Vision

Empowering the community of students of Electrical and Electronics Engineering with very high morals, values, ethics, skills and technical knowledge through a rich curriculum blending the equal proportions of theoretical and hands-on experience by a process of transformation via hard-work and perseverance, with a view to serving the society in the role of socially responsible engineers so as to look after the needs of the nation and to elevate the standard of living of the people by incorporating innovation and sustained research.

Mission

To attract the students to pursue not only the under graduation, but also up to the research level, with the exquisite infrastructure, learned faculties, state-of-the-art laboratories etc., from the Indian and International diasporas.

To foster the global standards in learning, teaching and research that owes to an overall development of the department, faculties and students within the university and from across the globe as well.

To enhance the calibre of students to be the most sought for, by the industrial and research entities.

To enable for a diversified and challenging career that is ensued by the highest degree of professionalism, entrepreneurship, managerial and administrative expertise.

PROGRAMME EDUCATIONAL OBJECTIVES

The core objectives of the B.E. programme in Electrical and Electronics Engineering are intended towards;

PEO-1

Enriching the technicalities of domain-specific-knowledge and moulding the fraternity of students to be the best bet for industry, research and academia.

PEO-2

Creating awareness and keen-interest in updating and exploiting the prevailing cutting-edge technologies unto the best possible extent, so as to address any complex, non-linear, real-time engineering issues.

PEO-3

Enabling to redress the problems of the chosen field of engineering with 4Es – ethical, economical, efficient and environmental concerns.
PEO-4
Paving foundation for developing multifaceted skills on the road to leadership, entrepreneurship, professionalism, interpersonal, critical thinking, problem solving, decision making, communication / presentation and innovation / imagination.

PROGRAMME OUTCOMES

PO-1
Identification, Analysis and Formulation of Real-time Engineering Problems and Ability to devise Innovative Methodologies for their Effective and Efficient Tackling.

PO-2
Application of Technical, Mathematical, Reasoning and Logical skills to Design and Implement Novel Systems, with a view to enhance the Standard of Living of the Society.

PO-3
Evaluation and Validation upon the State-of-the-art Solution Strategies employed in Various Spheres of Electrical and Electronics Engineering.

PO-4
Indulging in and Valuing the Ethical Principles, Eco-friendliness, Societal-benefits and Socio-economic concerns.

PO-5
To emulate in the Research pertaining to the Fundamental and Advanced Areas of Power Systems, Power Electronics, Digital Electronics, Microprocessors/Microcontrollers etc.

PO-6
Capability to excel in Multi-disciplinary Specializations and Research in bridging the gap between the Conventional and Modern Modalities / Requirements.

PO-7
Abiding by the Regulations, Norms, Standards and Rules that have been put forth by the Pioneers and Organizations of the E.E.E. Society.

PO-8
Exhibition of Skills that look after Team-playing Virtues and Nurturing Leadership Qualities, especially while working in tandem with Fellow Engineers for Social Goodness.

PO-9
Curiosity in developing Managerial and Administrative capabilities that aims for the betterment of Professionals and Professionalism.

PO-10
Ability to engage in self-education to enable competence globally.

PO-11
Interact with engineering community and with society at large, regarding intricate engineering activities of technical perspectives and emerge as an efficient motivator.

PO-12
Appreciate the need for life-long learning independently in the broadest contest of technological challenges.
## Mapping of PEO Vs PO

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## COURSES OF STUDY AND SCHEME OF EXAMINATIONS (REGULATION -2019)

### SEMESTER I

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Students must undergo Internship for 4 weeks during summer vacation which will be assessed in the forthcoming III Semester.

**COURSES OF STUDY AND SCHEME OF EXAMINATIONS (REGULATION -2019)**

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*For the Lateral entry students total credit for III Semester is 23.5 as they are exempted from internship during summer vacation of II semester.*

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**SEMESTER III**

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**SEMESTER IV**

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Students must undergo Internship for 4 weeks during summer vacation which will be assessed in the forthcoming V Semester.

**COURSES OF STUDY AND SCHEME OF EXAMINATIONS (REGULATION -2019)**

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Total Credits 26.5
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Total Credits 21.0

Students must undergo Internship for 4 weeks during summer vacation which will be assessed in the forthcoming VII Semester.

**SEMESTER VII**

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**PROFESSIONAL ELECTIVES**

EEPESCN-Electrical Machine Design  
EEPESCN-Electrical Energy Conservation and Auditing  
EEPESCN-Electrical Drives  
EEPESCN-Electrical and Hybrid Vehicles  
EEPESCN-Wind and Solar Energy Systems  
EEPESCN-Digital Signal Processing  
EEPESCN-Control Systems Design  
EEPESCN-Computer Architecture  
EEPESCN-Power System Protection  
EEPESCN-High Voltage Transmission Systems  
EEPESCN- Computer Aided Power System Analysis  
EEPESCN-Communication Engineering  
EEPESCN- VLSI Design  
EEPESCN-Micro Electro Mechanical Systems

**OPEN ELECTIVES**

EEOESCN- Electrical Safety Engineering  
EEOESCN- Generation of Electrical Energy  
EEOESCN- Electrical Materials  
EEOESCN-Soft Computing Tools for Electrical Engineering  
EEOESCN- Biomedical Engineering  
EEOESCN- Utilization of Electrical Energy
HONOURS COURSES

EEHESCN - Power System Dynamics and Control  
EEHESCN - Restructured Power Systems  
EEHESCN - Flexible AC Transmission System  
EEHESCN - Power Quality Studies  
EEHESCN - High Voltage Engineering  
EEHESCN - Digital Control Systems

MINOR ENGINEERING COURSES

EEMISCN – Analog Electronics  
EEMISCN – Digital Electronics  
EEMISCN – Electrical Measurements & Instruments  
EEMISCN – Microprocessor and Microcontroller  
EEMISCN – Control System  
EEMISCN – Industrial Electrical systems

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Course Objectives

- To train the students in partial differential equations, Fourier series, Boundary value problems, Fourier transform and Z-transform which can serve as basic tools for specialized studies in engineering.

Unit – I: Partial Differential Equations


Unit – II: Fourier series

Dirichlet’s conditions - General Fourier series - Odd and Even functions - Half range sine series - Half range cosine series - Complex form of Fourier series – Parseval’s identity.

Unit – III: Boundary Value Problems

Solutions of one dimensional wave equation – One dimensional heat equation (without derivation) – Fourier series solutions in Cartesian co-ordinates.

Unit – IV: Fourier Transform

Fourier integral theorem (without proof) – Fourier transform pair – Sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem - Parseval’s identity

Unit – V: Z-Transform and Difference Equations


Text Books

References

Course Outcomes
At the end of this course, students will demonstrate the ability to
1. Acquire basic understanding of the most common partial differential equations.
2. Understand Fourier series,
3. Ability to solve some boundary value problems.
4. Fourier transform and Z-transform analysis.
5. To know about the transform and Differential equation.

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Course Objectives
- To realize the importance of environment for engineering students.
- To understand the basics of ecosystems.
- To discuss various aspects of biodiversity and its conservation.
- To make aware the student about global environmental pollution problems and natural disasters.
- To give the ideas about advance technologies of engineering that will be useful to protect environment.

Unit-I: Multidisciplinary Nature of Environmental Studies
Definition, scope and importance - Need for public awareness. Natural resources and associated problems - Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people. Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. Energy resources:
Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies- Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.- Role of an individual in conservation of natural resources.- Equitable use of resources for sustainable lifestyles.

Unit–II: Ecosystems

Concept of an ecosystem - Structure and function of an ecosystem - Producers, consumers and decomposers - Energy flow in the ecosystem - Ecological succession - Food chains, food webs and ecological pyramids - Introduction, types, characteristic features, structure and function of the following ecosystem - Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Unit–III : Biodiversity and its Conservation


Unit–IV: Environmental Pollution

Definition - Cause, effects and control measures of Air pollution - Water pollution - Soil pollution - Marine pollution - Noise pollution - Thermal pollution - Nuclear hazards- Solid waste Management: Causes, effects and control measures of urban and industrial wastes - Role of an individual in prevention of pollution - Disaster management: floods, earthquake, cyclone and landslides. Sustainable development - Urban problems related to energy - Water conservation, rain water harvesting, and watershed management - Resettlement and rehabilitation of people; its problems and concerns. - Environmental ethics: Issues and possible solutions - Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust.


Unit–V: Human Population and the Environment

Field Work
Visit to a local area to document environmental assets – river / forest / grassland / hill / mountain – Visit to a local polluted site – Urban/Rural/Industrial/Agricultural - Study of common plants, insects, birds - Study of simple ecosystems-pond, river, hill slopes, etc. (Field work equal to 5 lecture )

Text Books
2. BharuchaErach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad – 380 013, India, Email:mapin@icenet.net (R).

References
2. Clark, R.S., Marine Pollution, Clanderson Press Oxford (TB).
5. Down to Earth, Centre for Science and Environment (R).
Course Outcomes

At the end of this course, students will demonstrate the ability to
1. Understand the importance of environment.
2. Analyze the importance of environment in engineering.
3. Apply their own ideas and demonstrate advanced technologies that will be useful to protect environment.
4. Employ awareness among the society about environmental problems and natural disasters.
5. Practice according to the present and future environmental issues.

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ETES303 ENGINEERING MECHANICS

Course Objectives

- To introduce the fundamentals of forces and their effects with their governing laws.
- To understand the definitions of particle, body forces and their equilibrium conditions.
- To discuss about geo material properties of different types of surfaces of solids.
- To analyze the dynamics of particles and Newton’s law of motion.
- To understand and predict the forces and its related motions.

Unit–I: Statics of Particles


Equilibrium of Particle-Vector representation of Space Force-Equilibrium of Particle in Space-Equivalent System of Forces-Principle of Transmissibility.

Unit–II: Equilibrium of Rigid Bodies


Unit–III: Geometrical Properties of Surfaces and Solids
Centroid and Centre of Gravity-Determination of Centroid of Sections of Different Geometry- Centre of Gravity of a Body-Area Moment of Inertia-Parallel Axis Theorem-Perpendicular Axis Theorem-Determination of Moment of Inertias of Rectangular, Triangular, Circular and Semi-circular- Moment of Inertias of structural Steel Sections of Standard and Composite Sections.
Polar Moment of Inertia-Radius of Gyration-Principal Moment of Inertia-Mass Moment of Inertia- Determination of Mass Moment of Inertia of a Thin Rectangular Plate, Thin Circular Disc, Solid Cylinder, Prism, Sphere and Cone from first principles.

Unit–IV: Dynamics of Particles
Introduction-Kinematics and Kinetics-Displacements, Velocity and Acceleration-Equations of Motion-Types of Motion-Rectilinear Motion-Relative Motion-Curvilinear Motion-Projectiles.

Unit–V : Friction and Elements of Rigid Body Dynamics
Rolling Resistance-Translation and Rotation of Rigid Bodies-Velocity and Acceleration-General Plane Motion of Simple Rigid Bodies such as Cylinder, Disc/Wheel and Sphere.

Text Books

References

Course Outcomes
At the end of this course, students will demonstrate the ability to
1. Understand the forces and its related laws of mechanics in static and dynamic conditions.
2. Analyze the forces and its motions on particles, rigid bodies and structures.
3. Solve the moment of inertia of any section and masses for the structural members.
4. To study about Dynamics of particles.
5. Understand the elements of rigid body dynamics.
Course Objectives

- To understand the physical properties of fluids, fluid pressure and its measurement.
- To derive the equation of conservation of mass and its application.
- To solve problems of fluid kinematics and dynamics specifically flow through pipes and open channel flow.
- To use important concepts of continuity equation, Bernoulli’s equation and apply the same to problems.
- To study the performance of Turbines, Radial flow, Reaction turbines and governing of turbines.
- To study the characteristics of Centrifugal pumps and reciprocating pumps.

Unit–I: Properties of Fluids, Fluid Pressure and its Measurement

Mass density, specific weight, specific volume, specific gravity, viscosity - Newton’s law of viscosity - compressibility - surface tension and capillarity - real and ideal fluids.

Pressure - atmospheric and vacuum pressures - measurement of pressure by manometers and pressure gauges - total pressure and center of pressure – Buoyancy - metacentre - simple problems.

Unit–II : Dynamics of Fluid Flow

Kinematics of flow - types of fluid flow - continuity equation - Euler’s equation of motion - Bernoulli’s equation - practical applications - venturimeter, orificemeter and pitot tube. Simple treatment of orifices, mouthpieces, notches and weirs.

Flow through pipes - loss of energy due to friction - minor energy losses - hydraulic gradient and total energy line - flow through pipes in series - Flow through parallel pipes - power transmission through pipes - flow through nozzles.

