Approaches to intelligent control. Architecture for intelligent control. Symbolic reasoning system, rule – based systems, the AI approach. Knowledge representation. Expert systems.

UNIT 2 ARTIFICIAL NEURAL NETWORKS

9 Hrs.

Networks and its basic mathematical model, McCulloch - Pitts neuron model, simple Perceptron, Adaline and Madaline, Feed-forward Multilayer Perceptron. Learning and Training the neural network. Hopfield network, Self organizing network and Recurrent network- Back propagation networks. Principal Component analysis and wavelet transformations related to power electronics.

UNIT 3 OPTIMIZATION TECHNIQUES

9 Hrs.

Objective function-Uni modal-Multi model Constraints-Fitness Function-Operators Genetic Algorithm, Tabu search, ant-colony search.

UNIT 4 FUZZY LOGIC SYSTEM

9 Hrs.

Introduction to crisp sets and fuzzy sets, basic fuzzy set operation and approximate reasoning. Introduction to fuzzy logic modelling and control. Fuzzification, inferencing, defuzzification. Fuzzy knowledge and rule bases. Fuzzy modelling and control schemes for nonlinear systems. Self-organizing fuzzy logic control - Neuro fuzzy controllers.

UNIT 5 APPLICATION (QUANTITATIVE APPROACH ONLY)

9 Hrs.

GA application to power electronics for the harmonic reduction in inverter. Case studies: Harmonic elimination method using Neural Network – V/F Speed control of an Induction Motor with Neural network based SVM modulator for inverter. Neuro Fuzzy Based efficiency optimized control-Stability analysis of fuzzy control systems.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Comprehend architecture of intelligent control system.
- CO2 - Examine the artificial neural networks by using different learning rule.
- CO3 - Analyze the optimization techniques by applying genetic algorithm.
- CO4 - Describe fuzzy methods of analyzing problems which involve incomplete or vague criteria rather crisp values.
- CO5 - Evaluate the harmonics elimination by implementing the application of genetic algorithm and neural Networks.
- CO6 - Develop Neuro fuzzy based system for any desired applications.

Employability

Entrepreneurship

Skill Development

TEXT / REFERENCE BOOKS

1. S.N.Sivanandam, S.Sumathi and S.N.Deepa, "Introduction to Neural Networks using MATLAB 6.0", McGraw Hill Publishing companies Limited, 4th Edition, July 2017.
2. Lawrence V.Fansett, "Fundamentals of Neural Networks: Architectures, Algorithms & Applications", Prentice Hall, 2010.
3. Simopn S.Haykin, "Neural Networks: A Comprehensive Foundation", Macmillan, 2008.
4. S.Rajasekaran, G.A.Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic & Genetic Algorithms: Synthesis & Applications", PHI, 4th Edition 2011.
5. S.N.Sivanandam & S.N.Deepa, "Introduction to genetic Algorithms", Springer Publications, 2nd Edition, 2010.
6. Timothy Ross, "Fuzzy Logic with Engineering Application", McGraw Hill, Edition 1997
7. James A. Freeman & Skapura, "Neural Networks", Pearson Education, 2011.
8. B.Yegnanarayana, "Artificial Neural Networks" Prentice Hall, September 2013.

S11BLH12	PROBLEM SOLVING TECHNIQUES USING C	L	T	P	EL	Credits	Total Marks
		2	0	2	0	3	100

COURSE OBJECTIVES

- Understand control structures, functions and Arrays in C.
- Construct modules for real time applications using Functions in C.
- Comprehend pointers and file handling mechanisms.

UNIT 1 BITS AND BYTES IN COMPUTING

9 Hrs.

Computers : Hardware – Software – Processor – Memory – I/O devices – Interface – Programming Languages – Evolution from COBOL, FORTRAN to C, Python – Need. Algorithms: Role in problem solving – Analysis – Design – Flowcharts: Role in problem solving – Symbols – Design – Pseudocode: Role in problem solving – Design - Program: Role in problem solving – Design.

Practice Problems:

1. Describe a simple real world problem in your domain/department and describe it in the form of problem statement, input, output and provide its solution in terms of algorithm, flowchart, pseudo code and program.

UNIT 2 C: MATH BEHIND CODING

9 Hrs.

C: Structure of program – Character set – Tokens – Keywords – Identifiers – Constants – Variables – Datatypes – Strings – Operators and its types – Functions – Header Files. Algorithmic Strategies: Iteration and Recursion – Efficiency – Role of Time and Space consumption while building an algorithm – Complexities.

Practice Problems:

1. Describe a simple real world problem in your domain/department and provide a computing and non-computing solution for the same. Calculate the time and space consumed in both solutions. Compare and contrast the pros and cons in both solutions.
2. Write an algorithm, flowchart, pseudo code followed by a simple C code to do find the Factorial and Fibonacci series using both iteration and recursion.

UNIT 3 C: MAGIC BEHIND INSTANT OUTPUTS

9 Hrs.

Advanced Coding Concepts: Decision Making using Branching Statements and its types – Decision Making using Looping Statements and its types – Switch Statements – Break – Continue – Goto – Jump Statements. Case Study: Fun with Code -- Printing Alphabets / Flags of Countries / Flying Alphabet Screensaver.

Practice Problems:

1. Describe a problem statement in your domain/department whose solution involves repetition of same steps and provide code as solution involving for, while and do while loops.
2. Describe a problem statement in your domain/department whose solution involves decision making and provide code as solution involving if-else, nested if-else and ladder if-else.
3. Develop a simple scientific calculator using Switch case statement.

UNIT 4 STORING GROUP OF HOMOGENOUS ELEMENTS: ARRAYS

9 Hrs.

Diving into Arrays: Definition – Syntax – Types – Representation: Row & Column Order – Dynamic Arrays. Idea behind Functions: Declaration – Definition – Types – Calling – Arguments – Prototypes – Call by Value – Call by Reference – Pointers.

Case Study: Fun with Code – Simple Game Development using Arrays and Functions

Employability

Entrepreneurship

Skill Development

Practice Problems:

1. Describe a problem statement in your domain/department where you need to work with group of same type of data. Provide a solution in terms of C program to store and manage the data effectively.
2. You're playing UNO cards, suddenly a person is getting rev card. Write a C program to reverse the round by storing the number of players in array.
3. Write a C program for Vehicle Regulation System where odd number ending vehicles can use the road on odd days and even number ending vehicles can use the road on even days using two separate arrays to store and display the odd and even numbers.

UNIT 5 STORING GROUP OF HETEROGENEOUS ELEMENTS: ARRAYS**9 Hrs.**

Outset of Structure and Union: Structure Definition & Declaration – Structures Fusion with: Arrays – Pointers – Functions – Union Initiation, Definition & Declaration. Working with Files: File Handling Functions – Read – Write – Other Operations – Different File Types .

Case Study: Report on using File Functions to create Score Board for any game, importing it to. Program.

Practice Problems:

1. Describe a problem statement in your domain/department where you need to work with group of different type of data. Provide a solution in terms of C program to store and manage the data effectively.
2. Write a C program to get the details of the student (roll no, name, date of birth, state, 10th percentage and 12th percentage) using Structure. Calculate the age of the student and display the eligibility status for his admission.
Eligibility criteria: more than 60 percent in 10th and 12th, age ≥ 17 , state == TN.
3. Write a menu driven C program for library management system with ten entries:
(i). Add Book (ii). Add Author (iii). Add Category (iv). Book Cost (v). Display - Book by Author, Book by Category, Book under cost.
4. Write a C program to create an employee Union with employee details (id, name, salary) Accept the details of 'n' employees, rearrange the data in ascending order of employee name, id and salary as three different functions and display it.

Max. 45 Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1 - Interpret the difference between components of problem solving such as algorithm, flowchart, pseudo code and source code.
- CO2 - Build simple solution for any given problem statement using various components of problem solving techniques and measure its efficiency in terms of time and space.
- CO3 - Infer and examine the roots and foundation of C programming's key concepts like data types, operators.
- CO4 - Devise and correlate the use of different core concepts such as arrays and functions in C language.
- CO5 - Formulate real time solutions through programs using structure and union in C language.
- CO6 - Design and develop various application oriented program for solving real time societal problems.

TEXT / REFERENCE BOOKS

1. Yashavant Kanetkar, 'Let us C', BPB Publications, Fourteenth Edition
2. R.G.Dromey "How to solve it by computer", Pearson Education, Low Price Edition.

Employability

Entrepreneurship

Skill Development

3. Balagurusamy, "Programming in ANSI C", McGrawHill Publications, Eighth Edition.
4. Greg Perry, Dean Miller "C Programming Absolute Beginner's Guide", Third Edition.

SEEA1801	SPECIAL ELECTRICAL MACHINES AND CONTROL	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To review the basic concepts of stepper motors and its applications.
- To understand the concept of the operating principle and characteristics of switched reluctance motors.
- To impart knowledge on the fundamental concepts and control of permanent magnet brushless DC motors.
- To introduce the concepts and control methods of permanent magnet brushless synchronous motors and synchronous reluctance motors.
- To impart knowledge on the microprocessor based control of special machines.

UNIT 1 STEPPING MOTORS

9 Hrs.

Constructional features, principle of operation, types, modes of excitation, Torque production in Variable Reluctance (VR) stepping motor, Static and Dynamic characteristics, Introduction to Drive circuits for stepper motor, suppressor circuits, Closed loop control of stepper motor- Applications.

UNIT 2 SWITCHED RELUCTANCE MOTORS

9 Hrs.

Principle of Operation, Constructional features, Torque equation, Power Semi-Conductor Switching Circuits, frequency of variation of inductance of each phase winding - Control circuits of SRM-Torque - Speed Characteristics, Microprocessor based control of SRM Drive, Applications.

UNIT 3 SYNCHRONOUS RELUCTANCE MOTORS

8 Hrs.

Constructional features: axial and radial air gap Motors. Operating principle, reluctance torque – Phasor diagram, Speed torque characteristics, Applications.

UNIT 4 PERMANENT MAGNET BRUSHLESS DC MOTORS

9 Hrs.

Commutation in DC motors, Electronic Commutation- Difference between mechanical and electronic commutators- Hall sensors, Optical sensors, Construction and principle of PMBL DC Motor, Torque and E.M.F equation, Torque-speed characteristics, Power Controllers-Drive Circuits, Applications.

UNIT 5 PERMANENT MAGNET SYNCHRONOUS MOTORS

10 Hrs.

Construction and types, Principle of operation, EMF and Torque equation, Phasor diagram- Torque Speed Characteristics, Power controllers- Self-control, Vector control, Microprocessor based Control, Applications.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Apply the reluctance concept to operation of various types of stepper motors.
- CO2 - Analyze the operation and characteristics of switched reluctance motors.
- CO3 - Evaluate the performance of synchronous reluctance motors.
- CO4 - Identify power controllers and driver circuits for permanent magnet brushless DC motor.
- CO5 - Justify best speed control for permanent magnet synchronous motor.
- CO6 - Develop control methods for Permanent magnet synchronous motor on real time applications.

TEXT / REFERENCE BOOKS

2. Miller T.J.E., "Brushless permanent magnet and reluctance motor drives", Clarendon Press, Oxford, 1989.
3. Kenjo T., "Stepping motors and their microprocessor control", Oxford University Press, 2000.
4. R.Krishnan, "Electric Motor Drives - Modeling, Analysis and Control", Prentice-Hall of India Pvt. Ltd., New Delhi, 2015.
5. Kenjo T. and Naganori, S "Permanent Magnet and Brushless DC motors", Clarendon Press, Oxford, 1985.
6. B.K. Bose, "Modern Power Electronics & AC drives", Dorling Kindersley India, 2006.

SECA1507	DIGITAL SIGNAL PROCESSING AND ITS APPLICATIONS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To impart basic ideas in discrete signals and systems.
- To gain knowledge of Analog and Digital filter design with various structural realizations.
- To learn DSP controller pertaining to Power Electronics via programming.

UNIT 1 INTRODUCTION TO DISCRETE TIME SIGNALS, SYSTEMS AND Z –TRANSFORM 9 Hrs.

Sampling theorem, Quantization, Quantization error, Aliasing- mathematical representation of signals, Classifications of Signals and Systems - Review of Z transform & Inverse Z Transform-ROC–Time response analysis using standard test signals (step and ramp) – linear convolution- Correlation.

UNIT 2 DISCRETE FOURIER TRANSFORM AND COMPUTATION 9 Hrs.

Discrete Time Fourier Transform analysis(DTFT), Discrete Fourier Transform (DFT)- Properties of DFT- frequency response analysis-magnitude and phase response, circular convolution, FFT computations using radix-2 Decimation in Time (DIT) and Decimation in frequency(DIF) algorithms.

UNIT 3 DESIGN OF INFINITE IMPULSE RESPONSE FILTER (IIR) 9 Hrs.

Design of IIR filters using Impulse invariant and Bilinear transformation method- Prewarping. Review of Butterworth and Chebyshev approximations- Frequency transformation in analog domain- Filter design using Butterworth and Chebyshev-Realization of recursive structures-Direct form-I-Direct form-II-Cascade-Parallel Forms.

UNIT 4 DESIGN OF FINITE IMPULSE RESPONSE (FIR) FILTER 9 Hrs.