Unit–III: Flow in Open Channels

Classification of flow in channels - Chezy’s and Manning’s formulae - most economical Rectangular, Trapezoidal and Circular sections of channel.-Non-uniform flow through open channels - specific energy and specific energy curve - critical depth - critical velocity - critical, supercritical and subcritical flows - alternate depths.
Unit–IV: Impact of Jet and Turbines

Impact of jets - force exerted by a fluid on stationary and moving flat plates held in various positions - force exerted on curved plates - concept of velocity triangles.


Unit–V: Pumps

Centrifugal pumps - main parts - work done - definitions of heads and efficiencies -multistage pumps - specific speed - priming - cavitations’.

Reciprocating pumps - main parts - working principle – slip - indicator diagrams - effects of acceleration and friction on indicator diagrams - maximum speed of a reciprocating pump - study of air vessels.

Text Books

References

Course Outcomes
At the end of this course, students will demonstrate the ability to
1. Apply the basic knowledge of fluid mechanics in finding fluid properties, performance parameters of hydraulic turbines and pumps.
2. Understand various dynamics of fluid flow.
3. Use fluid dynamics for study of flow through pipes and flow in open channels.
4. Present hydraulic design for the construction of efficient hydraulic turbines and pumps.
5. Get through knowledge of different kinds of pumps.

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Course Objectives

- To study of different network theorems, node and mesh analysis, duality.
- To impart knowledge on solving circuits using first and second order differential equation.
- To obtain the transient response of circuits.
- To introduce the analysis of single and three phase AC circuits.
- To analyze the electrical circuit using Laplace transforms and frequency response.
- To analyze Two Port Network for the calculation of impedance parameters

Unit - I: Network Theorems


Unit - II: Solution of First and Second order networks

Solution of first and second order differential equations for Series and parallel R-L, R-C, R-L-C circuits, initial and final conditions in network elements, forced and free response, time constants, steady state and transient state response.

Unit - III: Sinusoidal steady state analysis

Representation of sine function as rotating phasor, phasor diagrams, impedances and admittances, AC circuit analysis, effective or RMS values, average power and complex power. Three-phase circuits. Mutual coupled circuits, Dot Convention in coupled circuits, Ideal Transformer.

Unit - IV: Electrical Circuit Analysis Using Laplace Transforms


Unit - V: Two Port Network and Network Functions

Two Port Networks, terminal pairs, relationship of two port variables, impedance parameters, admittance parameters, transmission parameters and hybrid parameters, interconnections of two port networks.

Text Books
References

Course Outcomes:
At the end of this course, students will demonstrate the ability to
1. Apply network theorems for the analysis of electrical circuits.
2. Obtain the transient and steady-state response of electrical circuits.
3. Analyze circuits in the sinusoidal steady-state (single-phase and three-phase).
5. To understand two port network and met function.

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Course Objectives
- To provide sound knowledge at the fundamentals of electronic circuits
- To analyze the BJT circuits and its characteristics
- Introduction to MOSFET and small signal models
- To study multi-stage and operational amplifier
- To study the application Linear and nonlinear applications of op-amp circuits

Unit - I: Diode circuits
P-N junction diode, I-V characteristics of a diode; review of half-wave and full-wave rectifiers, Zener diodes, clamping and clipping circuits.

Unit - II: BJT circuits
Structure and I-V characteristics of a BJT; BJT as a switch. BJT as an amplifier: small-signal model, biasing circuits, current mirror; common-emitter,
common-base and common-collector amplifiers; Small signal equivalent circuits, high-frequency equivalent circuits

**Unit - III: MOSFET circuits**

MOSFET structure and I-V characteristics. MOSFET as a switch. MOSFET as an amplifier: small-signal model and biasing circuits, common-source, common-gate and common-drain amplifiers; small signal equivalent circuits - gain, input and output impedances, trans-conductance, high frequency equivalent circuit.

**Unit - IV: Differential, multi-stage and operational amplifiers**

Differential amplifier; power amplifier; direct coupled multi-stage amplifier; internal structure of an operational amplifier, ideal op-amp, non-idealities in an op-amp (Output offset voltage, input bias current, input offset current, slew rate, gain band width product)

**Unit - V: Linear applications of op-amp**

Idealized analysis of op-amp circuits. Inverting and non-inverting amplifier, differential amplifier, instrumentation amplifier, integrator, active filter, P, PI and PID controllers and lead/lag compensator using an op-amp, voltage regulator, oscillators (Wein bridge and phase shift).

Analog to Digital Conversion. Zero Crossing Detector, Square-wave and triangular-wave generators.

**Text Books**

**References**

**Course Outcomes:**
At the end of this course, students will demonstrate the ability to
1. Understand the characteristics of transistors.
2. Design and analyze various rectifier and amplifier circuits.
3. Design sinusoidal and non-sinusoidal oscillators.
4. Understand the functioning of OP-AMP and design OP-AMP based circuits.
5. Get knowledge about linear applications of OP-AMP.
Course Objectives
- To understand the properties of fluids and fluid statics, methods for determination of coefficient of discharge are to be explained and computed practically.
- To study of the characteristic features of pumps and turbines using experiments.
- To understand the significance and role of such utilities in their further course of study.

List of Experiments
1. Determination of Co-efficient of discharge of Mouth Piece
2. Determination of Co-efficient of discharge of Venturi meter
3. Determination of Co-efficient of Head loss due to Sudden Change in Section
4. Determination of Co-efficient of Head loss due to Friction in Pipe
5. Determination of Co-efficient of discharge of Rectangular Notch
6. Determination of Co-efficient of Impact of Jet on Vanes
7. Study of Performance characteristics of Elmo Pump (Centrifugal Pump)
8. Study of Performance characteristics of Sump Pump (Centrifugal Pump)
9. Study of Performance characteristics of Submersible Pump (Centrifugal Pump)
10. Study of Performance characteristics of Gould’s Pump (Reciprocating Pump)
11. Study of Performance characteristics of Pelton Turbine (Constant Speed method)
12. Study of Performance characteristics of Francis Turbine (Constant Head method)
13. Determination of Metacentric Height of a floating vessel (Demo Only)
14. Study on Flow through Open Channel (Demo Only)

Course Outcomes
At the end of this course, students will demonstrate the ability to
1. Determine the properties of fluids, pressure and their measurements.
2. Measure flow in pipes and determine frictional losses.
3. Compute forces on immersed plane and curved plates applying continuity equation and energy equation in solving problems on flow through conduits.
4. Develop Characteristics of pumps and turbines.
5. Develop Characteristics of turbines.

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**Course Objectives**

- To solve circuits by applying theorems.
- To illustrate the concepts of RL and RC circuits.
- To gain knowledge about resonance circuits

**List of Experiments**

1. Verification of Thevenin's theorem
2. Verification of Norton's theorem.
3. Verification of Super position theorem
4. Verification of Maximum power transfer theorem.
5. Verification of Reciprocity Theorem
6. Study of Series and parallel RL circuits
7. Study of Series and parallel RC circuits
8. Study of Series and parallel RLC circuits
9. Wave shaping circuits
10. Series resonance circuits
11. Parallel resonance circuits

**Course Outcomes**

At the end of this course, students will demonstrate the ability to

1. Basic Knowledge about theorems.
2. Analyze RL, RC and RLC series circuits.
3. Analyze RL, RC and RLC parallel circuits.
4. Understand different wave shaping circuits.
5. Ability to design resonance circuit.
Course Objectives
- To understand basic electronic components and its applications
- To understand the basic functions of operational amplifier.
- To illustrate the application of operational amplifier.

List of Experiments
2. Half wave and full wave rectifiers with capacitor filter.
3. Characteristics of Transistors.
5. Wave shaping circuits
6. Zero crossing detector and Schmitt trigger using OP-AMP
7. Precision Rectifiers
8. R.C Phase Shift Oscillator using OP-AMP
9. Voltage to Current Converter and Current to Voltage Converter
10. Instrumentation Amplifier
12. Analog to Digital Converter.

Course Outcomes
At the end of this course, students will demonstrate the ability to
1. Learn the application and characteristics of basic electronic devices.
2. Understand the characteristics of transistors.
3. Design and analyze various rectifier and amplifier circuits.
4. Understand the functioning of OP-AMP and design OP-AMP based circuits
5. Understand the circuit connections and testing points
### Course Objectives

- Be exposed to probability, random processes, and statistical methods designed to contribute to the process of making scientific judgments in the face of uncertainty and variation.
- To develop the skills of the students in numerical mathematics using method of finite difference interpolation.
- To find numerical solution of algebraic and transcendental equations.
- To find the numerical solution of ordinary and partial differential equations.

### Unit–I: Probability and Random Variables

Definition – Types of random variables - probability distribution function - probability density function – expectation and moments – moment generating functions - joint probability distribution - marginal probability distribution function – joint probability density function – marginal probability density function – conditional probability density function.

### Unit–II: Random Processes


### Unit–III: Test of Significance

Hypothesis, testing – Large sampling tests – small sampling test based on t, F and chi-square distributions – interval estimates of mean, standard deviation and proportion.

### Unit–IV: Interpolation, Numerical Differentiation and Integration

Unit–V: Solution of Algebraic, Transcendental and Ordinary Differential Equations


Text Books

References

Course Outcomes
At the end of this course, students will demonstrate the ability to
1. Acquire skills in handling situations involving random variables, random processes.
2. Ability to solve problems for engineers in using numerical methods.
3. Acquire skills in solving algebraic transcendental equations.
4. Able to obtain solution of ordinary and partial differential equations.
5. Acquire knowledge on different numerical methods.

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Course Objectives

- To introduce the concepts of linear data structure.
- To understand the different methods of nonlinear data structure representations.
- To introduce object oriented programming concepts.
- To study objects and classes.
- To important knowledge on different operations in C++.

Unit–I: Linear Data Structures

Introduction to data structures, Primitive and non-primitive data structures, Arrays In C -types, Structures in C, Stack-implementation, operations, Queues-operations-Lists-Linked list-types, Applications.

Unit–II: Non Linear Data Structures

Tree - Binary tree-representation - Tree traversal techniques- Graph-representation, traversal-Sorting- Selection Sorting, Insertion sorting, Merge sorting, Radix sorting, Searching -techniques -Hashing.

Unit–III: Object Oriented Programming

Object Oriented Programming concepts- Objects- classes – methods and message passing, encapsulation, abstraction, inheritance, polymorphism and dynamic binding-characteristics of OOPS-benefits of object orientation. Introduction to C++ and data types-Operators in C++.

Unit–IV: Objects and Classes

Objects and class -defining a class –defining member functions-Private and public member function–accessing class members, creating objects, object as function arguments- Array fundamentals - array within a class - array of objects. Constructors and destructors- Function overloading- Inline function - Virtual function.

Unit–V: Operations

Operator overloading – over loading unary, binary and relational operators-type conversion, Inheritance- derived class and base class-visibility mode-public, private and protected–various forms of in heritanse. Address and pointers-Files and streams.

Text Books

References

Course Outcomes
At the end of this course, students will demonstrate the ability to
1. Understand basic data structures such as arrays, linked lists, stacks and queues.
2. Apply algorithm for solving problems like sorting, searching, insertion and deletion of data.
3. Able to use object oriented programming language like C++ and associated libraries to develop object oriented programs.
4. Describe the procedural and object oriented paradigm with concepts of streams, classes, functions, data and objects.
5. Able to get knowledge about C++ programming.

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Course Objectives
- To learn about construction, principle of operation, characteristics and testing of DC machine.
- To have a sound knowledge about transforms.
- To familiarize the students with the constructions, operating principle, speed control of three phase induction motors.
- To provide basic knowledge about the single phase induction motor.
- To illustrate the different testing techniques available and obtain their characteristics.
- To important knowledge on various aspects of synchronous machines.
Unit–I: D.C. Machines

Unit–II: Transformers

Unit–III: Three Phase Induction Motors
Constructional features,cage and slipring rotors, principle of operation, synchronous rotation of gap flux, phasor diagram, equivalent circuit, expression for torque, torque-slip characteristic-condition for maximum torque and maximum power- load test- no-load and blocked-rotor tests-Pre-determination of motor performance on the basis of circle diagram- starting of slip-ring and cage motors- Speed control of induction motors- Variation of supply voltage-rotor resistance control.

Unit–IV: Single Phase Induction Motors
Double field revolving theory, cross field theory. Torque slip characteristic and its interpretation, split phase starting, resistance start, resistance start and run, capacitance start, capacitance start and run, typical performance characteristics, determination of constants of equivalent circuit, computation of performance from equivalent circuit.

Unit–V: Synchronous Machines
Constructional features of round rotor type and salient pole type machines, EMF equation, rotating magnetic field, armature reaction- synchronous reactance, phasor diagram-performance characteristics, predetermination of voltage regulationby synchronous impedance, ampereturn and potier methods-Parallel operation- Principle of operation of synchronous motor on infinite bus bars, phasor diagram, V curves and inverted V curves, hunting and its suppression-starting methods - Permanent magnet synchronous motors – Principle of operation and characteristics.

Text Books:
References

Course Outcomes
At the end of this course, students will demonstrate the ability to
1. Understand the construction, working principles & operations of all types of machines.
2. Predict the performance of electrical machines from their equivalent circuit models.
3. Select suitable machine to meet specific application requirement.
4. Validate the theoretical concepts by conducting experiments in practical sessions.
5. Study the different testing techniques available to assess the performance of machine.

Course Objectives
- To review the fundamental concepts relating to Number systems, codes and Boolean algebra function of logic gates and to explain the working and the characteristics of Logic families and Logic packages.
- To bring out the implementation of Boolean function using logic gates, simplification of Boolean Expression using K-map and implementation of various combinational circuits.
- To illustrate the function of various types of flip-flops and counters with the help of circuit diagram, truth table, state equation and timing diagram.
- To study about operation of A/D and D/A converters.
- To study the classification of semiconductor memories and programmable logic devices.
Unit - I: Fundamentals of Digital Systems and logic families
Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples of IC gates, number systems-binary, signed binary, octal hexadecimal number, binary arithmetic, one's and two's complements arithmetic, codes, error detecting and correcting codes, characteristics of digital lCs, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-state logic.

Unit - II: Combinational Digital Circuits
Standard representation for logic functions, K-map representation, simplification of logic functions using K-map, minimization of logical functions. Don’t care conditions, Multiplexer, De- Multiplexer/Decoders, Adders, Subtractors, BCD arithmetic, carry look ahead adder, serial adder, ALU, elementary ALU design, popular MSI chips, digital comparator, parity checker/generator, code converters, priority encoders, decoders/drivers for display devices, Q-M method of function realization.

Unit - III: Sequential circuits and systems
A 1-bit memory, the circuit properties of Bistable latch, the clocked SR flip flop, J- K-T and D- types flip flops, applications of flip flops, shift registers, applications of shift registers, serial to parallel converter, parallel to serial converter, ring counter, sequence generator, ripple(Asynchronous) counters, synchronous counters, counters design using flip flops, special counter IC’s, asynchronous sequential counters, applications of counters.

Unit - IV: A/D and D/A Converters

Unit - V: Semiconductor memories and Programmable logic devices.
Memory organization and operation, expanding memory size, classification and characteristics of memories, sequential memory, read only memory (ROM), read and write memory(RAM), content addressable memory (CAM), charge de coupled device memory (CCD), commonly used memory chips, ROM as a PLD, Programmable logic array, Programmable array logic, complex Programmable logic devices (CPLDS), Field Programmable Gate Array(FPGA).

Text Books

References
2. R. Anandh Digital Electronics – Kendra publishing house
Course Outcomes:
At the end of this course, students will demonstrate the ability to
1. Understand working of logic families and logic gates.
2. Design and implement Combinational and Sequential logic circuits.
3. Understand the process of Analog to Digital conversion and Digital to Analog conversion.
4. Be able to use PLDs to implement the given logical problem.
5. Able to design digital circuits for consumer application

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405 ELECTRICAL MEASUREMENTS & INSTRUMENTS  L  T  P  C
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Course Objectives
- To introduce the basic functional elements of instrumentation
- To discuss different methods of power and energy measurement.
- To explain various resistance and impedance measurement methods
- To study various storage and display devices
- To study various recorders, transducers and the data acquisition systems

Unit–I : Measurement of Voltage and Current
Units and standards-Dimensional analysis - D’Arsonval Galvanometer-Principle, construction, operation and comparison of moving coil, moving iron meters, dynamometer, induction type - Extension of range and calibration of voltmeter and ammeter – Errors and compensation.

Unit–II : Measurement of Power and Energy

Unit–III : Resistance and Impedance Measurements
Unit–IV :Storage and Display Devices

Sampling- CRO dual trace and dual beam oscilloscope- applications-Digital storage oscilloscope and applications - XY Mode - Phase measurement using oscilloscope –Null balance method- Phase shift to pulse conversion method Magnetic disk and tape, digital plotters and printers- CRT display- digital CRO-LED-LCD.

Unit–V :Recorders, Transducers and Data Acquisition Systems


Text Books

References

Course Outcomes
At the end of this course, students will demonstrate the ability to
1. Ability to understand basic principle of measuring instruments.
2. Understand the concept of measurement of power and energy in single and three phase circuits.
3. Knowledge on the measurement of resistance and impedance.
4. Acquire knowledge of display instruments, amplifier measurements and CRO
5. Distinguish recorders, transducers, data acquisition systems and display devices,frequency and period measurements.
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EEPC406 ELECTROMAGNETIC FIELDS

Course Objectives

- To look back mathematical tools like vector calculus for investigating the physics of electric and magnetic fields.
- To understand the concepts of electrostatics, electro field due to various charge distribution, electric potential, energy density.
- To study Electro static boundary conditions, capacitors of various geometries.
- To impart knowledge on the concepts of magneto statics, magnetic flux density, scalar and vector potential and their applications.
- To understand Faraday’s laws, time varying fields, magnetic boundary conditions and Maxwell’s equations.

Unit - I: Review of Vector Calculus

Vector algebra-addition, subtraction, scalar and vector multiplications, three orthogonal coordinate systems (rectangular, cylindrical and spherical), Conversion of a vector from one coordinate system to another. Vector calculus-vector operator-del, gradient, divergence and curl.

Unit - II: Static Electric Field


Unit - III: Conductors, Dielectrics and Capacitance

Current and current density, Ohms Law in Point form, Continuity of current, Boundary conditions of perfect dielectric materials. Permittivity of dielectric materials, Capacitance, Capacitance of a two wire line, Poisson’s equation, Laplace’s equation, Solution of Laplace and Poisson’s equation, Application of Laplace’s and Poisson’s equations.

Unit - IV: Static Magnetic Fields

Unit - V : Time Varying Fields and Maxwell’s Equations


Text Books

References

Course Outcomes:
At the end of the course, students will demonstrate the ability
1. To understand the basic laws of electromagnetism.
2. To obtain the electric and magnetic fields for simple configurations under static conditions.
3. To analyze time varying electric and magnetic fields.
4. To understand Maxwell’s equation in different forms and different media.
5. To understand the propagation of EM waves.

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Course Objectives

- To familiarize the students with the functioning of different types of DC, AC machines,
- To illustrate the different testing techniques available for DC, AC machines and transformer and obtain their characteristics practically.
- To make the students understand the concept of predetermination of voltage regulator of alternator by various method.

List of Experiments

1. Open Circuit Characteristics of DC Shunt Generator
2. Internal & External Characteristics of DC Shunt & Compound Generators
3. Swinburne's Test
4. Open Circuit & Short Circuit Tests on Single Phase Transformer
5. Separation of Losses in Single Phase Transformer
6. Pseudo load test on Three Phase Transformer
7. Load test on 3 phase slip ring induction generator
8. Load test on 3 phase slip ring induction motor
9. Predetermination of equivalent circuit of 1 phase induction motor
10. Predetermination of voltage regulation of 3 phase alternator using
11. EMF method b. MMF method c. ZPF method d) V and inverted V curves of synchronous motor
12. Synchronization and parallel operation of two 3 phase alternators

Course Outcomes

At the end of the course, students will demonstrate the ability
1. Understand the construction, working principles & operations of DC machines and transformers, Induction motors and Synchronous machines.
2. Predict the performance of electrical machines from their equivalent circuit models.
3. Validate the theoretical concepts by conducting experiments in practical sessions.
4. Distinguish the various categories of electrical machines.
5. Study the different testing techniques available to assess the performance of machine.

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Course Objectives

- To understand the basic code conversion and Karnaugh Map reduction
- To illustrate the design of Combinational and Sequential logic circuits.
- To design different counters.

List of Experiments
1. Verification of basic gates and logic circuit using universal building blocks.
2. Karnaugh Map reduction
3. Parity generator and checker circuits
4. Multiplexer and De multiplexer
5. a. Design of Half adder and full adder circuits
6. b. Full adder circuit using Multiplexer
7. Decimal to BCD converter.
8. BCD to seven segment display.
9. Design of Modulo UP Counters
10. Design of Modulo DOWN Counters
11. Design of digital to analog circuits
12. Design of Non-Sequential Counter
13. Design of Sequence Generator

Course Outcomes
At the end of the course, students will demonstrate the ability
1. Understand the basic code conversion and Karnaugh mapping technique
2. Acquire the operating theory of combinational and sequential circuits.
3. Explore the use of digital logic in integrated circuit applications.
4. Acquire the design capability of digital circuits
5. Able to design various counters

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Course Objectives:
- To Design understand the principle of DC and AC bridges.
- To illustrate the calibration of various instruments.
- To learn about various measurement methods and fault detection.

List of Experiments
1. Measurement of Inductance using
   a) Anderson’s bridge
   b) Hay’s bridge
2. Measurement of Resistance using
   a) Kelvin’s double bridge
   b) Wheatstone bridge
3. Measurement of Capacitance using
   a) Schering bridge
   b) Desauty bridge
4. Two Wattmeter Method of Power Measurement.
5. Determination of B-H loop in a transformer core using CRO
6. Calibration of ammeter, voltmeter and wattmeter using DC potentiometer
7. Calibration of single-phase Energy meter
8. Calibration of Three phase Energy meter
9. Measurement of ABCD constants in a short transmission lines
10. Cable fault detection
11. Measurement of Induction using three ammeter, three voltmeter method
12. Reactive power measurement.

Course Outcomes
At the end of the course, students will demonstrate the ability
1. Develop skills to find error in any meters.
2. Acquire knowledge in the detection of faults.
3. Concept of the bridge balancing method to determine R, L and C.
4. Understanding the principle of calibration.
5. Able to identify the cable faults

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EECP409  ELECTRICAL MEASUREMENTS LAB  L  0  T  0  P  3  C  1.5
Course Objectives

- To study the architecture, addressing modes and instructions set of 8085 microprocessors.
- To study the architecture, addressing modes and instructions set of 8051 microcontrollers.
- To gain knowledge about interrupt, I/O and communication interface.
- To know about interfacing related to various applications.

Unit - I: Fundamentals of programmable device - 8085


Unit - II: 8051 Architecture

Internal Block Diagram, CPU, ALU, address, data and control bus, Working registers, SFRs, Clock and RESET circuits, Stack and Stack Pointer, Program Counter, I/O ports, Memory Structures, Data and Program Memory, Timing diagrams and Execution Cycles.

Unit - III: Instruction Set and Programming

Addressing modes: Introduction, Instruction syntax, Data types, Subroutines Immediate addressing, Register addressing, Direct addressing, Indirect addressing, Relative addressing, Indexed addressing, Bit inherent addressing, bit direct addressing.

8051 Instruction set, Instruction timings. Data transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Subroutine instructions, Bit manipulation instruction. Assembly language programs.

Unit - IV: Memory, I/O and communication Interfacing:

Memory and I/O expansion buses, control signals, memory wait states. Interfacing of peripheral devices such as General Purpose I/O, ADC, DAC, timers, counters, memory devices, Synchronous and Asynchronous Communication. RS232, SPI, I2C. Introduction and interfacing to protocols like Blue-tooth and Zig-bee.

Unit - V: Interfacing and Control

LED, LCD and Keyboard interfacing, stepper motor interfacing, D.C motor interfacing, sensor interfacing, Introduction to 16-bit microcontroller - 8097

Text / References:

Course Outcomes:
At the end of this course, students will acquire the ability to
1. Understand the fundamental of microprocessors. 
2. Understand the structure of microcontroller.
3. Able to write the assembly language programs.
4. Interface the memory and peripheral devices.
5. Understand the microprocessor based automation system.

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Course Objectives
- To study different power switching devices and their characteristics.
- To introduce the basic theory of SCR and its practical application in the area of power of electronics.
- To explain the operating principle of conversion circuits and analyze study state response.
- To illustrate the usage of single phase voltage source inverters.
- To impart knowledge on three-phase VSI and sinusoidal modulation.

Unit - I: Power switching devices
Diode, Thyristor, MOSFET, IGBT: I-V Characteristics; Firing circuit for thyristor; Voltage and current commutation of a thyristor; Gate drive circuits for MOSFET and IGBT.

Unit - II: Thyristor rectifiers
Single-phase half-wave and full-wave rectifiers, Single-phase full-bridge thyristor rectifier with R-load and highly inductive load; Three-phase full-bridge thyristor rectifier with R-load and highly inductive load; Input current wave shape and power factor.
Unit - III: DC-DC buck converter
Elementary chopper with an active switch and diode, concepts of duty ratio and average voltage, power circuit of a buck converter, analysis and waveforms at steady state, duty ratio control of output voltage. Power circuit of a boost converter, analysis and waveforms at steady state, relation between duty ratio and average output voltage.

Unit - IV: Single-phase voltage source inverter
Power circuit of single-phase voltage source inverter, switch states and instantaneous output voltage, square wave operation of the inverter, concept of average voltage over a switching cycle, bipolar sinusoidal modulation and unipolar sinusoidal modulation, modulation index and output voltage.