Properties of IIR and FIR filters - Filter design using windowing techniques - Hamming, Hanning, Blackman, Rectangular, Triangular windows- Digital filter design using Frequency sampling technique- Realization of Structures for FIR and Linear phase FIR filter- Direct form-Transposed form- Cascaded form, Elementary Ideas of Finite Word Length effects in Digital Filters.

UNIT 5 DSP APPLICATIONS USING TMS 320C24X PROCESSOR 9 Hrs.

Nomenclature- TMS 320 family overview -Architectural Overview-Central Processing unit – Addressing modes- Event Manager- General purpose timers (GPR)- Full compare Unit (FCU)- Dead band unit- **simple programs for PWM generation using GPR and FCU pertaining to Power Electronic applications.**

Max. 45 Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1 - Analyze various signals, systems and transforms.
- CO2 - Apply Discrete-Fourier Transform and Fast Fourier Transform on discrete time signals.
- CO3 - Design IIR digital filters for suitable applications.
- CO4 - Design and analyze FIR digital filters.
- CO5 - Comprehend the architecture of digital signal processing controller (TMS320CX2407).
- CO6 - Develop ALP for motor control application using TMS320CX2407.

TEXT / REFERENCE BOOKS

2. John G. Proakis & Dimitris G.Manolakis, "Digital Signal Processing - Principles, Algorithms & Applications", 4th Edition, Pearson education / Prentice Hall, 2007.
3. Emmanuel C..Ifeachor, & Barrie.W.Jervis, "Digital Signal Processing", 2nd Edition, Pearson Education / Prentice Hall, 2002.
4. Alan V.Oppenheim, Ronald W. Schaffer & Hohn. R.Back, "Discrete Time Signal Processing", Pearson Education, 2nd Edition, 2005.

Employability

Entrepreneurship

Skill Development

5. Andreas Antoniou, "Digital Signal Processing", Tata McGraw Hill, 2001.

SEEA1602	ADVANCED CONTROL SYSTEMS	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- To gain knowledge in the designing of state space analysis.
- To obtain the state transition matrices and the solution of state equations.
- To design a state observer using the concept of controllability and observability.
- To have a clear understanding in Digital Data Systems.
- To have an exposure in different stability analysis of Nonlinear Systems.

UNIT 1 STATE SPACE MODEL

9 Hrs.

Introduction to State Space, State Variables, Physical Variables, Phase Variables-Matrices, Eigen Values and Eigen vectors - Diagonalization, Canonical and Jordan forms - State Space Models from Differential Equations - Conversion of State Variable Models to Transfer Function.

UNIT 2 MATHEMATICAL ANALYSIS

9 Hrs.

Computation of State Transition Matrix - Laplace Transformation Method, Canonical Transformation - Cayley Hamilton Theorem-Solution of State Equation.

UNIT 3 STATE FEEDBACK AND OBSERVERS

9 Hrs.

Concepts of Controllability and Observability - Design of State Space Feedback using Pole Placement Technique-State Observers.

UNIT 4 SAMPLED DATA SYSTEMS

9 Hrs.

Reconstruction of Sampled Signals using Hold Circuits - Zero Order Hold - its Representation - Bode Plot of Hold Circuit - Z - Transform of Sampled Signals - Theorems on Z- Transform - Inverse Z-transform - Mapping between s and z Planes - Pulse Transfer Function Impulse Response - Closed Loop Operation - Characteristic Equations - Jury's Stability Criterion

UNIT 5 NONLINEAR SYSTEMS

9 Hrs.

General Properties of Non-Linear Systems - Describing Function Method - On / Off, Dead Zone, Saturation and Hysteresis Non Linearities - Determination of Limit Cycle by Describing Function - Stability of Limit Cycle - System Stability in the Sense of Lyapunov - Lyapunov's Direct Method - Stability and Instability Theorems - Application of Lyapunov Method for Linear Systems - Basic Concepts of Phase Plane Method.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Develop the state model of any linear time invariant system
- CO2 - Obtain the state transition matrices and their solutions.
- CO3 - Analyze controllability and observability for real time systems
- CO4 - Design a state observer using pole placement technique.
- CO5 - Analyze any discrete systems.
- CO6 - Determine the stability of any Nonlinear systems.

TEXT / REFERENCE BOOKS

1. K.Ogata, "Modern control Engineering", 5th Edition. Prentice Hall India, New Delhi. 2010.
2. B.C.Kuo, "Automatic Control Systems", Phi learning Pvt Ltd, 9th Edition, 2009.
3. Philips C.L., & John Parr "Feedback Control Systems" 5th Edition, Prentice Hall International. 2010.
4. Naresh K. Sinha, "Control Systems", New Age International Ltd., Reprint 2004.
5. Stanley M.Shinners, "Modern Control System Theory and Design", 3rd Edition, John Wiley & Sons. 2004.
6. M.Gopal, "Digital Control and State Variable Methods", 4th Edition, Tata McGraw Hill Ltd., New Delhi, 2012.
7. Roy Choudhry, "Modern Control Engineering" Phi Learning, 2009.

Employability

Entrepreneurship

Skill Development

SEEA1603	ELECTRICAL DRIVES AND CONTROL	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To impart knowledge in modeling of power converters.
- Understand the dynamics of mechanical system found in industrial application.
- Characterize the operation of motor, drive, sensor and mechanical power within the drive.
- Understand the operation of DC and AC Motor drive.
- Understand the method of starting and braking of electric motor.
- To have a knowledge of various motor drive applications.

UNIT 1 DRIVES CHARACTERISTICS**8 Hrs.**

Electric drives - Advantages - Choice of electric drive, Speed/Torque Characteristics of various types of loads and drive motors, Classes of motor duty- Selection of power rating for drive motors with regard to duty. Thermal model of motor for heating and cooling, Overloading and load variation factors- load equalization.

UNIT 2 DC DRIVE**10 Hrs.**

Starting and braking operations of DC motor drive-Speed control of DC motors - Ward Leonard scheme - Drawbacks - Ward Leonard Ilgener scheme - Thyristor converter fed DC Drives: single, two and four quadrant operations. Chopper fed DC Drives: control strategies - single, two and four quadrant operation.

UNIT 3 THREE PHASE INDUCTION MOTOR DRIVES**10 Hrs.**

Speed control of three phase induction motors: Stator control - Stator voltage, frequency and voltage/frequency control - VSI, CSI and Cycloconverter fed induction motor drives. Rotor control : Rotor resistance control- Static control of rotor resistance using DC Chopper, slip power recovery schemes -Kramer and Scherbius drives.

UNIT 4 THREE PHASE SYNCHRONOUS MOTOR DRIVES**10 Hrs.**

Speed control of three phase synchronous motors - types of control , Voltage source and current source converter fed synchronous motors -Cycloconverter fed synchronous motors -Commutator less DC motor- Effects of harmonics on the performance of AC motors - **Closed loop control of drive motors, Marginal angle control and power factor control.**

UNIT 5 DRIVE APPLICATIONS**7 Hrs.**

Selection of drives and control schemes for steel rolling mills, Paper mills, textile mills and cranes - Traction- conventional DC and AC Traction drives- DC Traction using Chopper Controlled Drives- Poly phase AC motors for Traction Motors.

Max. 45 Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1 - Select suitable drives for a specific application.
- CO2 - Analyze the construction, characteristics and application of D.C. motor.
- CO3 - Design the converter for AC and DC drives.
- CO4 - Analyze the performance of speed control of three phase synchronous motor drive.
- CO5 - Design solutions by using drives in traction unit in railways.
- CO6 - Design torque, speed and position controller of motor drives Control schemes for steel rolling mills, Paper mills, lifts and crane.

TEXT / REFERENCE BOOKS

1. Gopal K. Dubey, "Fundamentals of Electrical Drives", Alpha Science International Ltd, 2002.
2. Vedam.Subrahmanyam "Electric Drives" Mc graw hill, 2nd Edition 2011.
3. Rashid M.H., "Power Electronics circuits Devices and Applications", Prentice Hall, 3rd Edition, New Delhi, 2009.
4. Juha Pyrhonen , Valeria Hrabovcova & R. Scott Semken, "Electrical Machine Drives Control: An Introduction", 2016.
5. B.K.Bose, "Power Electronic & AC drives", Prentice Hall, 2006.
6. Control of Electrical Drives by Ws. Leonhard (Springer 2001).

SECA3026	FUNDAMENTALS OF FUZZY LOGIC AND NEURAL NETWORKS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To impart knowledge on signal transmission in human al system.
- To understand the various artificial neural architectures based on human neural network.
- To study and analyze the principles of fuzzy logic.
- To implement Fuzzy logicbased controllers for different applications.

UNIT 1 FUNDAMENTALS OF ANN**9 Hrs.**

Introduction - Biological Neuron structure, ANN - Definition – Topology - Models - Learning strategies. Characteristics of ANN - Different Learning Rules - Activation dynamics - Synaptic dynamics - Perceptron Model (Both Single & Multi-Layer) - Training Algorithm - Linear Separability Limitation and Its Over Comings, Problems in perceptron weight adjustments.

UNIT 2 MULTI LAYER NETWORKS**9 Hrs.**

BPN - Training - Architecture-Algorithm, Counter Propagation Network - Training - Architecture, BAM - Training-stability analysis, Adaptive Resonance Theory - ART1- ART2 – Architecture -Training, Hop Field Network - Energy Function - Discrete - Continuous - Algorithm - Application – TSP.

UNIT 3 SOM & SPECIAL NETWORKS**9 Hrs.**

SOM-Introduction - Kohonan SOM - Linear vector quantization, Probabilistic neural network ,Cascade correlation, General Regression neural network, Cognitron - Application of ANN - Texture classification - Character recognition.

UNIT 4 INTRODUCTION TO FUZZY LOGIC**9 Hrs.**

Classical set - Operations and properties - Fuzzy Set - Operations and properties - Problems, Classical Relations - Operations and Properties, Fuzzy Relations - Operations and Properties - Compositions Membership function -FLCS- Need for FLC- Fuzzification - Defuzzification.

UNIT 5 FLCS, CLASSIFICATION & APPLICATIONS**9 Hrs.**

Fuzzy decision making -Types, Fuzzy Rule Based System, Knowledge Based System, Non linear Fuzzy Control system - Fuzzy Classification - Hard C Means - Fuzzy C Means. Applications of fuzzy - Water level controller, Fuzzy image Classification, Speed control of motor.

Max. 45 Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1 - Classify various topologies of artificial neural networks.
- CO2 - Illustrate training and learning of neural systems using supervised and unsupervised methodologies.
- CO3 - Demonstrate the usage of multi-layer and special networks for different case studies.
- CO4 - Describe the behavior of Fuzzy Logic control system.
- CO5 - Explain the Defuzzification, fuzzy decision systems.
- CO6 - Implement Fuzzy based controller for motor speed control, image processing etc.

TEXT / REFERENCE BOOKS

1. Timothy Ross, "Fuzzy Logic with Engineering Application", McGraw Hill, Edition 1997.
2. James A. Freeman & Skapura, "Neural Networks", Pearson Education, 2007.
3. B.Yegnanarayana, "Artificial Neural Networks" Prentice Hall, September 2007.
4. Simon Haykin, "Artificial Neural Networks", 2nd Edition, Pearson Education.
5. Drainkov, H.Hallendoor and M.Reinfrank, "An Introduction to Fuzzy Control", Edition 2001.

SEEA3027	Green Energy Systems	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To understand the need and advantages of renewable energy.
- To study the performance, efficiency and the relevancy to the future energy needs.

UNIT 1 INTRODUCTION**9 Hrs.**

Overview of conventional & renewable energy sources, need, potential & development of renewable energy sources, types of renewable energy systems, Future of Energy Use, Present Indian and international energy scenario of conventional and RE sources, Energy for sustainable development, Environmental Aspects of Energy, Limitations of RE sources.

UNIT 2 SOLAR ENERGY**9 Hrs**

Theory of solar cells - VI and PV curves - Equivalent circuit. Concept of solar PV module, Panel, Array, Maximum Power Point tracking - Solar PV systems - Solar Collectors Classifications-- Solar PV Applications- Solar Refrigeration - Solar Pond Power Plant - Solar Thermal Power Plant.

UNIT 3 WIND ENERGY**9 Hrs.**

Wind Power and its Sources-Energy from Wind - Horizontal axis Wind Turbine - Vertical Axis Wind Turbine - Wind Energy Conversion Systems - Cp Vs Speed Curve.

UNIT 4 HYDROGEN PRODUCTION AND HYDROGEN STORAGE**9 Hrs.**

Chemical Production of Hydrogen- Electrolytic Hydrogen- Thermolytic Hydrogen- Photolytic Hydrogen- Photobiologic Hydrogen Production- Compressed Gas- Cryogenic Hydrogen- Storage of Hydrogen - Adsorption- Chemical Compounds- Hydride Hydrogen Compressors- Hydride Heat Pumps.

UNIT 5 HYBRID RENEWABLE ENERGY SYSTEMS**9 Hrs.**

Need for Hybrid Systems- Range and type of Hybrid systems - Configuration and Coordination, Electrical interface: wind-PV, Wind-PV-Fuel cell.

Max. 45 Hours**COURSE OUTCOMES**

- CO1 - Apply green energy system as an alternative forms of energy for India.
- CO2 - Analyse various types of solar photo voltaic system.
- CO3 - Select a suitable generator for wind energy system.
- CO4 - Estimate the hydrogen production system from fuel cell.
- CO5 - Apply hybrid energy system to improve performance of the system.
- CO6 - Select a suitable hybrid energy system between solar / wind / fuel cell.