Unit - V: Three-phase voltage source inverter
Power circuit of a three-phase voltage source inverter, switch states, instantaneous output voltages, average output voltages over a sub-cycle, three-phase sinusoidal modulation

Text/References:

Course Outcomes:
At the end of this course students will demonstrate the ability to
1. Understand the details of switching devices.
2. Analyze use of thyristors in different types of rectifier circuits.
3. Analyze the operation of DC-DC buck and boost converters.
4. Analyze the operation of single phase voltage source inverters.
5. Obtain knowledge about three phase voltage source inverters.

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Course Objectives

- To develop a mathematical model for physical systems – translational and rotational system block diagram reduction techniques for obtaining transfer function.
- To study time response analysis of various standard inputs for first order and second order systems.
- To study frequency response analysis and frequency domain specification by bode plot and polar plot.
- To analyze stability of system and design of controllers.
- To study the concept of controllability and observability and state space analysis. (Obtaining state equation for physical, phase and canonical variable)

Unit - I: Introduction to control problem


Unit - II: Time Response Analysis


Unit - III: Frequency-response analysis


Unit - IV: Introduction to Controller Design


Unit - V: State variable Analysis

Text/References:

Course Outcomes:
At the end of this course, students will demonstrate the ability to
1. Understand the modeling of linear-time-invariant systems using transfer function and feedback control systems.
2. Gain knowledge about time response analysis and the use of Root - loci to determine stability of systems.
3. Understand the concept of frequency response analysis.
4. Design simple feedback controllers.
5. Acquire knowledge about state variable analysis.

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Course Objectives
- To develop expressions for the computation of transmission line parameters.
- To improve the voltage profile of the transmission system by determining voltage regulation and efficiency.
- To analyze the voltage distribution in insulator strings and cable for improving voltage profile.
- To understand the operation of different types of distribution systems.

Unit-I: Determination of Line Parameters
Fundamentals of power systems: Single phase transmission - Three phase transmission - complex power - Load characteristics. Inductance of a single phase two wire line - Inductance of composite conductor lines - Inductance of three phase lines - Inductance of double circuit three phase lines - Bundled conductors - Skin effect and proximity effect.
Capacitance of a two-wire line - Capacitance of a three phase line with equilateral spacing - Capacitance of a three phase line with unsymmetrical spacing - Capacitance of a double circuit line - Effect of earth on transmission line capacitance.

Unit–II : Performance of Transmission Lines

Characteristics and performance of transmission lines : Representation of lines - Short lines - Medium length lines - Solution by nominal T and π methods - Calculation of sending and receiving end voltages and current - Regulation and efficiency of a transmission line - Long transmission line - Hyperbolic form of equations for long lines - ABCD constants - Ferranti effect - Tuned power lines - Equivalent circuit of a long line.

Voltage control: Methods of voltage control-shunt capacitors, series capacitors, tap changing transformers and booster transformers-Sending end and receiving end power circle diagrams.

Unit–III : Mechanical Characteristics of Transmission Lines

Mechanical characteristics of transmission lines: Sag in overhead lines - the catenary curve – calculation of sag with supports at different levels - Effects of wind and ice loading - Stringing chart-Sag template-Equivalent span - Stringing of conductors-vibration and vibration dampers.


Unit–IV : Insulators

Overhead line insulators - Types of insulators-Potential distribution over a string of suspension insulators - Methods of equalizing potential - Causes of failure of insulators.

Underground cables-Types of cables-capacitance of single core cable-Grading of cables- Power factor and heating in cables-Capacitance of three core cable.

Unit–V : Distribution Systems

Feeders, distributors and service mains: D.C. distributors - Singly fed and doubly fed two wire and three wire systems, with concentrated and uniformly distributed loads. A.C. distributor - Single phase and three phase -Division of load between lines in parallel.

Effect of Working voltage on the size of feeders and distributors - Effect of system voltage on economy - Voltage drop and efficiency of transmission-Distribution systems: Types of distribution systems - Section and size of feeders - Primary and secondary distribution - Distribution substations - Qualitative Treatment of Rural distribution and Industrial distribution.
Text Books

References

Course Outcomes
1. Understand the concepts of power systems
2. Able to determine the line parameters and analyze the performance of transmission lines
3. Acquire knowledge of mechanical characteristics of transmission lines
4. Analyze the concepts of distribution systems
5. Understand concept of insulation

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Course Objectives
- To understand practically the programmable devices.
- To have a sound knowledge about different categories of processors and controllers.
- To familiarize the students with the functioning of different peripheral interfacing.
- To illustrate the different processing capabilities of 8085, 8051 and 8097 practically.
- To expose the students to the programming facilities available in the lab.

List of Experiments
1. Study of 8085 Microprocessor
   a. Finding out the largest and smallest number
   b. Sorting an array
2. Multi byte Addition and Subtraction using 8085 Microprocessor
3. Study of 8255 PPI – I/O Mode and BSR Mode
4. Serial Data Communication using USART 8251 and Timer 8253
5. Study of 8051 Microcontroller
   a. Arithmetic Operations
   b. Code Conversion
6. Stepper Motor Control using 8051 Microcontroller
7. Seven Segment LED Display using 8051 Microcontroller
8. Study of Keyboard Display Interface 8279 using 8051 Microcontroller
9. Serial Data Communication Between Two 8051 Kits
10. Timer and Counter Programming in 8051 Microcontroller
11. Study of 8097 Microcontroller
   a. Arithmetic Operations
   b. Logical Operations
12. Applications of 8097 Microcontroller
   a. DAC
   b. ADC
   c. PWM Generation

Course Outcomes

At the end of this course, students will demonstrate the ability to
1. Understand the architecture and operations of microprocessors and microcontrollers.
2. Able to write programs for performing real world a task.
3. Validate the theoretical concepts by performing experiments in practical sessions.
4. Distinguish the various categories of programmable devices.
5. Study the different interfacing techniques available for 8085 and 8051.

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Course Objectives

- To explain the characteristics of power electronic devices.
- To train the students about the operation and uses of power converter circuits.
List of Experiments
1. Switching characteristics of IGBT and MOSFET.
2. Performance evaluation of single phase semi and full converters with R load.
3. Extended firing angle control of single phase semi converter.
4. Performance evaluation of three phase semi and full converters.
5. Time ratio control of IGBT based single quadrant DC chopper.
6. Time ratio control of IGBT based two quadrant DC chopper.
8. Modulation index control of single phase bridge inverter.
9. PWM pulse generation for power switches.
11. PSIM of AC-DC bridge converter.
12. PSIM of chopper

Course Outcomes
At the end of this course, students will demonstrate the ability to
1. Develop schemes for generation of firing pulses suitable for the power switches in converter circuits.
2. Formulate procedures for testing the operation of power converters.
3. Evaluate the performance of power converter circuits.
4. Experience the platform for simulation of power electronic circuits.
5. Acquire knowledge on characteristics of switching devices

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Mapping with Programme Outcomes

Course Objectives:
To provide the students simple hands-on-experience in the basic aspects of various control scheme’s implementation to various control system components.

List of Experiments
1. Potentiometer Error Detector
2. D.C Position Control System
3. D.C Speed Control System
4. PID Controller
5. Linear System Simulator
6. Temperature Control System
7. Compensation Design
8. Stepper Motor Study
9. Relay Control System
10. Digital Control System
11. Electronic PID Controller
12. AC Servo motor Position Controller
13. Phase plane Analysis of Nonlinear Control System
14. Computation of Steady State Error Caused by nonlinear systems elements

**Course Outcomes**
1. Able to use basic tools of designing various controllers.
2. Experience with various control schemes for electrical motors, process control equipments.
3. Develop skill to implement various compensating schemes for improved output response of various control system components.
4. Able to understand the non linear control system.
5. Acquire knowledge about digital control system.

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**Course Objectives**
- To introduce the formation of bus impedance and bus admittance matrices.
- To introduce different techniques of dealing with sparse matrices for large scale power systems.
- To impart in-depth knowledge on different methods of power flow solutions.
- To perform short circuit fault analysis and understand the consequence of different type of faults.

**Unit–I : Modelling of Power Systems Components**
Representation of power system components : Single phase solution of balanced three phase networks - One line diagram - Impedance or reactance diagram - Per unit system - Per unit impedance diagram - Complex power - representation of loads.
Review of symmetrical components - Transformation of voltage, current and impedance (conventional and power invariant transformations) - Phase shift in star-delta transformers - Sequence impedance of transmission lines - Sequence impedance and sequence network of power system components (synchronous machines, loads and transformer banks) - Construction of sequence networks of a power system.

**Unit–II : Bus Impedance and Admittance Matrices**

Development of network matrix from graph theory - Primitive impedance and admittance matrices - Bus admittance and bus impedance matrices – Properties - Formation of bus admittance matrix by inspection and analytical methods.


**Unit–III : Power Flow Analysis**


**Unit–IV : Fault Analysis**

Short circuit of a synchronous machine on no load and on load - Algorithm for symmetrical short circuit studies - Unsymmetrical fault analysis - Single line to ground fault, line to line fault, double line to ground fault (with and without fault impedances ) using sequence bus impedance matrices - Phase shift due to star-delta transformers - Current limiting reactors - Fault computations for selection of circuit breakers.

**Unit–V : Short Circuit Study Based on Bus Admittance Matrix**

Phase and sequence admittance matrix representation for three phase, single line to ground, line to line and double line to ground faults (through fault impedances) - Computation of currents and voltages under faulted condition using phase and sequence fault admittance models - Sparsity based short circuit studies using factors of bus admittance matrix.

**Text Books**


**References**


Course Outcomes
1. Ability to understand and analyze power system.
2. Ability to form power system matrices.
3. Ability to model power system components.
4. Apply load flow analysis to an Electrical power network and interpret the results of the analysis.
5. Analyze a network under symmetrical and unsymmetrical fault conditions and interpret the results.

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Course Objectives
1. To provide knowledge of fundamental embedded systems, design paradigms and architectures.
2. To introduce students to PIC microcontrollers and its programming.
3. To study the interfacing capabilities of PIC and varies memories.
4. To impart knowledge on Arm Architecture and its programming.
5. To give an overview of operating system, resources, tasks.

Unit–I: Overview of Embedded Systems

Unit–II: PIC Microcontroller
Introduction to PIC microcontrollers - PIC 16C74A Architecture -Comparison of PIC with other CISC and RISC based systems- memory organization – addressing modes – instruction set – PIC programming in Assembly language.
Unit –III : Interfacing capabilities of PIC

Unit–IV : Arm Architecture and Programming

Unit–V : Operating System Overview

Text Books

References

Course Outcomes:
At the end of this course, students will demonstrate the ability to
1. Understand the architecture and its programming aspects.
2. Distinguish between the general computing system and embedded system.
3. Design real time embedded systems using the concept of RTOS.
4. Acquire knowledge about architecture, registers, instruction set of arm processor.
5. Know about operating system function, resource and task management function.
Course Objective:

- To have hands on experience on various system studies and different techniques adapted for power system planning, operation and control.

List of Experiments:

1. Modeling of transmission lines and computation of their parameters
2. Formation of bus admittance matrix
3. Formation of bus impedance matrix
4. DC load flow analysis
5. Solution to load flow problem using Gauss-Siedel method
6. Economic load dispatch without losses
7. Single area load frequency control
8. Power flow analysis of radial distribution systems
9. Solution to load flow problem using Newton-Raphson approach
10. Fast Decoupled method for the solution of load flow problem
11. Symmetrical Short circuit analysis
12. Unsymmetrical Short circuit analysis
13. Economic load dispatch with losses

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Familiar with analyzing the load flow problems.
2. Capable of analyzing load frequency problem.
3. Capable of performing short circuit studies.
5. Ability to perform economic load dispatch.
Mapping with Programme Outcomes

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Course Objectives:
- To understand practically the programmable controllers.
- To have a sound knowledge about different applications performed by microcontrollers.
- To familiarize the students with the functioning of ARM7 processing system.
- To illustrate the various capabilities of 89C51 and PIC16F877 microcontrollers practically.
- To expose the students to the programming facilities available in the lab.

List of experiments:
1) Study of 89C51 Microcontroller
2) Application of 89C51 Microcontroller
   a. Frequency Measurement
   b. Boolean Operation
3) Stepper Motor Control Using 89C51 Microcontroller
4) Seven Segment LED Display Using 89C51 Microcontroller
5) Study of PIC Microcontroller 16F877
6) Application of PIC Microcontroller 16F877
   a. Seven Segment LED Display
   b. Analog to Digital Conversion
   c. PWM Generation
7) Real Time Clock Using PIC Microcontroller 16F877
8) I²C Logic Based Character Display Using PIC Microcontroller 16F877
9) Study of ARM Processor LPC2148
10) Seven Segment LED Display Using ARM Processor LPC2148
11) ADC Using ARM Processor LPC 2148
12) Study of DSP Processor TMS320C50
Course Outcomes:
At the end of this course, students will demonstrate the ability to
1. Understand the architecture and operations of MICROCHIP microcontrollers.
2. Able to write programs in Embedded C for performing a task.
3. Validate the theoretical concepts by performing experiments in practical sessions.
4. Distinguish the various categories of programmable devices.
5. Acquire knowledge about different interfacing capabilities of 89C51, PIC and ARM7.

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Course Objectives:
- To understand the moral and ethical dimensions in engineering.
- To provide knowledge about research entries, codes and industrial standard.
- To analyze the safety and risk assessment, government regulators to reduce risk with practical case studies.
- To explain about collegiality and loyalty, discrimination between employee, professional and intellectual property rights.
- To know the ethics of business, environment and computer and various roles of engineers.

Unit–I

Unit–II
Engineering as Experimentation- Engineers as Responsible Experimenters – Research Ethics – Codes of Ethics - Industrial Standards - A balanced outlook on law – The Challenger Case Study.
Unit–III
Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis-
Reducing Risk- The Government Regulators Approach to Risk-Chernobyl and
Bhopal Case Studies.

Unit–IV
Collegiality and Loyalty - Respect for Authority - Collective Bargaining -
Confidentiality - Conflicts of Interest - Occupational Crime - Professional rights -
Employee Rights- Intellectual Property Rights (IPR)- Discrimination.

Unit–V
Multinational Corporations-Business Ethics- Environmental Ethics- Computer
Ethics- Role in Technological Development – Weapons Development- Engineers as
Managers - Consulting Engineers - Engineers as Expert Witness and Advisers –
Honesty- Moral Leadership- Sample Code of Conduct.

Text Books
1. Govindarajan, M., Natarajan, S., Senthil Kumar, V.S., “Professional Ethics and
   Human Values”, PHI Learning, New Delhi, 2013.

References
1. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, “Engineering
3. John R. Boatright, “Ethics and the Conduct of Business”, Pearson Education,

Course Outcomes:
At the end of this course, students will demonstrate the ability to
1. Understand the relationship between the engineering and the society.
2. Learn the importance of codes in engineering practice.
3. Acquire knowledge on the legal, moral and ethical aspects in engineering.
4. Understand the importance of abiding the regulations , norms and standards.
5. Learn about values of ethical principles and social concerns.

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Mapping with Programme Outcomes
Course Objectives:

- To impart a wide knowledge about the components of LT system wiring components and their selection.
- To provide detects regarding residential and commercial working systems, guide lines for their installation.
- To learn about various industrial electrical system and their production schemes.
- To enable the student to acquire thorough knowledge about the automation of Industrial Electrical systems.
- To understand different types of illumination systems and its design.

Unit - I: Electrical System Components

LT system wiring components, selection of cables, wires, switches, distribution box, metering system, Tariff structure, protection components- Fuse, MCB, MCCB, ELCB, inverse current characteristics, symbols, single line diagram (SLD) of a wiring system, Contactor, Isolator, Relays, MPCB, Electric shock and Electrical safety practices.

Unit - II: Residential and Commercial Electrical Systems

Types of residential and commercial wiring systems, general rules and guidelines for installation, load calculation and sizing of wire, rating of main switch, distribution board and protection devices, Earthling system calculations, requirements of commercial installation, deciding lighting scheme and number of lamps, earthing of commercial installation, selection and sizing of components.

Unit - III: Industrial Electrical Systems

HT connection, industrial substation, Transformer selection, Industrial loads, motors, starting of motors, SLD, Cable and Switchgear selection, Lightning Protection, Earthing design, Power factor correction – kVAR calculations, type of compensation, Introduction to PCC, MCC panels. Specifications of LT Breakers, MCB and other LT panel components.

Unit - IV: Industrial Electrical System and Automation

DG Systems, UPS System, Electrical Systems for the elevators, Battery banks, Sizing the DG, UPS and Battery Banks, Selection of UPS and Battery Banks. Study of basic PLC, Role of in automation, advantages of process automation, PLC based control system design, Panel Metering and Introduction to SCADA system for distribution automation.

Unit - V: Illumination Systems

Understanding various terms regarding light, lumen, intensity, candle power, lamp efficiency, specific consumption, glare, space to height ratio, waste light factor, depreciation factor, various illumination schemes, Incandescent lamps and modern luminaries like CFL, LED and their operation, energy saving in illumination systems, design of a lighting scheme for a residential and commercial premises, floodlighting.
TextBooks
References
2. Web site for IS Standards.
Course Outcomes:
At the end of this course, students will demonstrate the ability to
1. Understand the electrical wiring systems for residential, commercial and industrial consumers, representing the systems with standard symbols and drawings, SLD.
2. Understand various components of industrial electrical systems.
3. Analyze and select the proper size of various electrical system components.
4. Understand the design of illumination system.
5. Acquire knowledge about various automation system.

| Mapping with Programme Outcomes |
|-------------------------------|----------------|
| PO1  | PO2  | PO3  | PO4  | PO5  | PO6  | PO7  | PO8  | PO9  | PO10 | PO11 | PO12 |
| CO1  | ✓    | ✓    | ✓    |      |      |      |      |      |      |      |      |
| CO2  |      |      |      |      |      |      |      |      |      |      | ✓    |
| CO3  |      |      |      |      |      |      |      |      |      |      | ✓    |
| CO4  |      |      |      |      |      |      |      |      |      |      |      |
| CO5  | ✓    |      |      |      |      |      |      |      |      |      |      |

Course Objectives
1. To provide the students simple hands-on-experience in the basic aspects of electrical engineering diagrams using CADD.
2. Exercises in estimating the materials and cost of materials required for pump room, industry and house wiring.
3. To use of CADD tools, vice, line, poly line, circle, ellipse, arc, break, text, hatch, etc – Simple drawing exercises relevant to electrical engineering.

List of Experiments
1. Principles of estimation
2. Types of wiring system
3. Pump room wiring layout
4. Industrial wiring layout
5. Residential wiring layout
6. Substation layout
7. Office lighting
8. Symbols
9. Earthing
10. Insulators
11. Lamps
12. SF6 circuit breaker
13. Towers
14. Three phase four wire energy meter

Course Outcomes:
At the end of this course, students will demonstrate the ability to
1. Understand basic tools of CADD.
2. Able to estimate of the materials required.
3. Able to draw various electrical components.
4. Acquire the designing wiring system.
5. Able to understand the design of lighting schemes.

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Course Objectives:
- To work on a technical topic and acquire the ability of written and oral presentation
- To acquire the ability of writing technical papers for Conferences and Journals
- To train the students in the field work related the Power Systems and to have a practical knowledge in carrying out Power Systems field related works.
- To train and develop skills in solving problems during execution of certain works related to Power Systems.

The students will work for two periods per week guided by student counsellor. They will be asked to present a seminar of not less than fifteen minutes and not more than thirty minutes on any technical topic of student’s choice and to engage in discussion with audience. They will defend their presentation. A brief copy of
their presentation should also be submitted. Evaluation will be done by the student counsellor based on the technical presentation and the report and also on the interaction shown during the seminar.

The students individually undergo a training program in reputed concerns in the field of Power Systems during the summer vacation (at the end of second semester for full-time / fourth semester for part-time) for a minimum stipulated period of four weeks. At the end of the training, the student has to submit a detailed report on the training he/she had, within ten days from the commencement of the third semester for Full-time / fifth semester for part-time. The students will be evaluated, by a team of staff members nominated by Head of the Department, through a viva-voce examination.

**Course Outcomes:**

At the end of this course, students will demonstrate the ability to

1. The students will be getting the training to face the audience and to interact with the audience with confidence.
2. To tackle any problem during group discussion in the corporate interviews.
3. The students can face the challenges in the field with confidence.
4. The students will be benefited by the training with managing the situation that arises during the execution of works related to Power Systems.

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**Course Objectives:**

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same.
- To train the students in preparing project reports and to face reviews and viva voce examination.

**Method of Evaluation:**

- The students in a group of 3 to 4 works on a topic approved by the Head of the Department under the guidance of a faculty member and prepare a comprehensive project report after completing the work to the satisfaction of the supervisor.
- The progress of the project is evaluated based on a minimum of three reviews. The review committee will be constituted by the Head of the Department.
A project report is required at the end of the semester.

The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

**Course Outcomes:**

At the end of this course, students will demonstrate the ability to

1. On completion of the project work students will be in a position to take up any challenging practical problems and find solution by formulating proper methodology.

2. Carrying out any experimental works.

3. Understand the modeling, analysis and design.

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**PROFESSIONAL ELECTIVES**

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**Course Objectives:**

- To provide sound knowledge about constructional details and design of various electrical machines.
- To provide knowledge about constructional details of transformers.
- To study about mmf calculation and thermal rating of various types of electrical machines.
- To learn about the various materials used in electrical machines, heating and cooling of electrical machines.
- To learn to design electrical machines using software.

**Unit - I: Introduction**

Major considerations in electrical machine design, electrical engineering materials, space factor, choice of specific electrical and magnetic loadings, thermal considerations, heat flow, temperature rise, rating of machines.

**Unit - II: Transformers**

Sizing of a transformer, main dimensions, kVA output for single- and three-phase transformers, window space factor, overall dimensions, operating characteristics, regulation, no load current, temperature rise in transformers, design of cooling tank, methods for cooling of transformers.
Unit - III: Induction Motors

Sizing of an induction motor, main dimensions, length of air gap, rules for selecting rotor slots of squirrel cage machines, design of rotor bars & slots, design of end rings, design of wound rotor, magnetic leakage calculations, leakage reactance of polyphase machines, magnetizing current, short circuit current, circle diagram, operating characteristics.

Unit - IV: Synchronous Machines

Sizing of a synchronous machine, main dimensions, design of salient pole machines, short circuit ratio, shape of pole face, armature design, armature parameters, estimation of air gap length, design of rotor, design of damper winding, determination of full load field mmf, design of field winding, design of turbo alternators, rotor design.

Unit - V: Computer aided Design (CAD):

Limitations (assumptions) of traditional designs, need for CAD analysis, synthesis and hybrid methods, design optimization methods, variables, constraints and objective function, problem formulation. Introduction to FEM based machine design. Introduction to complex structures of modern machines-PMSMs, BLDCs, SRM and claw-pole machines.

Text / References:
7. Electrical machines and equipment design exercise examples using Ansoft’s Maxwell 2D machine design package.

Course Outcomes:
At the end of this course, students will demonstrate the ability to
1. Understand the construction and performance characteristics of electrical machines.
2. Under the construction and performance characteristics of transforms.
3. Understand the various factors which influence the design: electrical, magnetic and thermal loading of electrical machines
4. Understand the principles of electrical machine design and carry out a basic design of an ac machine.
5. Use software tools to do design calculations.
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<th>Course Objectives:</th>
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<td>• To enable the students to get knowledge about the Electrical energy Scenario.</td>
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<td>• To introduce various forms of energy and its Basic.</td>
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<td>• To inculcate the students on feasibility of Energy management and Auditing.</td>
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<tr>
<td>• To impart a thorough knowledge about Energy efficiency in Industrial systems</td>
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<tr>
<td>• To Familiarize the students about Energy efficient technologies in Electrical systems.</td>
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<th>Unit - I: Energy Scenario</th>
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<td>Commercial and Non-commercial energy, primary energy resources, commercial energy production, final energy consumption, energy needs of growing economy, long term energy scenario, energy pricing, energy sector reforms, energy and environment, energy security, energy conservation and its importance, restructuring of the energy supply sector, energy strategy for the future, air pollution, climate change. Energy Conservation Act-2001 and its features.</td>
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<th>Unit - II: Basics of Energy and its various forms</th>
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<td>Electricity tariff, load management and maximum demand control, power factor improvement, selection &amp; location of capacitors, Thermal Basics-fuels, thermal energy contents of fuel, temperature &amp; pressure, heat capacity, sensible and latent heat, evaporation, condensation, steam, moist air and humidity &amp; heat transfer, units and conversion.</td>
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<th>Unit - III: Energy Efficiency in Electrical Systems</th>
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| Electrical system: Electricity billing, electrical load management and maximum demand control, power factor improvement and its benefit, selection and location of capacitors, performance assessment of PF capacitors, distribution and transformer losses. Electric motors: Types, losses in induction motors, motor efficiency, factors affecting motor performance, rewinding and motor replacement issues, energy saving opportunities with energy efficient motors. Compressed Air System: Types of air compressors, compressor efficiency, compressor operation, Compressed air system components, capacity assessment, leakage test, factors affecting the performance and savings opportunities in HVAC, Fans and blowers: Types,

**Unit - IV: Energy Efficient Technologies in Electrical Systems**

Maximum demand controllers, automatic power factor controllers, energy efficient motors, soft starters with energy saver, variable speed drives, energy efficient transformers, electronic ballast, occupancy sensors, energy efficient lighting controls, energy saving potential of each technology.

**Unit - V: Energy Management & Audit**

Definition, energy audit, need, types of energy audit. Energy management (audit) approach- understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel & energy substitution, energy audit instruments. Material and Energy balance: Facility as an energy system, methods for preparing process flow, material and energy balance diagrams.