TEXT / REFERENCE BOOKS

1. Aldo Vieira da Rosa , Juan Carlos Ordenez,"Fundamentals of Renewable Energy Processes" -Elsevier academic press 4th Edition 2021
2. Janaka Ekanayake and Nicholas Jenkins "Renewable Energy Engineering"- Cambridge university press-2017
3. B Khan , "Non conventional Energy resources", Tata McGrawHill, 2 nd Edition 2009.
4. Mukund R. Patel ,Wind & Solar Power Systems- Design, Analysis and Operation, , Taylor and Francis, 2nd Edition 2005.
5. James Larminie & Andrew Dicks, "Fuel Cell Systems Explained", John Wiley & Sons, 2nd Edition.
6. John Twideu and Tony Weir, "Renewal Energy Resources" BSP Publications, 2006.
7. C.S. Solanki, "Renewal Energy Technologies: A Practical Guide for Beginners" PHI Learning.

SEEA3028	Electric Vehicle	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To understand the concept of conventional vehicle
- To acquire the knowledge about the electric vehicle
- Apply the control of control techniques for motors
- To understand the transmission system used in electric vehicle
- To acquire the knowledge about the battery charging system

UNIT 1 VEHICLE FUNDAMENTALS**9 Hrs.**

General Description of Vehicle Movement, Vehicle Resistance, Dynamic Equation, Tire–Ground Adhesion and Maximum Tractive Effort, Power Train Tractive Effort and Vehicle Speed-Vehicle Power Plant and Transmission Characteristics-Vehicle Performance-Braking Performance-Performance of Electric Vehicles.

UNIT 2 ELECTRIC VEHICLE FUNDAMENTALS**8 Hrs.**

EV Types, EV Configurations, Energy Sources, Motors Used, Charging Systems, Power Conversion Techniques, Technological Problems, Control Algorithms, Trends and Future Developments

UNIT 3 ELECTRIC TRAIN**9 Hrs.**

Series Hybrid Electric Drive Train Design-Sizing of the Major Components- The Hybrid Electric Vehicle-Energy Use in Conventional Vehicles-Energy Savings Potential of Hybrid Drive trains-HEV Configurations-Series Hybrid System-Parallel Hybrid System-Series-Parallel System-Complex Hybrid System.

UNIT 4 ELECTRIC PROPULSION SYSTEM**10 Hrs.**

DC motor drive-Chopper control of DC motor drive- multi-quadrant control of Chopper fed drive Induction motor drive-constant v/f control-power electronics control-FOC-VSI for FOC. PMLDLC motor drive-basic principle – construction-classification-performance and control of PMLDLC machine. SRM drive-basic magnetic structure-SRM drive converter-modes of operation-generating modes of operation.

UNIT 5 BATTERY STORAGE AND CHARGING**9 Hrs.**

Batteries-Overview-Types of battery-Fuel Cell-Super capacitor -Flywheel. Charging, standards and infrastructure-Wireless power transfer-Solar charging case study. Case studies-General motor EV-1 and Tesla roadster

Max. 45 Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1 - Apply Vehicle concept to electric vehicle
- CO2 - Analyze the power conversion technique of electric vehicle
- CO3 - Examine the performance of different electric drive train
- CO4 - Select the appropriate electric motor for electric propulsion system
- CO5 - Select a suitable battery for electric vehicle
- CO6 - Develop a solar charging technique for electric vehicle.

TEXT / REFERENCE BOOKS

- 1.M. Ehsani, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2005
Suggested Reading.
- 2.Tom Denton, Electric and Hybrid vehicle routledge,2016.
- 3.Husain, Electric and Hybrid Electric Vehicles, CRC Press, 2003
4. Un-Noor, F., Padmanaban, S., Mihet-Popa, L., Mollah, M.N. and Hossain, E., 2017. A comprehensive study of key electric vehicle (EV) components, technologies, challenges, impacts, and future direction of development. Energies, 10(8), p.1217.

SCSA1202	PROGRAMMING WITH C AND C++	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- To learn the fundamental programming concepts and methodologies which are essential to building good C/C++ program.
- To demonstrate a thorough understanding of modular programming by designing programs which require the use of programmer-defined functions.
- To impart the knowledge about pointers which is the backbone of effective memory handling.
- To demonstrate adeptness of object oriented programming in developing solutions to problems demonstrating usage of data abstraction, encapsulation, and inheritance.

UNIT 1 BASICS OF C PROGRAMMING

9 Hrs.

Introduction to C: Features of C - Structure of C program-Data Types-'C' Tokens-Input/output statements-Control Statement, Functions: - Types of Functions -Recursion.

UNIT 2 ARRAYS, STRINGS AND STRUCTURES

9 Hrs.

Arrays : Single and Multidimensional Arrays— Array as Function Arguments, Strings: String Handling Functions, Structure: Nested Structures – Array of Structures – Structure as Function Argument-Function that Returns Structure, Union.

UNIT 3 POINTERS AND FILE PROCESSING

9 Hrs.

Pointers: Introduction, Arrays Using Pointers – Structures Using Pointers – Functions Using Pointer, Dynamic Memory Allocation, Storage Classes, File Handling in 'C'.

UNIT 4 OBJECT ORIENTED PROGRAMMING CONCEPTS

9 Hrs.

Introduction-Procedure vs. object oriented programming-Concepts: Classes and Objects-Operator & Function Overloading-Inheritance-Polymorphism and Virtual Functions.

UNIT 5 TEMPLATES AND EXCEPTION HANDLING

9 Hrs.

Function Templates and Class Templates – Name spaces – Standard Template Library - Casting – Exception Handling – case study.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, the student will be able to

- CO1 - Develop simple applications in C using basic constructs.
- CO2 - Design and Implement applications using arrays and strings.
- CO3 - Develop and Implement applications using memory allocation and File concepts.
- CO4 - Apply proper class protection to provide security.
- CO5 - Examine the reusability of code through Inheritance.
- CO6 - Analyze virtual functions to implement polymorphism.

TEXT / REFERENCE BOOKS

1. Deitel and Deitel, "C how to Program", 7th Edition, Pearson Education, 2013.
2. Brian W.Kernighan and Dennis M.Ritchie, "The C Programming Language", Pearson Education, 2015.
3. Yashavant Kanetkar, "Understanding Pointers in C", 4th Revised & Updated Edition, Bbp Publications, 2008.
4. E Balagurusamy, "Object Oriented Programming with C++", 3rd edition, Tata McGraw Hill, 2006.
5. Bhawe, "Object Oriented Programming with C++", Pearson Education, 2004.
6. John R Hubbard, "Programming with C++", Schaums Outline Series, McGraw Hill, 2nd edition, 2009.
7. Bjarne Stroustrup, "Programming: Principles and Practice using C++", 1st Edition, Addison Wesley Publications, 2008.

SEEA1401	POWER ELECTRONICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To impart knowledge on different types of power semiconductor devices and its switching characteristics.
- To study the operation, characteristics and performance parameters of controlled rectifiers.
- To understand the operations of choppers and inverters.
- To get acquainted with the applications of power electronics converters.

UNIT 1 POWER SEMICONDUCTOR DEVICES

9 Hrs.

Overview of V-I characteristics of switching devices - Switching characteristics of Power Diode, Power BJT, Power MOSFETs, IGBT and Thyristor - SCR Protection circuits - Thyristor Turn-ON methods - Firing circuits - Commutation techniques.

UNIT 2 PHASE CONTROLLED RECTIFIERS

10 Hrs.

Principle of phase controlled converter operation - single phase half wave converter, semi converter & full converter with R, RL & RLE load - Freewheeling diode - Inverter operation of full converter - Three phase Semi converter & full converter with RL load.

UNIT 3 DC & AC CHOPPERS

9 Hrs.

DC - DC: Principle of operation of Step down and step up choppers - Control Strategies - One, Two and Four quadrant operation. AC - AC Chopper: Single phase AC voltage controllers with R & RL load - Multistage sequence control. Single phase step up and step down cycloconverters.

UNIT 4 INVERTERS

9 Hrs.

Principle of operation: Single phase half bridge & full bridge voltage source inverters - Series Inverters - Parallel Inverters. Three phase Voltage source inverters (120° and 180° mode) - Single phase current source inverter. PWM techniques: Single pulse PWM, Sinusoidal PWM, Modified sinusoidal PWM and multiple PWM.

UNIT 5 APPLICATIONS

8 Hrs.

SMPS: Flyback and Push Pull - UPS: Redundant and Non-Redundant - HVDC Transmission systems - DC - DC converters for Electric Vehicles - Inverters for standalone photovoltaic systems.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Examine the V - I and Switching Characteristics of various Semiconductor Devices.
- CO2 - Evaluate the various performance parameters of different converters.
- CO3 - Analyze different Chopper Circuits.
- CO4 - Design various Inverters based on real time applications.
- CO5 - Analyze the Knowledge acquired in Power Electronics for High voltage applications.
- CO6 - Design Power Electronic Converters to enhance the performance of Renewable Energy sources.

TEXT / REFERENCE BOOKS

1. Rashid M.H., "Power Electronics circuits Devices and Applications", Prentice Hall, 3rd Edition, New Delhi, 2013.
2. P.S.Bimbhra, "Power Electronics", Khanna Publishers, 4rd Edition, 2017.
3. P.C.Sen, "Power Electronics", Tata Mc Graw Hill Company, New Delhi, 2015.
4. M.D.Singh and K.B.Khanchandani, "Power Electronics" TMH, New Delhi, 2nd Edition, 2008.
5. Ned Mohan, Tore .M. Undel and William P. Robbins "Power Electronics: Converters, Applications and Design", John Wiley & Sons, 3rd Edition, 2003.
6. Philip T. Kerin, "Elements of Power Electronics" Oxford University Press, 2004 Edition.

SEEA1402	T TRANSMISSION AND DISTRIBUTION	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- To impart knowledge about the fundamental concepts of electrical power transmission & distribution, both AC & DC and busbar arrangements.
- To interpret the transmission line parameters and performance of overhead transmission system.
- To have a knowledge on insulators and cables.
- To introduce the need of FACTS technology and high voltage AC and DC transmission.

UNIT 1 STRUCTURE OF ELECTRIC POWER SYSTEM**10 Hrs.**

Single Line Diagram - Distributors with Concentrated and Uniform Loading - DC Two Wire and Three Wire Systems - AC Distributors - Radial and Ring Distributors - Interconnectors - **Electrical Layout & Bus Bar Arrangement in Generating Sub Stations and Bulk Power Substation** - Kelvin's Law for the Design of Feeders and its Limitations.

UNIT 2 TRANSMISSION LINE PARAMETERS**9 Hrs.**

Resistance, Inductance and Capacitance of Single Phase and Three Phase (Including Double Circuits) Transmission Lines - Stranded and Bundled Conductors - Symmetrical and Unsymmetrical Spacing - Transposition - Application of Self and Mutual GMD - Skin and Proximity Effect - Inductive Interference with Neighboring Circuits - Corona - Factors Affecting Corona - Advantages and Disadvantages of Corona - Methods of Reducing Corona Effect.

UNIT 3 PERFORMANCE OF TRANSMISSION LINES**9 Hrs.**

Equivalent Circuits for Short, Medium (π and T circuits) and Long Lines - Efficiency and Regulation - Attenuation Constant, Phase Constant, Surge Impedance and Surge Impedance Loading - Real and Reactive Power Flows in Lines - Power Circle Diagrams for Receiving and Sending Ends - Ferranti Effect.

UNIT 4 INSULATORS, CABLES AND MECHANICAL DESIGN OF OH LINES**9 Hrs.**

Insulators - Types and Construction - Voltage Distribution in String Insulator - string Efficiency - Methods of Improving String Efficiency - Cables - types - Capacitance of Cables - Insulation Resistance - Dielectric Stress and Grading - Dielectric Loss - Thermal Characteristics - capacitance of Three Core Cables - Stress and Sag Calculations - Effect of Wind and Ice - Supports at Different Levels - stringing Chart.

UNIT 5 RECENT TRENDS IN TRANSMISSION**8 Hrs.**

Extra High Voltage AC (EHVAC) Transmission - Need, Advantages, Limitations -High Voltage Direct current Transmission (HVDC) - Terminal Equipment for HVDC Systems - Classifications, Advantages, Limitations - Economic Distance for HVDC - Comparison of EHVAC and HVDC Transmission -Interconnection of HVDC & AC Systems - **Voltage Control of Lines - Introduction to FACTS Technology -SVC,TCSC,STATCOM, UPFC.**

Max. 45 Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1 - Apply basic circuit knowledge on calculating voltage-current for transmission and distribution system.
- CO2 - Evaluate transmission line parameters for single and three phase system.
- CO3 - Analyze the performance of over head transmission line.
- CO4 - Design the overhead transmission line on mechanical aspect and estimate the performance parameters of line insulator and cables.
- CO5 - Develop compensation techniques for transmission line using FACTS devices.
- CO6 - Examine the economic aspects of high voltage transmission (AC and DC).