**Text/References**

2. Success stories of Energy Conservation by BEE, New Delhi (www.bee-india.org)

**Course Outcomes:**

At the end of this course, students will demonstrate the ability to

1. Understand the current energy scenario and importance of energy conservation.
2. Understand various forms of energy.
3. Understand the concepts of energy management.
4. Understand the methods of improving energy efficiency in different electrical systems.
5. Understand the concepts of different energy efficient devices.

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Course Objectives

- To enable the students to acquire a thorough knowledge about the electrical drives, techniques for controlling the drives and their applications in industries.

- To impart a wide knowledge about the modern electric drives and its latest developments and also its industrial applications.

Unit–I : Performance of Electric Drives

Electric Drives – Types of electric drives - Characteristics of Electric Drives - Advantages of electric drives - speed torque characteristics of various types of loads and drive motors - Joint speed torque characteristics - Selection of power rating for drive motors based on thermal limits, overload capacity and load variation factors.

Unit–II : Phase Controlled DC Drives

Solid state Drives : Introduction - comparison between solid state and conventional drives - open loop and closed loop speed control - DC motor transfer function - speed and current control loops - converter fed DC drives (using thyristors) - single, two and four quadrant operations - Reversible drives - Armature and field current reversal - Dynamic and regenerative braking.

Unit–III : Chopper Controlled DC Drives (Using Devices other than Thyristors)

Principles of chopper operation - chopper configuration - chopper fed D.C. motors, analysis and performance characteristics - Dynamic and regenerative braking of chopper controlled drives - regenerative reversals.

Unit–IV : Induction Motor Drives (Using Devices other than Thyristors)

Speed control of three phase induction motor - stator voltage and frequency control – V/F control - Rotor control - static control of rotor resistance using DC chopper - slip power recovery scheme – Static Kramer and Scherbius drives.

Unit–V : Synchronous Motor and Special Machine Drives

Speed control of synchronous motors - modes of operation - Adjustable frequency operation - controlled current operation - voltage source inverter and current source inverter fed synchronous motor drive - PWM inverter fed synchronous motor drives – cyclo converter fed synchronous motor drives Special Machines Drives (qualitative treatment) – Principle of operation, Torque speed characteristics of Switched reluctance, Brush less DC and Permanent Magnet Synchronous Motor drives.

Text Books
References

Course Outcomes
1. Acquire knowledge about various electric drives with their characteristics that are used in the industries.
2. Able to choose a particular motor to suit a particular application.
3. Learn about the modern electric drives, its latest developments and their industrial applications.
4. Understand the operation and control of synchronous and induction motor drives.
5. Understand the operation of chopper fed drive.

| Mapping with Programme Outcomes |
|-------------------------------|---|---|---|---|---|---|---|---|---|---|---|
|                               | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1                           | ✓   | ✓   |     |     |     |     |     |     |     |      |      |      |
| CO2                           |     | ✓   |     |     |     |     |     |     |     |      |      |      |
| CO3                           |     |     | ✓   | ✓   | ✓   | ✓   |     |     |     |      |      |      |
| CO4                           | ✓   |     |     |     |     |     |     |     |     |      |      |      |
| CO5                           | ✓   |     |     |     |     |     |     |     |     |      |      |      |

EEPESCN ELECTRICAL AND HYBRID VEHICLES

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Course Objectives:
- To understand the fundamental concepts, principles, analysis and design of hybrid and electric vehicles.
- To understand deeper into various aspects of hybrid and electric drive train such as their configuration, types of electric machines used, energy storage device etc.
- To understand the various types of energy storage method in hybrid and electric drive
- To understand the energy management strategies and implementation in hybrid and electric drive
- To understand the design of hybrid electric vehicle and battery electric vehicle.
**Unit - I: Introduction**

Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, mathematical models to describe vehicle performance.

**Unit-II: Hybrid Vehicles**

Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies.

Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.

**Unit - III: Electric Trains**

Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis. Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.

**Unit - IV: Energy Storage**

Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices. Sizing the drive system: Matching the electricmachine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems

**Unit - V: Energy Management Strategies**


**Text / References**

Course Outcomes:
At the end of this course, students will demonstrate the ability to
1. Understand the models to describe hybrid vehicles and their performance.
2. Understand the different possible ways of energy storage.
3. Under various topologies of electric drive and its control.
4. Understand the different strategies related to energy storage systems.
5. Knowledge about different energy management strategies.

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EEPESCN WIND AND SOLAR ENERGY SYSTEMS
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Course Objectives:
- To study the wind speed statistics and probability distributions
- To understand various wind generator topologies
- To estimate the solar energy availability
- To study the power electronics convertors and MPPT
- To analyze the hybrid and isolated operation of solar PV and wind systems

Unit - I: Physics of Wind Power:
History of wind power, Indian and Global statistics, Wind physics, Betz limit, Tip speed ratio, stall and pitch control, Wind speed statistics-probability distributions, Wind speed and power-cumulative distribution functions.

Unit - II: Wind Generator Topologies:

Unit - III: Solar Resources:
Introduction, solar radiation spectra, solar geometry, Earth Sun angles, observer Sun angles, solar day length, Estimation of solar energy availability.

Unit - IV: Solar Photovoltaic:
Technologies-Amorphous, mono crystalline, polycrystalline; V-I characteristics of a PV cell, PV Unit, array, Power Electronic Converters for Solar Systems, Maximum Power Point Tracking (MPPT) algorithms. Converter Control.
Unit - V: Network Integration Issues:
Overview of grid code technical requirements. Fault ride-through for wind farms - real and reactive power regulation, voltage and frequency operating limits, solar PV and wind farm behavior during grid disturbances. Power quality issues. Power system interconnection experiences in the world. Hybrid and isolated operations of solar PV and wind systems. Solar thermal power generation: central receivers, solar pond

Text / References

Course Outcomes
At the end of this course, students will demonstrate the ability to
1. Understand the energy scenario and the consequent growth of the power generation from renewable energy sources.
2. Understand the basic physics of wind and solar power generation.
3. Understand the power electronic interfaces for wind and solar generation.
4. Understand solar photo voltage power generation.
5. Understand the issues related to the grid-integration of solar and wind energy systems.

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EEPESCN | DIGITAL SIGNAL PROCESSING | L | T | P | C
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Course Objectives:
- To represent the discrete system using different equations
- To study Z and inverse Z transforms
- To understand DFT and FFT
- To design FIR filters & IIR filters
- To Study the application of Digital signal processing
Unit - I: Discrete-time signals and systems

Discrete time signals and systems: Sequences; representation of signals on orthogonal basis; Representation of discrete systems using difference equations, Sampling and reconstruction of signals; aliasing; Sampling theorem and Nyquist rate.

Unit - II: Z-transform


Unit - III: Discrete Fourier Transform


Unit - IV: Design of Digital Filters


Unit – V: Digital Signal Processors

Generic DSP Architecture – Architecture of TMS 320 F 2407 and TEXAS 5416 processor – memory and I/O Organization – CPU -Program control – Addressing modes – Assembly Language Instructions – On chip peripherals – Clock, watch dog and real time Interrupt, event manager units – Interface units – Simple Programs.

Text/Reference Books

Course Outcomes:
At the end of this course, students will demonstrate the ability to
1. Represent signals mathematically in continuous and discrete-time, and in the frequency domain.
2. Analyze discrete-time systems using z-transform.
3. Understand the Discrete-Fourier Transform (DFT) and the FFT algorithms.
4. Design digital filters for various applications.
5. Apply digital signal processing for the analysis of real-life signals.
Course Objectives:

- To study the effect of gain on transient and steady state response
- To understand the concept of different compensators in time domain
- To analyze a steady state and transient response with compensator in frequency domain
- To study the different controllers for first, second & third order systems
- To understand controllability & observability

Unit - I: Design Specifications

Introduction to design problem and philosophy. Introduction to time domain and frequency domain design specification and its physical relevance. Effect of gain on transient and steady state response. Effect of addition of pole on system performance. Effect of addition of zero on system response.

Unit - II: Design of Classical Control System in the time domain


Unit - III: Design of Classical Control System in frequency domain

Compensator design in frequency domain to improve steady state and transient response. Feedback and Feed forward compensator design using bode diagram.

Unit - IV: Design of PID controllers

Design of P, PI, PD and PID controllers in time domain and frequency domain for first, second and third order systems. Control loop with auxiliary feedback – Feed forward control.

Unit - V: Control System Design in state space


Text / Reference Books:
Course Outcomes:
At the end of this course, students will demonstrate the ability to
1. Understand various design specifications.
2. Design classical control system in time domain
3. Design classical control system in frequency domain.
4. Design controllers to satisfy the desired design specifications using simple controller structures (P, PI, PID, compensators).
5. Design controllers using the state-space approach.

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Course Objectives:
- To introduce the computer organization and Memory organization
- To study about Input–output Organization
- To impact knowledge about 16 and 32 (bit) microprocessors
- To illustrate Pipelining
- To study Different Architectures

Unit - I: Introduction to computer organization
Architecture and function of general computer system, CISC Vs RISC, Data types, Integer Arithmetic - Multiplication, Division, Fixed and Floating point representation and arithmetic, Control unit operation, Hardware implementation of CPU with Micro instruction, microprogramming, System buses, Multi-bus organization. System memory, Cache memory - types and organization, Virtual memory and its implementation, Memory management unit, Magnetic Hard disks, Optical Disks.

Unit - II: Input – output Organization
Unit - III: 16 bit and 32 bit microprocessors
80x86 Architecture, IA – 32 and IA – 64, Programming model, Concurrent operation of EU and BIU, Real mode addressing, Segmentation, Addressing modes of 80x86, Instruction set of 80x86, I/O addressing in 80x86.

Unit - IV: Pipelining
Introduction to pipelining, Instruction level pipelining (ILP), compiler techniques for ILP, Data hazards, Dynamic scheduling, Dependability, Branch cost, Branch Prediction, Influence on instruction set.

Unit - V: Different Architectures
VLIW Architecture, DSP Architecture, SoC architecture, MIPS Processor and programming.

Text/Reference Books

Course Outcomes:
At the end of this course, students will demonstrate the ability to
1. Understand architecture and function of computer system.
2. Understand various I/O interface.
3. Understand the concepts of microprocessors, their principles and practices.
4. Write efficient programs in assembly language of the 8086 family of microprocessors.
5. Introduce different architecture like VLIW, DSP, SOC.
Course Objectives:

- To impart knowledge on different components of protection system.
- To discuss different types of faults, overcurrent protection and relay coordination.
- To explain various equipment protection schemes.
- To study computer aided protection schemes.
- To understand various system protection and application of wide area measurement system.

Unit–I: Protective Relaying Schemes

Functional characteristics of a protective relay - operating principles of relays - over current relays - instantaneous and time over current relays - definite time and inverse time characteristics - Direct over current relay - Directional over current relay - universal torque equation - performance characteristics of distance relays - differential relays - under frequency and over frequency relays - translax scheme - HRC fuses for relays.

Unit–II: Circuit Breakers


Unit–III: Protection Schemes

Feeder protection - distance protection - alternator protection - short circuit protection of stator windings by percentage differential relays - protection against turn to turn faults in stator winding - field ground fault protection - protection of stator windings by overvoltage relays - protection against stator open circuits, loss of synchronism, loss of excitation, rotor overheating - protection of transformers - typical schemes - motor protection - Bus bar protection schemes.
Unit–IV: Digital Protection


Unit - V: System Protection


Text/References

Course Outcomes:
At the end of this course, students will demonstrate the ability to
1. Understand the different components of a protection system.
2. Understand the operation of circuit breakers.
3. Understand the protection schemes for different power system components.
4. Understand the basic principles of digital protection.
5. Understand system protection schemes, and the use of wide-area measurements.

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Course Objectives

- To study HVAC and HVDC for overhead and underground transmission systems and factors governing the choice of them.
- To learn about the properties of bundle conductors for reducing the corona effects.
- To introduce the problems of EHVAC transmission at power frequency.
- To introduce modern developments in HVDC transmission and FACTS.
- To learn about the overvoltage problem in extra high voltage system.

Unit–I : Introduction to EHVAC and HVDC Transmission

EHVAC and HVDC transmission - Comparison between HVAC and HVDC overhead and underground transmission scheme - Standard transmission voltages - Factors concerning choice of HVAC and HVDC transmission - Block diagram of HVAC and HVDC transmission schemes.

Unit–II : Corona

Properties of bundled conductors - Inductance and capacitance of EHV line - Surface voltage gradient on single, double, and more than three conductor bundles - Corona effects - Power loss - Increase in radius of conductors - Charge-voltage diagram - Qualitative study of corona pulses, their generation and properties.

Unit–III : EHVAC Transmission

Problems of EHVAC transmission at power frequency - Generalised constants - Power circle diagram and its use - Voltage control using compensators - High phase order transmission.