TEXT / REFERENCE BOOKS

1. C.L. Wadhwa, "Electrical Power Systems", 6th Edition, New Age International (P) Limited, New Delhi, 2010.
2. V.K. Metha & Rohit Metha, "Principles of Power System", S. Chand, 3rd Edition, 2006.
3. S.L. Uppal, Electrical Power, Khanna Publishers, New Delhi, 2006.
4. Chakrabarti A, Soni M.I., Gupta P.V., "Textbook on power system engineering", Dhanpat Rai & Co., 2008.
5. S.N. Singh, "Electric Power Generation, Transmission & Distribution", Prentice Hall of India, New Edn, New Delhi, 2008.
6. Soni, Bhatnagar and Gupta, "Electrical Power", Dhanpat Rai & Sons, New Delhi, 2006.
7. Colin R. Bayliss, Brian Hardy, 4th Edition, "Transmission and Distribution Electrical Engineering", Newnes, 2012.

SEEA3008	ELECTRICAL ESTIMATION AND ENERGY AUDITING			L	T	P	Credits	Total Marks
				3	0	0	3	100

COURSE OBJECTIVES

- To make key decision in the area of energy management.
- To maximize the profits on energy utilization (minimize cost).
- To convey knowledge on necessity to study energy auditing methods and energy saving opportunities in electrical system.

UNIT 1 SYSTEMS OF INTERNAL WIRING AND EARTHING**9 Hrs.**

Systems of Internal Wiring and Earthing Conventional symbols for various wiring items, accessories - Indian Electricity Rules (1956) on installation and earthing - Systems of Internal wiring Wiring systems - Types of wiring - points to be considered for selection of wiring - comparison - Looping back system and Joint box system and tree system - Earthing.

UNIT 2 DOMESTIC, COMMERCIAL AND INDUSTRIAL INSTALLATION ESTIMATE**9 Hrs.**

Conditions and Requirements for Domestic, Commercial and Industrial Installation - steps to be followed in preparing electrical estimate (domestic, industrial and agricultural installation) Estimate the quantity of material required for house and industrial wiring.

UNIT 3 ENERGY AUDITING AND ENERGY MANAGEMENT IN ELECTRICAL SYSTEM**9 Hrs.**

Energy Audit- Definition, Need, Types of Energy Auditing - Energy management approach understanding energy costs- bench marking - energy performance - power factor correction and maximum demand control.

UNIT 4 ENERGY CONSERVATION IN MOTORS, TRANSFORMERS MOTORS OPERATION OF INDUCTION MOTOR**9 Hrs.**

Special Design feature for high efficiency motor - Torque - Speed Characteristics - Operating parameters of motor - Losses - Measurement of efficiency - Determination of energy saving - determination of Load - Assessment of economic feasibility - Transformers Introduction - Transformer Losses - Fixed Losses - Load Losses.

UNIT 5 ENERGY CONSERVATION IN LIGHTING SYSTEM, PUMPING SYSTEM AND DIESEL GENERATING SYSTEM LIGHTING SYSTEM**9 Hrs.**

Light source - choice of lighting - luminance requirement - Energy saving potential of electronic ballasts - Energy saving potential of Occupancy sensors - Fluorescent tube lights - CFL lamps - Energy efficient lighting control - Energy conservation avenues in Lighting system. Pumping Systems Pumping System characteristics - Factors affecting pump performance - Efficient pumping system operation - Energy performance assessment of Diesel conservation avenues.

Max. 45 Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1 - Draw the conventional symbols for various electrical installations. To quote the relevant IE rules for a given electrical installation, earthing and clearance of service lines. Familiarize the types of wiring.
- CO2 - List the points to be considered for selection wiring. Determine the size of wire for internal wiring, Explain the necessity and types of earthing.
- CO3 - Estimate the quantity of materials required for earthing. Differentiate between neutral, earth wire, and domestic and industrial wiring.
- CO4 - Explain the concept and types of energy audit, the energy saving opportunities in Transformer, Induction motor, lighting and DG system.
- CO5 - Explain the roll of power factor controller in energy saving system.
- CO6 - Explain the roll of sensors in energy saving system, Explain the energy efficient technologies in electrical system.

TEXT / REFERENCE BOOKS

1. K.B. Raina, S.K. Bhattacharya, "Electrical Design: Estimating and Costing" New Age International (P) Limited, 2018.
2. Anlan Chakrabarti, "Energy Engineering And Management" Kindle Edition PHI (30 January 2011).
3. Dr. Subhash Gadhave Anup Goel Siddu S. Laxmikant D. Jathar, "Energy Audit and Management for SPPU" Technical Publications; 1st Edition (2018).
4. Sonal Desai, "Handbook of Energy Audit" McGraw Hill Education (1 July 2017).

SEEB5201	SOLID STATE AC DRIVES	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- Ability to understand and analyse the VSI and CSI fed drive.
- Understand the speed control of induction motor by stator and rotor side control.
- Ability to learn synchronous motor drives with fixed and variable frequency.

UNIT 1 STATOR VOLTAGE CONTROL OF INDUCTION MOTOR**9 Hrs.**

Torque, Slip characteristics, Equivalent circuit, Speed control – Variable Voltage, Variable Frequency, Constant V/F operation, Operation with different types of loads, Performance, Comparison of different AC power controllers, Speed reversal, Closed loop control.

UNIT 2 STATOR FREQUENCY CONTROL**9 Hrs.**

Operation of induction motor with non sinusoidal supply waveforms, Variable frequency operation of 3 phase induction motors, Constant flux operation, Current fed operation, Dynamic and regenerative braking of CSI and VSI fed drives.

UNIT 3 ROTOR RESISTANCE CONTROL**9 Hrs.**

Torque, Slip characteristics, Types of rotor choppers, Torque equations, Constant torque operation, TRC strategy, Closed loop speed control.

UNIT 4 SLIP POWER RECOVERY SCHEME**9 Hrs.**

Equivalent circuit, Torque equation, Torque - Slip characteristics - Power factor considerations - Sub synchronous operation and closed loop speed control, Vector or Field control - Direct Vector control.

UNIT 5 SYNCHRONOUS MOTOR DRIVES**8 Hrs.**

Need for leading PF operation - Open loop VSI fed drive and its characteristics - Self control - Torque angle control - Power factor control - Brush less excitation system - Starting methods - Principles of vector control.

Max. 45 Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1 - Examine solid state drives for speed control of 3 phase induction motor
- CO2 - Analyse different speed control methods in A.C motors using thyristor based control schemes.
- CO3 - Examine vector control method for controlling the Induction motor drive.
- CO4 - Develop vector control method for controlling the synchronous motor drive.
- CO5 - Design solid state drives for speed control of 3 phase Synchronous motor
- CO6 - Evaluate the performance and speed control of AC drives.

TEXT / REFERENCE BOOKS

1. Murphy, J.M.D., Turnbull F.G., "Thyristor control of AC motors", Pergamon Press, 2010.
2. B.K.Bose, "Power Electronics & AC drives", Academic Press, 2006.
3. Dubey .G.K., "Power Semiconductor Controlled Drives", Prentice Hall International, Newyork, 2001.
4. Dewan.S.B. Slemon, G.R. Straughen.A., "Power semiconductor drives", John wiley and sons, Newyork, 1984.
5. I.J.Nagrath & D.P.Kothari, "Electrical Machines", Tata McGraw-Hill Publications, 2006.
6. V.R.Moorthi, "Power Electronics Drives, Circuits, and Industrial Applications," Oxford University press, First published in India 2005, (sixth impression 2008).
7. R. Krishnan, "Electric Motor Drives: Modelling, Analysis, and Control", Prentice Hall, 2001.
8. Leonhard, Werner, "Control of Electrical Drives", 3rd edition, 2001, Springer 2001.
9. Paul C. Krause, Oleg Wasynczuk, Scott D. Sudhoff - "Analysis of Electric Machinery and Drive systems", IEEE press, 2013.

SEEB5202	ADVANCED POWER SEMICONDUCTOR DEVICES	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To study the characteristics of advanced power semiconducting switches.
- To analyse the on-state and switching losses involved in the operation of power semiconducting switches.
- To study the firing and protection circuits of advanced power semiconducting switches.

UNIT 1 INTRODUCTION

9 Hrs.

Power switching devices overview – Attributes of an ideal switch, application requirements, circuit symbols; Power handling capability – (SOA); Device selection strategy – On-state and switching losses – EMI due to switching – Power diodes – Types, forward and reverse characteristics, switching characteristics – Rating.

UNIT 2 CURRENT CONTROLLED DEVICES

9 Hrs.

BJT's – Construction, static characteristics, switching characteristics; Negative temperature co-efficient and secondary breakdown; Power Darlington – Thyristors – Physical and electrical principle underlying operating mode, Two transistor analogy – concept of latching; Gate and switching characteristics; converter grade and inverter grade and other types; series and parallel operation; comparison of BJT and Thyristor – Steady state and dynamic models of BJT & Thyristor.

UNIT 3 VOLTAGE CONTROLLED DEVICES

9 Hrs.

Power MOSFETs and IGBTs – Principle of voltage controlled devices, construction, types, static and switching characteristics, steady state and dynamic models of MOSFET and IGBTs – Basics of GTO, MCT, FCT, RCT and IGBT.

UNIT 4 FIRING AND PROTECTING CIRCUITS

9 Hrs.

Necessity of isolation, pulse transformer, opto-coupler – Gate drive circuit: SCR, MOSFET, IGBTs and base driving for power BJT. - Over voltage, over current and gate protections; Design of snubbers.

UNIT 5 THERMAL PROTECTION

9 Hrs.

Heat transfer – conduction, convection and radiation; Cooling – Liquid cooling, vapour – Phase cooling; Thermal modelling of power switching devices: Thermal equivalent circuit, Coupling of electrical & thermal components, heat sink types and design – Mounting.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Examine the concept of Power semiconductor devices.
- CO2 - Analyse the performance of the current controlled and voltage controlled devices.
- CO3 - Explain the working of power semiconductor devices.
- CO4 - Evaluate the characteristics of all power semiconductor devices.
- CO5 - Examine the applications of power semiconductor devices.
- CO6 - Design firing circuits protection circuits and to provide thermal protection for power semiconductor devices.

TEXT / REFERENCE BOOKS

1. Mohan N., Undeland and Robbins, "Power Electronics – Converters, Application & Design", John Wiley & Sons, Inc, 3rd Edition, Newyork, Reprint, 2009.
2. Simon M.Sze & Kwok K.Ng, "Physics of Semiconductor Devices", A Wiley Inter Science Publications, John Wiley and Sons, New Jersey, 3rd Edition, 2007.
3. Rashid M.H., "Power Electronics Circuits, Devices and Applications", Pearson Education, 2013.
4. M.D.Singh and K.B. Khanchandani, "Power Electronics", Tata McGraw Hill Companies, Electrical and Electronics Engineering Series, 2nd Edition, 3rd Reprint, 2008.
5. Jayant Baliga, "Advanced Power Rectifier Concepts", Springer, 2008.
6. Jayant Baliga, "Advanced High Voltage Power Devices Concepts", Springer, 2010.
7. Dieter K.Schroder, "Semiconductor Material and Device Characterization", A John Wiley and Sons Inc, Publication, New Jersey, 2006.
8. Robert F.Pierret, "Semiconductor Device Fundamentals", Pearson Education, 2nd Impression, 2008.
9. Donald A.Neamen, "Semiconductor Physics and Devices", McGraw Hill companies, Special Indian Edition, 2007.
10. P.C. Sen, "Power electronics", S.Chand Ltd., 2007.

SEEB7006	POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To provide the knowledge of photo voltaic system and wind energy system.
- To analyse the knowledge for standalone PV systems.
- To obtain the analysis of power control through PV inverters for hybrid and grid connected PV systems.
- To design control and gate driver circuitry for wind energy converter.
- To develop a prototype of wind energy converter with recent control technique.

UNIT 1 INTRODUCTION**9 Hrs.**

Overview of Indian energy scenario – Energy sources and availability – Energy crisis – Need to develop new energy technologies – Solar energy availability in India – Wind survey in India – Emerging trends in electrical energy utility – Energy and environment.

UNIT 2 POWER ELECTRONICS FOR PHOTOVOLTIC SYSTEMS**9 Hrs.**

Solar cell fundamentals – Conversion of sunlight to electricity – Cell performance – Basics of photovoltaic – Types of PV power systems – Standalone PV systems – Battery charging – PV charge controllers – Maximum Power Point Tracking (MPPT) – Inverters for stand alone PV systems – Solar water pumping – Power conditioning unit for PV water pumping.

UNIT 3 HYBRID AND GRID CONNECTED PV SYSTEMS**9 Hrs.**

PV Diesel hybrid systems – Control of PV – Diesel hybrid system – Grid connected PV systems – Inverters for grid connected applications – Inverter – Inverter types – Power control through PV inverters – System configuration – Grid inverter characteristics.

UNIT 4 POWER ELECTRONICS FOR WIND POWER SYSTEM**9 Hrs.**

Basics of wind power – Types of wind turbines – Types of wind generators – Types of wind power systems – Stand alone wind diesel hybrid systems – Grid connected wind energy systems.

UNIT 5 SYSTEM MANAGEMENT OF WIND ENERGY CONVERTER**9 Hrs.**

Prototype development – Control circuitry – Microcontroller – Complex programmable logic device – Gate driver circuitry for wind energy applications.

Max. 45 Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1 - Comprehend the concepts of photovoltaic system and wind energy system.
- CO2 - Examine power electronics for standalone photovoltaic systems.
- CO3 - Design a hybrid grid connected PV systems.
- CO4 - Develop a power electronics based grid connected wind energy system.
- CO5 - Analyse gate driver circuitry for wind energy applications.
- CO6 - Develop prototype for energy applications.

TEXT / REFERENCE BOOKS

1. Rashid. M. H, "Power Electronics Handbook", Academic press, 4th edition, September 29th, 2017.
2. Erickson. R., Angkrittakul. S, Al – Nasean. O and Lujan. G, "Novel power electronics systems for wind energy applications" – Final report, National Renewable Energy Laboratory, Colorado, U.S. – Aug 24, 1999 – Nov 30, 2002.

SEEB7008	FLEXIBLE AC TRANSMISSION SYSTEMS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To emphasize the necessity for FACTS controllers.
- To learn the characteristics and applications of Static Var Compensator.
- To impart the knowledge on Thyristor Controlled Series Capacitor.
- To be familiar with the operation and control of Static Synchronous Compensator.
- To analyze the concept of Sub Synchronous Resonance.

UNIT 1 INTRODUCTION

9 Hrs.

Concepts of reactive power – Load compensation – System compensation – Midpoint conditions of a symmetrical line – Passive shunt and series compensation – Synchronous condenser – Saturated reactor – Phase shifting transformer – Concept of FACTS devices.

UNIT 2 STATIC VAR COMPENSATOR (SVC)

9 Hrs.

Thyristor Controlled Reactor (TCR) - Thyristor Switched Reactor (TSR) - Thyristor Switched Capacitor (TSC) - Fixed Capacitor - Thyristor Controlled Reactor (FC-TCR) - Thyristor Switched Capacitor - Thyristor Controlled Reactor (TSC - TCR) – V-I Characteristics of Static Var Compensator (SVC) - Advantages of slope in dynamic Characteristic – Voltage control by SVC – Design of SCV voltage regulator. Applications: Increase in power transfer capacity – Enhancement of transient stability – Prevention of voltage instability.

UNIT 3 THYRISTOR CONTROLLED SERIES CAPACITOR (TCSC)

9 Hrs.

Concept of series compensation - Thyristor Controlled Series Capacitor (TCSC) controller: Basic principle – Modes of Operation – Advantages - Analysis – Capability Characteristic, Modelling of TCSC, Applications: Open loop and closed loop control – Improvement of the system stability limit – Enhancement of system damping- Concept of Advanced Series Capacitor (ASC).

UNIT 4 EMERGING FACTS CONTROLLER

9 Hrs.

Static Synchronous Compensator (STATCOM): Principle of Operation – V-I Characteristic – Harmonic performance – Steady state model. SSSC: principle of operation – Control system. Unified Power Flow Controller (UPFC) : Principle of Operation – Injection model. Interline Power Flow Controller (IPFC): Principle of Operation – Control structure - Hybrid Power Flow Controller (HPFC) - Evaluation of different FACTS controllers.

UNIT 5 SUB SYNCHRONOUS RESONANCE (SSR)

9 Hrs.

NGH-SSR damping scheme – Thyristor controlled braking resistor (TCBR) – Coordination of Multiple Controllers using Linear Control Techniques – Approximate multimodal decomposition method for the design of FACTS controllers.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Examine reactive power compensation.
- CO2 - Analyse the operation and control of static var compensator.
- CO3 - Develop model for Thyristor controlled series capacitor.
- CO4 - Design emerging FACTS controller.
- CO5 - Analyse coordination of multiple controllers.
- CO6 - Design FACTS controllers.

TEXT / REFERENCE BOOKS

1. R. Mohan Mathur, Rajiv K. Varma, "Thyristor-based facts controllers for electrical transmission systems", Wiley-IEEE, 2002.
2. K.R.Padiyar, "Facts Controllers in Power Transmission & Distribution", New Age International Publishers (P) Ltd., 2016.

3. Enrique Acha, Claudio R. Fuerte-Esquivel, Hugo Ambriz-Perez, Cesar Angeles-Camacho, "FACTS: Modelling and Simulation in Power Networks", John Wiley & Sons Ltd., 2004.
4. S. Sivanagaraju, S.Sathyabharayana, "Electric Power Transmission and Distribution", Pearson Education, 2009.
5. Kalyan K. Sen & Mey Ling Sen, "Introduction to FACTS Controllers: Theory, Modelling, and Applications", Wiley-IEEE, 2009.
6. Narain G. Hingorani, Laszlo Gyugyi, "Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems", IEEE Press Standard Publishers Distributors, 2000.

SEEB7009	HIGH VOLTAGE DIRECT CURRENT TRANSMISSION	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To impart knowledge on operation, modelling and control of HVDC link.
- To impart knowledge on HVDC Converter.
- To convey knowledge on HVDC system control.
- To analyze performance converter model.

UNIT 1 DC POWER TRANSMISSION TECHNOLOGY**9 Hrs.**

Introduction - Comparison of AC and DC transmission - Application of DC transmission – Description of DC transmission system - Planning for HVDC transmission - Modern trends in DC transmission.

UNIT 2 ANALYSIS OF HVDC CONVERTERS**9 Hrs.**

Pulse number, choice of converter configuration - Simplified analysis of Graetz Circuit - Converter bridge characteristics – Characteristics of a twelve pulse converter - Detailed analysis of converters.

UNIT 3 CONVERTER AND HVDC SYSTEM CONTROL**9 Hrs.**

General principles of DC link control - Converter control characteristics - System control hierarchy - Firing angle control - Current and extinction angle control - Starting and stopping of DC link - Power control - Higher level controllers - Telecommunication requirements.

UNIT 4 MULTITERMINAL DC SYSTEM**9 Hrs.**

Multiterminal DC systems: Introduction – Potential application of MTDC systems – Types of MTDC systems – Control and protection of MTDC systems - Operation of HVDC breaker.

UNIT 5 HARMONICS AND CONVERTER COMPONENT MODEL**9 Hrs.**

Introduction - Generation of harmonics - Design of AC filters - DC filters - Carrier frequency and RI noise. Converter model - Continuous time model - Discrete time converter model - Detailed model of the converter.

Max. 45 Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1 - Examine need of DC transmission, and various plans to transmit HVDC.
- CO2 - Analysis of various converter and identification of suitable converter for HVDC transmission.
- CO3 - Select better control system of the converter for HVDC system.
- CO4 - Examine the different types of DC system and protection methods of MTDC system.
- CO5 - Analysis of various converter model components performance.
- CO6 - Analysis of harmonic generation and effect of filters.

TEXT / REFERENCE BOOKS

1. Padiyar K.R., "HVDC Power Transmission Systems", New Age International (P) Limited, Publishers, 2015.
2. Rakosh Das Begamudre, "Extra High Voltage AC Transmission Engineering", 3rd Edition, New Age International (P) Limited, Publishers., 2009
3. Chakrabarti A., M.L.Soni, P.V.Gupta, U.S.Bhatnagar, "Power System Engineering", Dhanpat Rai & Co., 2010.
4. Sunil S.Rao, "Switchgear Protection and Power Systems", Khanna Publishers, 2008.

SISB9101	RESEARCH METHODOLOGY AND IPR	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To understand the concepts of research.
- To provide an insight into the techniques of research.
- To learn the requisites of writing a research report.
- To impart knowledge on formulation of research problem, research methodology, ethics involved in doing research and importance of IPR protection

UNIT-I RESEARCH PREPARATION AND PLANNING 9 Hrs

Objectives of research – Understanding research and its goals, Critical thinking, Techniques for generating research topics. Topic selection and justification. Techniques involved in designing a questionnaire – Methods of scientific enquiry – Formulation of hypotheses and testing of the same – Development of a research proposal

UNIT-II RESEARCH RESOURCES 9 Hrs

Sources of information. Literature search. World Wide Web, Online data bases – search tools. Citation in does – Principles underlying impact factor – Literature review – Case studies, review articles and Meta analysis – Role of the librarian. Ethical and moral issues in Research, Plagiarism, tools to avoid plagiarism

UNIT-III ACADEMIC WRITING AND PRESENTATION 9 Hrs

Proposal submission for funding agencies, Elements of Style. Organization of proposals, Basic knowledge of funding agencies, Research report writing, Communication skills, Tailoring the presentation to the target audience – Oral presentations, Poster preparations, Submission of research articles for Publication in Reputed journal, Thesis writing and Research report writing. Elements of excellent presentation: preparation, visual and delivery, oral communication skills and oral defense.

UNIT-IV DATA COLLECTION, ANALYSIS AND INFERENCE 9 Hrs

Basic statistical distributions and their applications. Sample size determination and sampling techniques. Large sample tests and small sample tests

UNIT-V INTELLECTUAL PROPERTY RIGHTS 9 Hrs

Nature of Intellectual Property: Patents, Designs, Trade Mark and Copyright. Process of Patenting and Development: technological research, innovation, patenting & development. Procedure for grants of patents, Patenting under PCT. Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System.

Total Hrs: 45

COURSE OUTCOMES

On completion of the course, student will be able to

- CO 1** Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
- CO 2** Understand research problem formulation & Analyze research related information and Follow research ethics
- CO 3** Correlate the results of any research article with other published results. Write a review article in the field of engineering
- CO 4** Appreciate the importance of IPR and protect their intellectual property.

- C05** Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits

TEXT / REFERENCE BOOKS

1. Cooper Donald R, Schindler Pamela S and Sharma JK, "Business Research Methods", Tata McGraw Hill Education, 11e (2012).
2. Catherine J. Holland, "Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets", Entrepreneur Press, 2007.
3. David Hunt, Long Nguyen, Matthew Rodgers, "Patent searching: tools & techniques", Wiley, 2007.
4. The Institute of Company Secretaries of India, Statutory body under an Act of parliament, "Professional Programme Intellectual Property Rights, Law and practice", September 2013.
5. James C. Van Horne, Stanford University, Financial Management and Policy, Prentice Hall,
6. James R. McGuigan, R. Charles Moyer, Frederick H. deB. Harris, Managerial economics – applications, strategy and Tactics, Cengage learning, India
7. Philip Kotler, Marketing management Pearson Education, India
8. Modern Production / Operations Management, Elwood S. Buffa & Rakesh Sarin, Wiley India
9. Ronald R. Sims, Organizational success through effective human resources Management, Quorum books, London
10. Ganesan R, Research Methodology for Engineers, MJP Publishers, Chennai. 2011 .

SBAA4002	PRINCIPLES OF MANAGEMENT AND PROFESSIONAL ETHICS			L	T	P	Credits	Total Marks
				3	0	0	3	100

COURSE OBJECTIVES

- To gain knowledge about the fundamentals of management.
- To understand the tools and techniques of the various aspects of management.
- To apply management concepts in decision making.

UNIT 1 MANAGEMENT THEORIES

9 Hrs.

Definition of management, science or art, manager vs entrepreneur; Types of managers - managerial roles and skills; Evolution of management-scientific, human relations, system and contingency approaches; Types of Business Organizations, sole proprietorship, partnership, company, public and private enterprises; Organization culture and environment; Current trends and issues in management.

UNIT 2 PLANNING, DECISION MAKING AND ORGANISING

9 Hrs.

Nature and purpose of Planning, types of Planning, objectives, setting objectives, policies, Strategic Management, Planning Tools and Techniques, Decision making steps & processes. Nature and purpose of Organizing, formal and informal organization, organization structure, types, line and staff authority, departmentalization, delegation of authority, centralization and Decentralization, job design.

UNIT 3 STAFFING AND LEADING

9 Hrs.

Human resource management, HR Planning, Recruitment selection, training & development, performance management, career planning and management, Directing individual and group behavior, motivation, motivation theories, motivational techniques, job satisfaction, job enrichment, leadership, types & theories of leadership, effective communication.

UNIT 4 CONTROLLING AND REPORTING

9 Hrs.

Controlling, system and process of controlling, budgetary and non-budget control technique, use of computer and IT in management control, productivity problems and management, control and performance, direct and preventive control, reporting.

UNIT 5 VALUES AND ETHICS

9 Hrs.

Human Values – Natural acceptance - Ethics – Definition- Objectives - Virtues – Challenges in the work place - Engineering ethics - Scope - Moral issues and judgment - Moral development theories – Engineers as responsible experimenters - Codes of ethics - Industrial standards - Global Issues: Environmental ethics- Computer ethics - Ethics and codes of business conduct in MNC.

Max. 45 Hrs.

COURSE OUTCOME

On completion of this course, the students will be able to

- CO1 - Describe the evolution and development of management concepts.
- CO2 - Understand the functions of management.
- CO3 - Apply the concepts and develop key competencies for managing human resources.
- CO4 - Analyze appropriate management techniques for Controlling and Reporting.
- CO5 - Evaluate the various aspects of decision making and demonstrate critical thinking.
- CO6 - Elaborate the importance of the ethical dimension in workplace.