Unit–IV : DC Transmission

Review of rectification and inversion process - Constant current and constant extinction angle modes of operations - Analysis of DC transmission systems - Harmonics on AC and DC sides and filters for their suppression - Multiterminal DC transmission systems - Parallel operation of AC and DC transmission - Modern developments in HVDC transmission/Introduction to FACTS.

Unit–V : Overvoltage in EHV Systems

Origin and types - Ferro resonance overvoltage - switching surges, reduction of switching surges on EHV systems. Introduction to EHV cable transmission, electrical characteristics of EHV cables, properties of cable insulation materials. EHV insulators - characteristics and pollution performance - Protection of HVAC and HVDC systems.

Text Books

Reference

Course Outcomes
1. Understand the factors governing the choice of HVAC and HVDC for overhead and underground transmission system.
2. Learn properties of bundled conductors.
3. Analyze the DC transmission system in case of harmonics and as well as multi terminal DC transmission system.
4. Knowledge about the EHV cables and insulating materials.
5. Learn about protection of HVAC and HVDC systems.

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Course Objectives
- To study the economic operation of power system.
- To learn optimal power flow and unit commitment.
- To illustrate different numerical integration methods in transient stability analysis.
- To model power-frequency dynamics and to design load-frequency controller.
- To examine the concept of transient stability in the power system.

Unit–I : Economic Load Dispatch
System constraints - Economic dispatch neglecting losses - Optimum load dispatch including transmission losses - Exact transmission loss formula - Modified co-ordination equations – hydro-thermal scheduling

Unit–II : Optimal Load Flow
Unit–III : Unit Commitment


Unit–IV : Load Frequency Control

Necessity of maintaining frequency constant- Load Frequency Control (Single Area Case)-Turbine Speed Governing System-Model of Speed Governing System- Turbine Model-Generator-Load Model-Block Diagram model of LFC-Steady State Analysis-Dynamic Response-Control Area Concept-Proportional plus Integral Control-Optimal Control-State variable model of single area and two-area power systems

Unit–V : Transient Stability Studies

Transient stability - Power angle curve and swing equation of single machine connected to infinite bus - Equal area criterion - Numerical solution of swing equation of single-machine system by point by point method - Factors affecting transient stability - Multi machine transient stability - solution techniques using modified Euler and RungeKutta methods

Text Books

Reference Books

Course Outcomes
1. Able to understand and analyze power system operation, stability and control.
2. Gain knowledge in economic load dispatch, load frequency control and transient stability studies that are useful for day-to-day operation of power system.
3. Study the concept of optimal load flow and unit commitment.
4. Gain knowledge from contemporary issues.

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Course Objectives

- To give an exposure of different types of analog modulation techniques and their significances in communication systems.
- To familiarize the students about angle modulation techniques in communication systems.
- To introduce pulse modulation techniques.
- To introduce the concepts of Pulse Code Modulation techniques and multiple access techniques used in communication systems for enhancing the number of users.
- To focus on various media for digital communication and future data communication.

Unit–I: Linear Modulation / Demodulation

Need for modulation – Amplitudemodulation - Power spectrum - Power relation – Different types of modulation - Double sideband suppressed carrier (DSB/SC), Single sideband suppressed carrier (SSB) and Vestigial sideband (VSB) generation. AM transmitters - Block diagram - Amplitude demodulation - Detection of DSB, SSB signals - Receiver characteristics - Super heterodyne reception - Automatic volume control.

Unit–II: Angle Modulation

Principle of frequency and phase modulation - Generation of FM and PM signals - Direct and indirect methods - FM transmitters - Block diagram - Pre-emphasis circuit - Frequency demodulation - Detection of FM and PM signals - Automatic frequency control - De-emphasis circuit.

Unit–III: Pulse Modulation

Analog and digital communication systems and techniques: Pulse modulation systems - Sampling theorem - Pulse amplitude modulation - Channel bandwidth - Detection of PAM signals - Cross talk in PAM signals - Pulse time modulation - Generation of PDM and PPM - Conversion of PDM to PPM - Detection of PTM signals - Cross talk in PTM signals.

Unit–IV: Pulse Code Modulation Systems

Quantization - Compounding - Pulse code modulation - Sampling and digitizing - Aliasing - Sample and hold circuit - Practical implementation of sampling and digitizing - Equalization - Multiplexing - Frequency Division Multiplexing (FDM) and Time Division Multiplexing (TDM) - Data communications - Serial synchronous, asynchronous communication protocol - Hardware USARTS - Software USART.

Unit–V: Wireless Communication Systems

Evolution of generations (1G, 2G, 2.5, 3G, 4G and beyond 4G) - GSM and CDMA systems - Cellular structure - Frequency reuse - Handoff - Bluetooth and UWB network - Wi-Fi and Wi-Max. (Quantitative treatment only)
Text Books

Reference Books

Course Outcomes
At the end of this course, students will demonstrate the ability to
1. Provide idea about modulation and demodulation techniques employed in communication systems.
2. Understand angle modulation technique in communication system
3. Understand pulse modulation technique and its conversion
4. Explain the concepts of pulse modulation systems and multiple access techniques used in communication field applications.
5. Understand the various broadband communication systems and recent advancements in communication systems.

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Course Objectives:
- To provide an understanding of VLSI Design process and to bring both system and circuit view on design together.
- To familiarize the MOS circuit realization of the various building blocks that is common to any microprocessor or digital VLSI circuit.
- To learn transistor level CMOS logic design and to understand NMOS and CMOS fabrication process.
To impart knowledge about designing digital circuits like adders and multipliers.

To study programming technologies and architectures of FPGAs and understand the concepts of modeling a digital system using VHDL.

**Unit–I : VLSI Design Concepts**


**Unit–II : VLSI Fabrication Techniques**


**Unit–III : Analog VLSI**


**Unit–IV : Digital VLSI**

Logic design: Switch logic and Gate logic - Dynamic CMOS logic - Structured design examples: Simple combinational logic and Clocked sequential design. Sub-system design: Design of shifters, Design of Adders: Ripple carry adders, Carry select adder, carry save adder, Manchester carry –chain adder, Carry Look-ahead adder, Design of Multipliers: Serial, Parallel and pipelined multiplier arrays, Booth multiplier, Wallace tree multiplier.

**Unit–V : Programmable ASCIS and VHDL**

Architecture and Programming technologies of ROMs, EPROMs, PLA, PAL, Gate arrays, CPLD and FPGA – Xilinx FPGA’s LCA, I/O block and interconnect – Programming technology. VHDL overview- Hardware modeling issues –VHDL code structure: Library declaration, Entities and Architectures –Data types- Operators-Concurrent and Sequential statements-Signals and Variables-Packages and Libraries - Introduction to behavioral, dataflow and structural modeling-simple VHDL code examples.
Text Books

Reference Books

Course Outcomes:
At the end of this course, students will demonstrate the ability to
1. Provide comprehensive idea about the techniques of chip design using programmable devices.
2. Analyze VLSI systems, VHDL and MOS circuit realization of the various building blocks that is common to any microprocessor or digital VLSI circuit.
3. Design and analyze of analog circuit
4. Design and analyze digital circuits like multipliers, adders and understand the architecture and programming technologies of FPGA.
5. Model a simple digital system using VHDL.

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Course Objectives:
- To Provide Knowledge of Semiconductors and Solid Mechanics to Fabricate MEMS Devices.
- To Educate on the Rudiments of Micro Fabrication Techniques.
- To Introduce Various Sensors and Actuators
- To Introduce Different Materials used for MEMS
- To Educate on The Applications of MEMS to Disciplines Beyond Electrical and Mechanical Engineering.
Unit I: Introduction


Unit II : Sensors and Actuators


Unit III : Sensors and Actuators


Unit IV : Micromachining


Unit V : Polymer and Optical MEMS

Polymers In MEMS– Polimide – SU-8 – Liquid Crystal Polymer (LCP) – PDMS – PMMA – Parylene – Fluorocarbon – Application To Acceleration, Pressure, Flow And Tactile Sensors- Optical MEMS – Lenses And Mirrors – Actuators For Active Optical MEMS.

Text Books:

References:

**Course Outcomes:**
At the end of this course, students will demonstrate the ability to
1. Ability to Understand the Operation of Micro Devices, Micro Systems And Their Applications.
2. Understand operation of different sensors and actuators
3. Ability to Design the Micro Devices, Micro Systems Using the MEMS Fabrication Process.
4. Ability to understand the application of MEMs
5. Ability to understand polymer and optical MEMs

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**Course Objectives:**
- To impart knowledge about safety its requirements
- To impart knowledge on prevention of electrical shocks
- To create awareness about various Hazardous areas
- To create awareness about various first aid methods
- To study about safety management

**Unit–I: Introduction**
General Background-Objectives of safety and security measures-Hazards associated with electric current and voltage-principles of electrical safety-Approaches to Prevent Accidents- Fire Prevention and Fire Fighting-Objectives and scope of IE act and IE rules-General requirements for electrical safety as per IE rules

**Unit–II: Electrical Shocks and their Prevention**
Unit–III: First Aid


Unit–IV: Electrical Safety in Hazardous Areas

Introduction-Classification of Hazardous zones-causes of sparks and flashovers in electrical plants and machines-functional requirements of electrical equipment and installations for hazardous area/zones-classification of equipment/enclosure for hazardous locations.

Unit–V: Electrical Safety Management

Introduction-Principles of safety management-management’s safety policy-safety organization-organization charts for construction phase of a project, maintenance mode of a plant and for safety department – safety auditing-training and supervision-annual reports - motivation to managers, supervisors and employees.

Text Books:

References

Course Outcomes:
At the end of this course, students will demonstrate the ability to
1. Learn about Electrical safety, IE act and IE rules
2. Acquire knowledge about preventing electrical shocks
3. Acquire knowledge about various first aid measures.
4. Familiarize with electrical safety in hazardous areas.
5. Get introduced to safety management.

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Course Objectives:
- To emphasize on power generation technology using conventional and non-conventional energy sources
- To create an understanding of conversion of various forms of energy to electrical energy.
- To highlight the operation and major components of electric generating plants.
- To highlight the operation and major components of hydro power plant.
- To introduce to the basics of Tariff structure for energy production.

Unit – I: Thermal, Gas and Diesel Power Plants
Thermal Power Plant: Plant layout, Components of thermal power plant, Advantages and disadvantages, choice of site.
Gas Turbine Power Plants: Plant layout, advantages and disadvantages, Applications, Open cycle and closed cycle gas turbine power plant, combined cycle power plant, Comparison with steam power plants.
Diesel power plant: Plant Layout, advantages and disadvantages, Applications, Choice and characteristic of diesel engines, auxiliaries.

Unit – II: Hydro Power Plant
Advantages and disadvantages, choice of site, Classification, Schematic arrangement, constituents of hydro power plant, Hydro turbines, Economics of small hydro schemes, Pumped storage plants, types, Advantages.

Unit – III: Nuclear Power Plant
Location and size selection, Layout and components of Nuclear Power Plants, Nuclear reactors-types and applications, Safety measures for Nuclear Power plants—Radiation shielding, Radioactive and waste disposal

Unit- IV: Power from Renewable Energy
Principle, Construction, working and types of Wind, Tidal, Solar Photo Voltaic (SPV), Solar Thermal, Geo Thermal, Biogas, Fuel Cell and Magneto-Hydro dynamic system.

Unit-V: Power Plant Economics and Tariffs
Factors affecting cost of generation, Selection of type of generation and generation equipment, Load curve, load duration curve, Effect of load on power plant design, tariffs, depreciation, causes and effects of low power factor and its improvement.

Text Books

References
Course Outcomes:
At the end of this course, students will demonstrate the ability to
1. Students can able to know different types of power plants, their functions and issues related to them.
2. Students can able to understand the significance of Hydro Energy and its economical benefits.
3. Students can able to understand the principle of operation and performance of various nuclear reactors and their impact on environment.
4. Students can able understand the importance of renewable energy sources as an alternative to energy crisis.
5. Students can learn the basics of Tariff structure for energy production.

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Course Objectives:
- To introduce the basic concepts of conducting materials.
- To understand the properties of semiconducting, magnetic and dielectric materials.
- To study the properties and applications of optical materials.
- To learn the new materials used in communication engineering.

Unit–I: Conducting Materials
Classical free electron theory - electrical conductivity - drawbacks of classical theory - quantum free electron theory of metals and its importance - density of energy states - Fermi-Dirac statistics - calculation of Fermi energy and its importance - concept of hole – energy bands in solids (qualitative treatment only) - effective mass of electron - high resistivity materials, superconductors-properties and applications.