TEXT / REFERENCE BOOKS

2. Robins S.P. and Couiter M, "Management", Prentice Hall India, 11th Edition, 2012.
3. Harold Koontz and Heinz Weihrich, "Essentials of Management", Tata McGraw Hill, 10th Edition, 2015.
4. Nagaraazan. R. S, "A Text Book on Human Values and Ethics", New Age International Publishers, New Delhi, 2018.
5. Stoner James A. F., Freeman. R. E and Gilbert. R. D, "Management", Pearson Education, 6th Edition, 2018.
6. Griffin, R. W., "Management", South-Western College Publication 11th Edition, 2012.
7. Gregory. G. D, Gerry. M. C and Alan. E, "Strategic Management: Text and Cases", McGraw Hill, 8th Edition, 2018.
8. Tripathy. P. C & Reddy. P. N, "Principles of Management", Tata McGraw Hill, 5th Edition, 2012.
9. Gupta C.B, "Management Theory and Practice", Sultan Chand and Sons, New Delhi 19th Revised and Enlarged Edition, 2017.

10. Tulsian. P.C & Pandey. V, "Business Organisation & Management", Pearson - Education, 2011.
11. Joseph L. Massie, "Essentials of Management", Pearson Education, 4th Edition, 2016.
12. Harris Pritchard and Rabins, "Engineering Ethics", Cengage Learning, New Delhi. 4th Edition, 2014.

SEEA2601	MEASUREMENTS AND CONTROLS LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

COURSE OBJECTIVES

- To impart knowledge on analysis and design of control system along with basics of instrumentation.
- To implement the measurement techniques for various electrical quantities.
- To analyze the transfer function of DC machines.
- To design compensators for an appropriate applications.
- To synthesis speed of multiple machines by applied voltage control method.

SUGGESTED LIST OF EXPERIMENTS

- 1 Measurement of self-inductance by Maxwell's inductance bridge.
- 2 Calibration of Ammeter, Voltmeter and Wattmeter.
- 3 Calibration of Three phase energy meter.
- 4 Instrumentation Amplifier.
- 5 Study of LVDT and Pressure Transducer.
- 6 Design of P, PI and PID controller.
- 7 Study of temperature measuring transducers (Thermocouple).
- 8 Transfer function of DC generator.
- 9 Transfer function of Field controlled DC motor.
- 10 Transfer function of Armature controlled DC motor.
- 11 Speed Control of Ward Leonard system.
- 12 Transfer function of lag, lead and lag-lead network.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Apply optimal control and non-linear control techniques.
- CO2 - Analyze design and operation of control systems employed in various industries.
- CO3 - Analyze the transfer function of various DC Machines.
- CO4 - Describe P, PI, PID controller for any applications using MATLAB.
- CO5 - Examine the physical parameters by using various transducers.
- CO6 - Evaluate the basic meters and energy meter by calibrating the error.
- arming techniques to solve practical engineering problems.

SEEA2602	POWER SYSTEMS LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

COURSE OBJECTIVES

- To have hands on experience on various system studies and different techniques used for system planning using Software packages.
- To gain Knowledge in designing of automation problem.

SUGGESTED LIST OF EXPERIMENTS

1. Computation of Power System Components in Per Unit.
2. Formulation of the bus admittance matrix by Direct inspection method.
3. Formulation of the bus admittance matrix by Singular transformation method.
4. Formation of bus impedance matrix.
5. Analysis of Daily Load Curve.
6. Automatic Generation Control.
7. Determination of Transmission line parameters.
8. Numerical Integration of Swing equation.
9. Load flow solution using Gauss – Seidal method.
10. Load flow solution using Newton – Rapson method.
11. Fault analysis.
12. Characteristics of Microcontroller based Frequency relay.
13. Construction of simple ladder program for Logic gates.
14. Applications of Delay Timers in PLC.
15. Applications of Counters in PLC.

COURSE OUTCOMES:

On completion of the course, student will be able to

- CO1 - Create bus impedance and admittance matrix and compute P.U power system model.
- CO2 - Estimate the various fault currents in power system and compute inductance in Transmission lines.
- CO3 - Solve the power flow analysis using Gauss Seidel and N-R method.
- CO4 - Analyze the daily load curve and automatic generation control.
- CO5 - Identify the stability of system and characteristics of various relay.
- CO6 - Design ladder diagram for different automation problem using PLC.

SITA3011	Block Chain Technologies	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To introduce Bit coin and other crypto currencies.
- To study the algorithms and techniques in block chain.
- To understand the practical aspects in the design of crypto currency
- To understand the function of Block chains as a method of securing distributed ledgers.
- To design, code, deploy and execute a smart contract.

UNIT 1 INTRODUCTION TO BLOCKCHAIN

Basics of blockchain-Public Ledgers-Block Chain as Public Ledgers-Types of Block chains- Pillars of Block chain Government Initiatives of Block Chain-Bitcoin-Smart Contracts

UNIT 2 ARCHITECTURE AND CONCEPTUALIZATION OF BLOCK CHAIN, CRYPTO CURRENCIES

Block in a Block chain-find Transactions-Distributed Consensus-Proof of work, Stake, Space- Attacks on POW-EthereumPos/POW Hybrids-Crypto currency to block chain 2.0, Model of Blockchain-Algorand.

UNIT 3 CRYPTO PRIMITIVES, SECURING AND INTERCONNECTING PUBLIC AND PRIVATE BLOCK CHAINS

Hash Function and Merkle Tree-Security Properties-Security Considerations for block chain-Digital Signature-Public Key Cryptography-Bit coin block chain incentive structures- Nash Equilibriums- evolutionary stable strategies, -and Pareto- efficiency (game theory) Weaknesses and new Points of Failure- Mitigation Methods- Redundancies and fall-back methods

UNIT 4 MINING AND CRYPTO CURRENCIES - HOW TO USE AND INTERACT

Mining-Pools-Impact of CPU and GPU-Transaction in Bit coin Network- Block Mining-Block propagation and block relay

UNIT 5 USE CASES-APPLICATIONS IN DIFFERENT AREAS

Industry applications of Blockchain-Blockchain in Government-Government use cases-Preventing Cybercrime through blockchain-BlockChain in defense, tax payments

COURSE OUTCOMES:

On completion of the course, the student should be able to

- CO1: Explain the structure of a block chain.
- CO2 :Analyze the incentive structure in a block chain based system.
- CO3 :Judge the scenario where "smart" contract is most appropriate.
- CO4 :Identify Basic knowledge of Bitcoin, Ethereum.
- CO5 :Apply Blockchain in future use cases for security.
- CO6 :Understand the various Block Chain applications.

TEXT / REFERENCE BOOKS

1. Mastering Bitcoin: Unlocking Digital Cryptocurrencies, by Andreas Antonopoulos O'Reilly, First Edition, 2014.
2. Blockchain by Melanie Swa, O'Reilly Media 2015
3. Zero to Block chain - An IBM Redbooks course, by Bob Dill, David Smits -

SEEA2702	EMBEDDED AND DSP LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

COURSE OBJECTIVES

- To impart knowledge in basic of embedded programming using PIC16F877.
- To analyze the various application of embedded systems using Arduino..
- To analyze the various application of embedded systems.
- To have a knowledge in DSP processor, TMS320C24X.

SUGGESTED LIST OF EXPERIMENTS

EMBEDDED LAB

Using PICF877

1. Basic illustration programs for arithmetic operations using PIC16F877.
2. Basic illustration programs for logical operations using PIC16F877.
3. Interfacing LED.
4. Illustration of TIMER.
5. Interfacing of LDR .

Using Arduino

6. Interfacing LCD for display.
7. Interfacing of sensors.
8. Interfacing with the wireless communication modules
9. Design of Stepper Motor Control System
10. Design of Temperature Monitoring System Using RF Modem

Using ARM Processor

11. Program to interface relay card
12. Interface 4-digit seven-segment display to display any four letter word
13. Interfacing real time clock and serial port
14. Interface 2-line LCD module to output a moving message on it.
15. Implementing zigbee protocol with ARM.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Familiarize with the various basic operations using PIC16F877.
- CO2 – Interface sensors and display units with microcontroller.
- CO3 - Analyze the performance of TIMER and Interrupts.
- CO4 - Design of microcontroller-based embedded systems.
- CO5 - Understand the instruction set of 32 bit microcontroller ARM, and the software tool required for programming in Assembly and C language.
- CO6 - Design ARM for a specific Application

SEEA2402	POWER ELECTRONICS AND ELECTRIC VEHICLE LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

COURSE OBJECTIVE

- To enhance practical knowledge in power conversion technique
- To examine power converter circuits with various loads.
- To understand the operation of power converter using timing diagram
- To examine the controller used for motor in E-Vehicle
- To understand the charging and discharging characteristics of battery

SUGGESTED LIST OF EXPERIMENTS

- 1 Single Phase Half & Fully Controlled Bridge Rectifier
- 2 SCR based series and Parallel Inverter
- 3 AC Regulator-Phase Control Using DIAC & TRIAC
- 4 Single phase Cyclo converter
- 5 MOSFET Based Buck & Boost Converter
- 6 IGBT Based Single Phase PWM Inverter
- MATLAB / Simulink Simulation
- Buck Converter
- 7 Boost Converter
- Buck-Boost Converter
- Controlled Rectifier
- 8 Real Time FPGA controlled BLDC HUB motor drive for E-Bike
- 9 Real Time FPGA controlled Mid-Drive motor drive for E-Vehicle
- 10 Discharge characteristics of Lithium –Ion Battery for different load current.
- 11 Study and testing of two wheeler control components function
- 12 Design and testing of battery using battery emulator
- 13 Charging and Discharging test of real battery using battery emulator

Course Outcomes:

On completion of the course, student will be able to –

- CO1 - Apply power conversion to different load using SCR and MOSFET
- CO2 - Analyze the DC-AC power conversion using different control methods
- CO3 - Examine the AC power control for varying frequency and voltage
- CO4 - Design a FPGA controller to control the BLDC motor for E-Vehicle
- CO5 - Analyze the charging and discharging characteristics of battery using emulator

CO6 – Testing of E-Bike control components function

SEEB6101	POWER ELECTRONICS AND DRIVES LAB	L	T	P	EL	Credits	Total Marks
		0	0	4	0	2	100

Pre requisite: SEEB5101

Co requisite: Nil

COURSE OBJECTIVES

- To design and analyze the various DC and AC drives.
- To generate the firing pulses for converters and inverters.
- To design three phase AC voltage regulator.

SUGGESTED LIST OF EXPERIMENTS

1. Single Phase Half and Full converter with R, RL, RLE loads.
2. Three Phase Half and Full converter with R, RL, RLE loads.
3. Three Phase AC voltage regulator.
4. Four quadrant chopper.
5. Modified McMurray - Bedford Inverter.
6. Resonant DC to DC Converter.
7. Speed control of PMDC motor using Voltage Commutated Chopper.
8. Speed control of PMDC motor using Current Commutated Chopper.
9. IGBT based speed control of three phase induction motor using PWM technique.
10. Speed control of BLDC motor.
11. Speed control of SRM motor.
12. Speed control of PMSM
13. Single phase Multi Level Inverter based induction motor drive.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Examine the half and full converter with R, RL and RLE load.
- CO2 - Determine the voltage for three phase AC voltage regulator.
- CO3 - Analyze speed control of PMDC motor using VCC and CCC.
- CO4 - Analyze the performance characteristics of DC-DC converter.
- CO5 - Determine performance characteristics of various motor drives.
- CO6 - Examine the characteristics of Multilevel Inverter based induction motor drive.

SCSA2203	PROGRAMMING IN C AND C++ LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

COURSE OBJECTIVES

- To understand the basic concepts of C/C++ programming.
- To demonstrate the techniques for implementing engineering applications using computer programs.
- To equip students with sound skills in C/C++ programming language.
- To Identify, formulate and solve problems by using computer programming Language.
- To write diversified solutions using C language.

SUGGESTED LIST OF PROGRAMS

1. Programs using Control Statements.
2. Programs using Arrays and Functions.
3. Programs using Structures and Union.
4. Programs using Dynamic Memory Allocation.
5. Programs using Files.
6. Programs using Class and Objects.
7. Programs using Constructor and Destructor.
8. Programs using Function & Operator overloading.
9. Programs using Virtual Functions.
10. Programs using Inheritance.

COURSE OUTCOMES

On completion of the course, the students will be able to

- CO1 - Apply good programming design methods for program development.
- CO2 - Construct programs that demonstrate effective use of C features including arrays, structures, pointers and files.
- CO3 - Develop Recursive Programs.
- CO4 - Develop programs that perform explicit memory management.
- CO5 - Develop programs in object oriented programming.
- CO6 - Apply generic programming techniques to solve practical engineering problems.

SECB1101	FUNDAMENTALS OF ELECTRONIC DEVICES	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To acquaint the students with the construction, theory and operation of the basic electronic devices.
- To understand the mechanisms of current flow in semi-conductors.
- To familiarize on the principle of operation, capabilities and limitation of various advanced semiconductor devices and its practical application.
- To design practical circuits with alternate electronic devices.
- To study Nano devices

UNIT 1 BASIC SEMICONDUCTOR DEVICES

9 Hrs.

PN junction diode- construction and operation, Current equations, Diffusion and drift current densities, forward and reverse bias characteristics, Breakdown in PN Junction Diodes. Applications- Rectifiers, Limiting and Clamping Circuits, Zener diode-construction and VI characteristics.

UNIT 2 BIPOLAR JUNCTION TRANSISTORS

9 Hrs.

Bipolar junction transistors, NPN -PNP, construction, forward and reverse bias characteristics -Early effect, current equations-Input and Output characteristics of CE, CB, CC-Ebers Moll Model-Multi Emitter Transistor, Gummel Poon-model

UNIT 3 FIELD EFFECT TRANSIST

9 Hrs.

FETs-Drain and Transfer characteristics,-Current Equations-Pinch off voltage and its significance-MOSFET- Characteristics- Threshold voltage -Channel length modulation, D-MOSFET, E-MOSFET- Characteristics – Comparison of MOSFET with JFET, DUAL GATE MOSFET

UNIT 4 SPECIAL SEMICONDUCTOR DEVICES

9 Hrs.

Schottky barrier diode-SCR, DIAC, TRIAC, Varactor diode, Tunnel diode, UJT, LDR, Phototransistor, Gallium Arsenide device

UNIT 5 NANO DEVICES

9 Hrs.

Nano Sensors for measurement of temperature, humidity, pressure- Bio Sensors for measurement of blood pressure, heart rate, glucose level, SPO₂- Chemical Sensors for pH, gas measurement- sensors for automation, Linearity characteristics of sensors.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Apply the knowledge of basic semiconductor materials by understanding fabrication processes.
- CO2 - Analyze the characteristics of various electronic devices
- CO3 - Analyze the various circuit configurations and its classifications of Transistor and MOSFETs.
- CO4 - Analyze the characteristics of special semiconductor devices.
- CO5 - Analyze the performance characteristics of various sensors.
- CO6 - Select suitable sensors for automation.

TEXT / REFERENCE BOOKS

1. Donald A Neaman, "Semiconductor Physics and Devices", 4th Edition, Tata McGraw Hill Inc. 2012.
2. Wolfgang Fritzsche (Editor), Jürgen Popp (Editor) "Optical Nano- and Microsystems for Bio-analytics (Springer Series on Chemical Sensors and Biosensors Book 10)" 2012th Edition.
3. Juin J. Liou (Editor), Shien-Kuei Liaw (Editor), Yung-Hui Chung (Editor), "Nano Devices and Sensors Hardcover – Import, 25 April 2016".

4. Salivahanan.S, SureshKumar.N,Vallavaraj.A,"Electronic Devices and circuits",3rd Edition, Tata McGraw Hill,2008.
5. David Bell, "Fundamentals of Electronic Devices and Circuits",5thEdition, Oxford University Press2012.

SECB1102	Fundamentals of Digital Systems	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To impart knowledge on various types of Binary logics.
- To design a binary logic circuit for an arithmetic expression.
- To understand the usage of registers and counters used in various digital circuits.
- To understand the design of memory devices used.
- To get an exposure about the electronics behind design of Basic digital logical elements.

UNIT 1 NUMBER SYSTEMS, LOGIC FUNCTIONS AND BOOLEAN ALGEBRA 9 Hrs.

Number systems – Number systems conversions – Binary arithmetic – Binary codes – Logic functions-Universal gate functions – Boolean algebra – Functionally complete operation sets, Reduction of switching equations using Boolean algebra, Realization of switching function.

UNIT 2 DESIGN OF COMBINATIONAL LOGIC

9 Hrs.

Design procedure of Combinational Logic – Design of two level gate networks – Sum of Products (SOP) – Product of Sums(POS) – Canonical SOP – Canonical POS – Karnaugh Map – Simplifications of Boolean functions using Karnaugh Map and implementation using Logic function – Advantages and limitations of K-Map – Tabulation method – Simplifications of Boolean functions using Tabulation method.

UNIT 3 COMBINATIONAL CIRCUITS

9 Hrs.

Introduction to Combinational circuits – Half Adder, Full Adder – Half Subtractor, Full Subtractor- Parallel binary Adder, Parallel binary Subtractor – Carry look ahead Adder- BCD Adder- Decoders- Encoders – Priority Encoder- Multiplexers- MUX as universal combinational modules- Demultiplexers- Code converters- Magnitude Comparator.

UNIT 4 SEQUENTIAL CIRCUITS

9 Hrs.

Introduction to Sequential circuits – Flip flops – SR, JK, D and T flip flops, Master Slave flip flop, Characteristic and excitation table – Realization of one flip flop with other flip flops – Registers – Shift registers – Counters – Synchronous and Asynchronous counters – Modulus counters – Ring Counter – Johnson Counter – State diagram, State table, State minimization – Hazards.

UNIT 5 DIGITAL LOGIC FAMILIES, MEMORIES AND PROGRAMMABLE DEVICES

9 Hrs.

Classification and characteristics of logic family – Bipolar logic family – Saturated logic family – Non saturated family – Unipolar family – MOS, CMOS logic families. Classification and Organization of memories – Programmable Logic Devices – Programmable Logic Array(PLA) – Programmable Array Logic (PAL) – Field Programmable Gate Arrays (FPGA) .

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Analyze various coding techniques and number conversion systems.
- CO2- Develop suitable techniques to minimize the Boolean equations.
- CO3 - Design the digital circuit using combinational logic.
- CO4 - Design the digital circuit using sequential logic.
- CO5 - Analyze the performance of various digital logic families.
- CO6 - Solve the arithmetic expressions using memories and programmable logic devices and implement memory units with Programmable logic devices.

TEXT / REFERENCE BOOKS

1. John M. Yarbrough, "Digital logic: Applications and Design", Thomas - Vikas Publishing House, 2002.
2. Morris Mano, "Digital design-With an Introduction to the Verilog HDL", 5th Edition, Pearson, 2013.
3. R.P.Jain, "Modern Digital Electronics", 4th Edition, TMH, 2010.
4. Thomas L Floyd, "Digital Fundamentals", 11th edition, Pearson, 2015

5. William H. Gothmann, "Digital Electronics", Prentice Hall, 2001.
6. Tutorial Website: https://www.tutorialspoint.com/digital_circuits/index.htm.

SMEB2102	ENGINEERING DRAWING AND DESIGN	L	T	P	EL	Credits	Total Marks
		0	0	4	0	2	100

COURSE OBJECTIVES

The main learning objective of this course is

- To understand the concept of graphic communication, develop the drawing skills for communicating concepts, ideas and designs of engineering products and to expose them to existing national standards related to technical drawings.
- To make the student to visualize and read the drawings.
- To make the students to understand the importance of sectioning and development of surfaces.
- To learn about the orthographic and pictorial projections.

CONCEPTS AND CONVENTIONS

Importance of graphics in engineering applications - Use of drafting instruments - BIS conventions and specifications — Size, layout and folding of drawing sheets — Lettering and dimensioning.

UNIT 1 PLANE CURVES

Basic Geometrical constructions, Curves used in engineering practices: Conics — Construction of ellipse, parabola and hyperbola by eccentricity method — Construction of cycloid — Drawing of tangents and normal to the above curves.

UNIT 2 PROJECTION OF POINTS AND LINES

Projection - Types of projection - Projection of points lying in four quadrants - Projection of lines (First angle projection only) - Projection of lines parallel and inclined to one or both the planes

UNIT 3 PROJECTION OF SOLIDS

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes and parallel to the other by rotating object method.

Practicing three-dimensional modeling of simple objects by CAD Software (Not for examination)

UNIT 4 SECTION OF SOLIDS

Purpose of sectioning - Sectional views - Hatching - Section plane perpendicular to one plane and parallel to other plane - Section plane inclined to HP-True shape of the section. Practicing three-dimensional modeling of simple objects by CAD Software (Not for examination)

UNIT 5 DEVELOPMENT OF SURFACES AND FREEHAND SKETCHING

Need for development of surfaces - Types of development of surfaces - Development of lateral surfaces of simple and sectioned solids — Prisms, pyramids, cylinders and cones. Orthographic Projection: Visualization concepts and Free Hand sketching: Visualization principles — Representation of Three Dimensional objects — Layout of views- Freehand sketching of multiple views from pictorial views of objects.

Practicing three-dimensional modeling of simple objects by CAD Software (Not for examination)

COURSE OUTCOMES

On completion of the course, students will be able to

- CO1 - Identify the national standards related to the Engineering drawing based on BIS and construct conic sections and polygons.
- CO2 - Solve practical problems involving projection of lines.
- CO3 - Draw orthographic projections of solids.
- CO4 - Draw orthographic section of solids and improve the students visualization skill to develop New products .
- CO5 - Draw the Development of surfaces and its applications in manufacturing industry
- CO6 - Draw the orthographic view of solids and learn to convert pictorial into orthographic projection.

TEXT / REFERENCE BOOKS

1. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 53rd Edition, 2019.
2. Natrajan K.V., "A Text Book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2018.
3. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2018.
4. Engineering drawing practice for schools and colleges, SP 46 – 1988 (http://web.iitd.ac.in/~achawla/public_html/201/lectures/sp46.pdf).

S14BLH21	CIRCUIT THEORY AND NETWORK ANALYSIS	L	T	P	EL	Credits	Total Marks
		2	0	2	0	4	100

COURSE OBJECTIVES

- To equip the students to analyze electrical circuits and networks
- To educate the phasor concepts in AC circuits.
- To convey the knowledge of resonance and transients.

UNIT 1 D.C.CIRCUITS**9 Hrs.**

Electrical quantities, Ohm's Law, Resistors - Series and parallel combinations, Current Division rule, Voltage Division rule, Source transformation - Kirchhoff's laws, Nodal and Mesh Analysis, Star Delta Transformation. Analysis and Experimental Verification of Kirchhoff's Law.

UNIT 2 SINGLE AND THREE PHASE AC CIRCUITS**9 Hrs.**

Sinusoidal Functions - RMS(effective) and Average Values - Phasor Representation - J operator – Sinusoidal Excitation Applied to Purely Resistive - Inductive and Capacitive Circuits - RL - RC and RLC Series and Parallel Circuits- Power and Power Factor.- Analysis of three phase 3-wire and 4-wire circuits with star and delta connected loads, balanced. Experimental Verification and comparison of Series and Parallel AC circuits, Series and Parallel Resonance

UNIT 3 NETWORK THEOREMS (ONLY DC)**9 Hrs.**

Superposition Theorem - Reciprocity Theorem - Thevenin's Theorem - Norton's Theorem - Maximum Power Transfer Theorem. Theoretical and Experimental Verification of Theorems.

UNIT 4 TRANSIENT ANALYSIS AND RESONANCE**9 Hrs.**

Time Domain Analysis - Transient response of RL, RC & RLC Networks with DC Input and Sinusoidal AC input. Series and Parallel resonance - Quality factor and Bandwidth. Apply steady state analysis to R-L and R-C circuits with DC transients.

UNIT 5 NETWORK PARAMETERS**9 Hrs.**

Network Parameters - Z,Y, h and ABCD- Conditions for Reciprocity - Parameter Conversion-Inter connection of Networks. Design of circuits using network parameter for solving real world problems.

Max. 45 Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to.

- CO1 - Analyze dc circuits by different methods.
- CO2 - Determine both magnitude and phase angle for various parameters of AC circuits.
- CO3 - Apply Electrical theorems to solve complex electrical circuits.
- CO4 - Analyze and interpret the transient response characteristics of electrical circuits.
- CO5 - Determine the various network parameters for electrical circuits
- CO6 - Design circuits for practical applications.

TEXT / REFERENCE BOOKS

1. William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuits Analysis", McGraw Hill publishers, 9th edition, New Delhi, 2020.
2. Chakrabarti A, "Circuits Theory (Analysis and synthesis)", Dhanpat Rai & Sons, New Delhi, 2020.
3. Joseph A. Edminister, Mahmood Nahvi, "Electric circuits", Schaum's series, McGraw-Hill, First Edition, 2019.
4. Mittle B.N., Aravind Mittle, "Basic Electrical Engineering", Tata McGraw Hill, 2nd Edition, July 2017.
5. Charles Alexander, Mathew Sadiku, "Fundamentals of Electric Circuits", Tata McGraw Hill, 6th Edition, 2017.
6. Smarajit Ghosh, "Fundamentals of Electrical and Electronics Engineering", PHI Learning Private Ltd, 2nd Edition, 2010.
7. Abhijit Chakrabarti, Sudiptanath & Chandan Kumar Chanda, "Basic Electrical Engineering", Tata McGraw Hill, 1st Edition, 2010.
8. Wadhwa C.L., "Basic Electrical Engineering", New Age International, 4th Edition, 2007, Reprint June 2010.

SEEB1202	DC MACHINES AND TRANSFORMERS	L	T	P	EL	Credits	Total Marks
		3	1	0	0	3	100

COURSE OBJECTIVES

- To analyze the electromechanical system.
- To impart knowledge in construction details, principle operation and performance characteristics of DC machines and transformer.
- To evaluate the different losses and performance of DC machines and transformer using different testing methods.
- To analyze the performance characteristics of DC machines.
- To impart knowledge in three phase transformer connection.

UNIT 1 MAGNETIC CIRCUITS

9 Hrs.

Terminologies in magnetic circuits - Analogy of Electric and Magnetic Circuits - Leakage Factor - force on current carrying conductor - Expression for generated EMF - Reluctances in Series and Parallel (Series and Parallel Magnetic Circuits) - Electromagnetic Induction - Fleming's Rule - Lenz's Law - Faraday's laws - statically and dynamically induced EMF - Self and mutual induced EMF - Self and mutual inductance.

UNIT 2 D.C. GENERATORS

9 Hrs.

Constructional Details - Principle of Operation - E.M.F Equation - Methods of Excitation - Types - losses and efficiency - No load and Load characteristics of Series, Shunt and Compound generators - Armature Reaction, Effects, Methods of Compensation - Commutation - Methods of Improving Commutation - Applications.

UNIT 3 D.C. MOTORS

9 Hrs.

Principle of Operation - Significance of Back E.M.F - Torque Equation - Characteristics of Series, Shunt & Compound Motors - Starters - Speed Control of DC Series & Shunt Motors - Testing of DC Machines - load Test and No load Test - Hopkinson's Test - Applications.

UNIT 4 SINGLE PHASE TRANSFORMER

9 Hrs.

Principle of Operation - Constructional Details - E.M.F. Equation - Transformation Ratio - losses and efficiency - Transformer on No Load - Parameters Referred to HV / LV Windings - Equivalent Circuit - Transformer On Load - Phasor diagram - Regulation - Testing of Transformer - Open Circuit and Short Circuit Test - All day Efficiency - Sumpner's Test.

UNIT 5 THREE PHASE AND SPECIAL TRANSFORMERS

9 Hrs.

Auto Transformer - Saving of copper in comparison with Two winding Transformer - Parallel Operation of Single Phase Transformers - Construction of Three Phase Transformer - Transformer Connections - Scott connection - Three Phase to Single Phase Transformer conversion - Elementary Ideas on Instrument Transformers.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Analyse the parameters of magnetic circuits.
- CO2 - Explain the principle, types, effect of armature reaction and commutation of DC generator.
- CO3 - Analyze the performance characteristics of DC motor using various testing methods.
- CO4 - Examine the equivalent circuit and performance of a single phase transformer.
- CO5 - Distinguish the saving of copper of auto transformer with a two winding transformer.
- CO6 - Analyze the various transformer connection for specific application.

TEXT / REFERENCE BOOKS

1. A K Theraja & B L Thereja, "A Text book of Electrical Technology (Vol II)", S Chand & Co- 23rd Edition 2008.
2. I J Nagrath and D P Kothari, "Electrical Machines", Tata McGraw Hill Publishing Company Limited New Delhi, 3rd

Edition, 2007.

3. R.K.Rajput, "Electrical Machine", Laxmi Publications, 5th Edition 2008.
4. S K Sen, "Electrical Machinery", Khanna Publishers, New Delhi, Reprint 2002.
5. John Hindmarsh, U.M.I.S.T England, "Electrical Machines & their applications", Pergamon, 4th edition 2014.

SEEB2203	ELECTRONIC DEVICES LAB	L	T	P	EL	Credits	Total Marks
		0	0	4	0	2	100

Pre Requisite: SECB1101

Co Requisite: Nil

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COURSE OBJECTIVES

- To know the usage of Electrical and Electronic equipment.
- To know the testing of components.
- To understand the transient and resonance circuits.
- To understand the PN diode operation in forward and reverse bias.
- To know the characteristics of transistor in CB, CE configurations.

SUGGESTED LIST OF EXPERIMENTS

1. Characteristics of PN junction diode to find static and dynamic resistance from the characteristics.
2. Characteristics of Zener diode to find static and dynamic resistance from the characteristics.
2. Characteristics of CB configuration.
3. Characteristics of CE configuration.
4. Drain and transfer characteristics of JFET. To obtain gain, trans conductance and amplification factor.
5. Characteristics of SCR, find holding current, break over voltage and holding voltage.
6. Characteristics of UJT, find intrinsic standoff ratio, Peak voltage and valley voltage.
7. Characteristics of LDR with illumination and without illumination.
8. Voltage multipliers.

Simulation experiments.

1. Design voltage regulator circuit using diodes.
2. Design Clippers and Clampers circuit using diodes.
3. To analyze the frequency response of CC amplifier.
4. To design and analyze ac voltage control circuit using TRIAC.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Analyze the characteristics of different electronic devices such as diodes, transistors..
- CO2 - Analyze the various circuit configurations and its classifications of MOSFETs
- CO3 - Analyze the performance of transients and resonance circuits.
- CO5 - Analyze the characteristics of special semiconductor devices.
- CO6 - Design electronic circuits for various applications.

SEEB2202	DC MACHINES AND TRANSFORMERS LAB	L	T	P	EL	Credits	Total Marks
		0	0	4	0	2	100

COURSE OBJECTIVES

- To impart knowledge to conduct test on various types of machines and transformer.
- To practice different types of wiring and apparatus connection.
- To analyze the operation of various DC machines with different load condition.
- To obtain the characteristics of DC machines and transformer by performing suitable test.

SUGGESTED LIST OF EXPERIMENTS

1. OCC and load characteristics of self excited DC shunt generator.
2. OCC and load characteristics of separately excited DC shunt generator.
3. Load characteristics of DC series generator.
4. Load characteristics of DC compound generator (Differential and Cumulative).
5. Load characteristics of DC shunt motor.
6. Load characteristics of DC series motor.
7. Load characteristics of DC compound motor (Differential and Cumulative).
8. Speed control of DC shunt motor.
9. Swinburne's test on DC shunt motor.
10. Hopkinson's test.
11. OC and SC test on Single Phase Transformer.
12. Load test on Single Phase Transformer.
13. Parallel Operation of Single Phase Transformer.
14. Sumpner's Test on Single Phase Transformer.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Analyze the performance characteristics of various DC generators.
- CO2 - Examine the performance characteristics of various DC motors.
- CO3 - Predetermine the losses and control the speed of a DC motor.
- CO4 - Predetermine the losses and efficiency of Single Phase Transformer.
- CO5 - Determine the efficiency of Single Phase Transformer.
- CO6 - Analyze the load sharing of Single Phase Transformer.

S34BLH21	SOILD STATE DC DRIVES	L	T	P	EL	Credits	Total Marks
		3	0	2	0	4	100

COURSE OBJECTIVES

- To study and analyze the operation of the converter / chopper fed DC drive, both qualitatively and quantitatively.
- To analyze and design the current and speed controllers for a closed loop solid state DC motor drives.
- To study and design the Siemens drive system for speed control, current and torque measurement.

UNIT 1 REVIEW OF CONVENTIONAL DC DRIVES

9 Hrs.

Different techniques of speed control and methods of braking of series and separately excited DC motor, Ward Leonard speed control, Model and transfer function of series and separately excited DC motor.

- Open Loop Control of Separately Excited DC Motor.
- Open Loop Control of DC Series Motor.
- Closed Loop Control of Separately Excited DC Motor.

UNIT 2 CONVERTER CONTROL OF DC MOTORS

9 Hrs.

Analysis of series and separately excited DC motor with single phase and three phase converters operating in different modes and configurations, Problems on DC machines fed by converter supplies, drive employing dual converter.

Simulation of Single Phase Half Converter with different loads.

- Three Phase Full Controlled Rectifier fed DC motor.
- Simulation of Single Phase Semi Converter with motor load.
- Simulation of Three Phase Converter with different loads.

UNIT 3 CHOPPER CONTROL OF DC MOTORS

9 Hrs.

Introduction to time ratio control and frequency modulation; Class A,B,C,D and E chopper controlled DC motor – Performance analysis, multi-quadrant control – Chopper based implementation of braking schemes – Multiphase Chopper.

- Simulation of Buck Converter
- Simulation of Boost Converter
- Simulation of Buck-Boost Converter
- Chopper fed DC motor drive

UNIT 4 DESIGN OF CONVERTER AND CHOPPER FOR DC DRIVES

9 Hrs.

Speed loop, P, PI, PID controllers, Current loop, Armature current reversal, Field current reversal – Digital controller and firing circuits, Simulation.

- Closed loop control of dc-dc converter
- Closed loop control of phase controlled rectifier
- Simulation of different firing circuits

UNIT 5 INDUSTRIAL DC DRIVES

9 Hrs.

Introduction to Siemens drive system - Speed control with emf feedback & tachogenerator – Current measurement & Torque Measurement - Tuning of drive, Phase locked loop control of DC drives.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Comprehend the principle and modelling of DC motor and conventional drives.
- CO2 - Examine the operation of single and three phase converter fed DC motor drives.
- CO3 - Analyze the operation of chopper fed DC motor drives.
- CO4 - Analyse the various methods of closed loop speed control of DC drives.
- CO5 - Evaluate the performance of Siemens drive system for speed control of DC drives.
- CO6 - Evaluate the performance the phase locked loop for speed control of DC drives.

TEXT / REFERENCE BOOKS

1. Buxbaum.A, Schierau.K and Staughem, "A Design of Control Systems for D.C.Drives", Springer - Verlag, Berlin, 1990.
2. Dubey .G.K , "Power Semiconductor Controlled Drives", Prentice Hall International, New jersey , 1989.
3. Sen P.C, "Thyristor D.C Drives", Krieger Publishing Company, 1991.
4. Subrahmanyam .V, "Electric Drives Concept and Applications", Tata McGraw Hill Publishing Co., LTD., New Delhi, 1st reprint 2010.
5. Siemen's Course Material
6. R. Krishnan, "Electric Motor Drives: Modelling, Analysis, and Control", Prentice Hall; 1stedition, 2001.
7. Leonhard, Werner, "Control of Electrical Drives", 3^d edition, 2001, Springer 2001.

WEB SITES

1. www.automation.siemens.com
2. www.legacypower.net

SECA2507	INTEGRATED CIRCUITS LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

COURSE OBJECTIVES

- To study the basic principles, configurations and practical limitations of op-amp.
- To understand the various linear and non-linear applications of op-amp.
- To analyze and design op-amp oscillators, single chip oscillators and frequency generators.
- To analyze, design and explain the characteristics and applications of active filters, including the switched capacitor filter.
- To understand the operation of the most commonly used D/A and A/D converter types and its applications.

SUGGESTED LIST OF EXPERIMENTS

ANALOG INTEGRATED CIRCUITS

1. Design and construct using IC741
 - a). Inverting
 - b). Non-inverting
 - c). Adder
 - d). Schmitt Trigger
 - e). Differentiator
2. Waveform Generators using IC741
 - a). Triangular wave generator
 - b). Square wave generator
 - c). Sine Wave generator
3. Design and construct PWM using IC 555 timer
4. Design a 3 bit DAC in R-2R ladder Configuration
5. Design, construct the filters using PSPICE
 - (a). Low pass filter
 - (b). High pass filter
 - (c). Band pass filter
 - (d). Band reject filter

DIGITAL INTEGRATED CIRCUITS

6. Verify the Basic gates / Boolean function using logic gates.
7. To Construct and verify the full and half adder using logic gates.
8. To Verify 2x4 Decoder and 4x2 Encoder functionally.
9. To construct and study the working of RS flip-flop, D flip-flop, T flip-flop, JK flip-flop
10. To verify various shift register
 - (a). SISO
 - (b). SIPO
 - (c). PISO
 - (d). PIPO
11. Design a counter using suitable flip-flop
 - (a). MOD Counter
 - (b). Ripple Counter
 - (c). Up- Down Counter

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Evaluate the op-amp's basic construction, characteristics, parameter limitations, various configurations and countless applications of op-amp.
- CO2 - Examine operation registers, flipflop counter.

- C03 - Analyze basic op-amp circuits, particularly various linear and non-linear circuits, active filters, signal generators and data converters.
- C04 - Examine the basic configuration of IC741, IC555 and various counter operation.
- C05 - Evaluate the logic gates and combinational circuit using the suitable IC.
- C06 - Evaluate the various characteristics of the filter circuits using Orcad PSPICE.

SECA2508	MICROPROCESSOR LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

COURSE OBJECTIVES

- To impart the knowledge of 8085 and 8086 processor.
- To develop assembly language program in 8085/8086 processor.
- To introduce the peripheral devices.
- To acquire the knowledge of interfacing and hardware implementation.

SUGGESTED LIST OF EXPERIMENTS

2. Programs for 8 bit Addition, Subtraction, Multiplication and Division.
3. Perform 32 bit Addition of two numbers.
4. Counting numbers of 1's in given word.
5. Arithmetic mean of Square of N Numbers.
6. Code Conversion – BCD to ASCII Conversion, ASCII to BCD Conversion.
7. Finding largest & smallest of given 16 bit Numbers.
8. To Sort given set of Numbers in Ascending & Descending Order.
9. Program using look up table Concept.
10. Matrix Manipulation – 16 bit addition.
11. Perform LCM of two 16 bit numbers, GCD of four 16 bit numbers.
12. Generate Fibonacci Series, Factorial of given Numbers.
13. Interfacing 8086 with Stepper motor. Use Step angle Calculation & rotate motor to a Specified angle.
14. Interface 8086 with DC motor & Control the Speed of the DC Motor using PWM.
15. Interface 8086 With ADC & display the digital input, Perform the resolution calculation and cross verify the result.
16. Interface 8086 With DAC & display the following waveform in CRO. a). Triangular b). Saw tooth c). Staircase.
17. Interface 8086 with 7 segment display to display numbers as Characters.
18. Interface 8086 with LCD to display the name of the person.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Understand the basic arithmetic operations using 8085/8086 microprocessor instruction set.
- CO2 - Familiarize with the Assembly Language programming and concepts of 8085/8086 microprocessors.
- CO3 - Ability to provide solutions to the problems related to advanced data processing.
- CO4 - Design and develop interfacing circuits for stepper motor and DC motor.
- CO5 - Design and develop interfacing circuits for ADC and DAC.
- CO6 - Design and develop interfacing circuits for LCD and Seven segment display.