Unit–II: Semiconducting Materials
Elemental and compound semiconductors and their properties - carrier concentration intrinsic semiconductors - carrier concentration in n-type and p-type semiconductors - variation of Fermi level and carrier concentration with temperature - Hall effect – applications.
Unit–III: Magnetic and Dielectric Materials

Different types of magnetic materials and their properties - domain theory of ferromagnetism - Heisenberg criteria - Hysteresis energy product of a magnetic material - merits and their applications - magnetic recording materials-metallic glasses - Dielectrics - Fundamental definitions - different types of electric polarization - dielectric loss – properties and different types of insulating materials - active and passive dielectrics and their applications - Ferro electrics – Piezo-electrics.

Unit–IV: Optical Materials

Optical properties of metals, insulators and semiconductors - phosphorescence and fluorescence - excitons, traps and colour centres and their importance - different phosphors used in CRO screens - liquid crystal as display material - Thermography and its applications - photoconductivity and photo conducting materials.

Unit–V: New Engineering Materials


Text Books:

References

Course Outcomes:
At the end of this course, students will demonstrate the ability to
1. Understand the concept of conducting materials.
2. Realize the properties of semiconducting, magnetic, dielectric and optical materials.
3. Realize the properties of magnetic and dielectric materials
4. Know the importance of optical materials in electrical engineering field.
5. Introduce new engineering materials in electrical engineering.

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Course Objectives:

- To familiarize the students with the various architectures and learning algorithms of Artificial Neural Network.
- To make the students to understand the basis of classifying neural networks and suitability for different applications.
- To enable the students to acquire knowledge on Fuzzy logic and their operations.
- To acquire the ability of designing Fuzzy logic controllers and Neuro Controllers.
- To introduce the concept of genetic algorithm and its operators.

Unit–I: Artificial Neural Networks


Unit – II: Neural Network Architecture And Algorithms


Unit – III: Fuzzy Logic


Unit – IV: Fuzzy Logic Controller


Unit – V: Genetic Algorithm

Optimization - Traditional optimization methods - Concept of Evolutionary Algorithm - Genetic Algorithm - encoding and decoding of variables - GA operators - reproductions - Cross over - mutation - fitness function - fitness scaling.
Text Books

References

Course Outcomes:
At the end of this course, students will demonstrate the ability to
1. Able to choose the suitable soft computing technique for the particular problem domain.
2. Recognize the feasibility of applying Artificial Neural Networks for a particular problem.
3. Apply Fuzzy Logic and reasoning to handle uncertainty and solve engineering problems.
4. Identify and apply Neuro-controller and Fuzzy Logic Controller for the solution of engineering problems.
5. Apply genetic algorithms to combinatorial optimization problems.

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Course Objectives:
- To give an exposure to various systems of human body.
- To learn the various types of biological transducers used in medical engineering field for signal acquisition.
- To familiarize the students about the bio-potential electrodes and amplifiers used in biomedical engineering.
- To focus on various cardiovascular, respiratory therapy equipments used in medical field.
- To familiarize the students about recent trends in medical imaging.
Unit–I: Electrophysiology


Unit–II: Bioelectric Signal Acquisition

Biomedical Instrumentation-Classification-design factors of biomedical instrumentation-Bio potential amplifiers - Instrumentation amplifier –Carrier amplifiers – Chopperamplifiers-Microprocessor/Microcontroller based instrumentation - Telemetry - Safety of biomedical equipments.

Unit–III: Bioelectric Potential and Cardiovascular Measurements


Unit–IV: Respiratory, Pulmonary Measurements and Rehabilitation

Physiology of respiratory system - respiratory rate measurement - Temperature - Pulmonary function measurement - Oximeter –Audiometers-types- Hearing aids - Functional neuromuscular stimulation - Physiotherapy - Diathermy -Nerve simulator/pain killer.

Unit–V : Recent Trends in Medical Imaging

Medical imaging - LASER applications in medical field - Ultrasound scanner - Echo cardiography - CT scan -Magnetic Resonance Imaging (MRI) –X-Ray imaging using special techniques- Holter monitoring.

Text Books:

References

Course Outcomes:
At the end of this course, students will demonstrate the ability to
1. Provide idea about different types of physiological transducers used in medical engineering which can be used to acquire biological signals from the human body.
2. Explain the anatomy and physiology of various subsystems of human body.
3. Get knowledge about acquiring biological signal and bioelectric potential and cardiovascular measurement.
4. Understand the principles of cardiovascular, respiratory and therapeutic assisting devices used in bio-medical field.

5. Describe the recent trends used in medical imaging.

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Course Objectives:
- To study about the different systems of electric traction
- To introduce the energy saving concept by different ways of illumination.
- To explore the utilisation of electrical energy for heating and welding
- To provide basic knowledge about Refrigeration and Air-conditioning
- To expose the students to the economics of Electrical Energy Utilization

Unit – I: Electric Drives And Traction

Unit – II: Illumination

Unit – III: Heating And Welding

Unit – IV: Refrigeration and Air Conditioning
Unit – V: Economics of Electrical Energy Utilization

Economics of Electric power supply – General rule for charging the energy – Economical cross section of a conductor – Ratings of a motor – temperature rise in a motor – power factor improvement– Economic choice of equipment – energy management – energy auditing

Text Books:

References:

Course Outcomes:
At the end of this course the students will be able to
1. Discuss about different type of electric drives and systems employed in electric traction.
2. Describe various lamps and design illumination schemes.
3. Classify the existing methods used for heating and welding.
4. Discuss the concepts of refrigeration and air conditioning.
5. Analyze the various energy saving methods.

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HONOUR ELECTIVES

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Course Objectives:
- To introduce various aspects of power system operation, stability and control
- To discuss about the analysis of linear dynamical system and various numerical integration techniques.
- To analyze the modeling of synchronous machines and associated controllers in detail
- To explain the modeling of various power system components
- To understand various types of stability analysis of power system.
Unit - I: Introduction to Power System Operations

Unit - II: Analysis of Linear Dynamical System and Numerical Methods

Unit - III: Modeling of Synchronous Machines and Associated Controllers

Unit - IV: Modeling of other Power System Components

Unit - V: Stability Analysis

Text/References

Course Outcomes:
At the end of this course, students will demonstrate the ability to
1. Understand basic power system operation
2. Understand the problem of power system stability and its impact on the system.
3. Analyze linear dynamical systems and use of numerical integration methods.
4. Model different power system components for the study of stability.
5. Understand the methods to improve stability.
Course Objectives:
- To understand the fundamentals of restructured power systems
- To learn the significance of Independent System Operator
- To impart knowledge on transmission open access and pricing
- To know about the ancillary services and their management
- To study about the power system analysis under market environment

Unit–I: Introduction to Restructuring

Unit–II: Power System Operation in Competitive Environment

Unit–III: Transmission Open Access and Pricing

Unit–IV: Ancillary Services Management
General Description of Some Ancillary Services-Frequency control-Reserves services-Reactive power and voltage control service-Black start capability service-Scheduling and Dispatch Services- Synchronous Generators as Ancillary Service Providers.

Unit–V: Power System Analysis in Market Environment
Text Books:

References

Course Outcomes:
At the end of this course, students will demonstrate the ability to
1. Understand the difference between traditional and restructured power systems
2. Understand about various entities involved in power markets.
3. Familiarize with transmission open access and electricity pricing
4. Understand various ancillary services management
5. Understand the power system analysis under market environment

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Course Objectives:
- To emphasize the need for controllers and basic varieties of compensators.
- To study the characteristics, modeling and operating schemes of different types of shunt and series switched reactive power generating devices.
- To discuss the model and performance of emerging FACTS controllers and their performance in unbalanced A.C systems.
- To explain the techniques for co-ordination of the different FACTS controllers and different power control schemes.

Unit - I: Classification of Compensators
Unit–II: Static VAR Compensators (SVC)


Unit–III: Static Series Compensators (SSC)

Objectives of Series Compensation – Variable impedance type Series Compensators – Modeling and operating control schemes of TSSC,TCSC – Variable reactance model –Switching Converter type Series Compensators – Model and Operating Control scheme of SSSC – Capability to provide real power Compensation.

Unit–IV: Emerging Facts Controllers

Static Synchronous Compensator (STATCOM) –Transfer function model – Dynamic performance –Capability to exchange real power – Operation in unbalanced ac systems – Comparison between STATCOM and SVC – Special purpose FACTS Controller – NGH-SSR Damping Scheme – Thyristor Controlled Braking resistor.

Unit–V: Coordination of FACTS Controllers


Text Books

References

Course Outcomes:
At the end of this course, students will demonstrate the ability to
1. Learn the classification of compensators and its application
2. Learn the characteristics, modeling and operating schemes of different types of shunt and series switched reactive power generating devices.
3. Learn the effect of compensators
4. Knowledge about emerging facts controllers
5. Build an enhanced knowledge of how to realize control strategies to ensure a smooth transfer of power with improved performance indices
Course Objectives:

- To introduce the definition of power quality disturbances along with cause, detrimental effects and mitigation methods.
- To learn the aspects of power quality in distribution system and various indices.
- To introduce the harmonic sources, active filters and standards.

Unit–I: Fundamentals of Power Quality

Characterization of Electric Power Quality: Transients- short duration and long duration voltage variations Voltage imbalance, waveform distortion, Voltage fluctuations, Power frequency variation, Power acceptability curves – power quality problems, Non linear and unbalanced loads, DC offset in loads, Notching in load voltage, Disturbance in supply voltage – Power quality standards.

Unit–II: Analysis of Single Phase and Three Phase System


Unit–III: Conventional Load Compensation Methods


Unit–IV: Load Compensation Using DSTATCOM

Compensating single phase loads – Ideal three phase shunt compensator structure – generating reference currents using instantaneous PQ theory – Instantaneous symmetrical components theory – Generating reference currents when the source is unbalanced – Realization and control of DSTATCOM – DSTATCOM in Voltage control mode
Unit–V: Series Compensation of Power Distribution System


Text Books:

References

Course Outcomes:
At the end of this course, students will demonstrate the ability to
Describe power quality issues in a power system.
1. Know the severity of power quality problems.
2. Understand and analyze single phase and three phase system
3. Compute the concept of improving the power quality to sensitive load by various mitigating methods.
4. Knowledge about load compensation using DSTATCON
5. Understand the series requirement of dynamic voltage regulation fills

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Objectives:
- To develop a mathematical model of sample and hold circuit
- To study Z and inverse Z transforms
- To analyze the stability of discrete time system
- To study the state space analysis of discrete time systems
- To analyze the design of discrete PID controller, discrete observer and discrete compensator
Unit - I: Discrete Representation of Continuous Systems

Unit - II: Discrete System Analysis

Unit - III: Stability of Discrete Time System

Unit - IV: State Space Approach for discrete time systems

Unit - V: Design of Digital Control System

Text Books

Course Outcomes:
At the end of this course, students will demonstrate the ability to
1. Obtain knowledge on discrete representation of LTI systems.
2. Analyse stability of open loop and closed loop discrete-time systems.
3. Design and analyse digital controllers.
4. Design state feedback and output feedback controllers.
5. Able to design discrete controllers

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Course Objectives:

- To provide sound knowledge at the fundamental of electronics circuits
- To analyze the BJT circuits and its characteristics
- Introduction to MOSFET and small signal models
- To study multi-stage and operational amplifier
- To study the application Linear and non linear applications of op-amp circuits

Unit - I: Diode circuits

P-N junction diode, I-V characteristics of a diode; review of half-wave and full-wave rectifiers, Zener diodes, clamping and clipping circuits.

Unit - II: BJT circuits

Structure and I-V characteristics of a BJT; BJT as a switch. BJT as an amplifier: small-signal model, biasing circuits, current mirror; common-emitter, common-base and common-collector amplifiers; Small signal equivalent circuits, high-frequency equivalent circuits

Unit - III: MOSFET circuits

MOSFET structure and I-V characteristics. MOSFET as a switch. MOSFET as an amplifier: small-signal model and biasing circuits, common-source, common-gate and common-drain amplifiers; small signal equivalent circuits - gain, input and output impedances, trans-conductance, high frequency equivalent circuit.

Unit - IV: Differential, multi-stage and operational amplifiers

Differential amplifier; power amplifier; direct coupled multi-stage amplifier; internal structure of an operational amplifier, ideal op-amp, non-idealities in an op-amp (Output offset voltage, input bias current, input offset current, slew rate, gain bandwidth product)

Unit - V: Linear applications of op-amp

Idealized analysis of op-amp circuits. Inverting and non-inverting amplifier, differential amplifier, instrumentation amplifier, integrator, active filter, P, PI and PID controllers and lead/lag compensator using an op-amp, voltage regulator, oscillators (Wein bridge and phase shift) Analog to Digital Conversion. Zero Crossing Detector, Square-wave and triangular-wave generators

Text/References:

Course Outcomes:
At the end of this course, students will demonstrate the ability to
1. Understand the characteristics of transistors.
2. Design and analyse various rectifier and amplifier circuits.
3. Design sinusoidal and non-sinusoidal oscillators.
4. Understand the functioning of OP-AMP and design OP-AMP based circuits.
5. Understand the structure and I.V characteristics of MOSFET & BJT.

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Course Objectives:
- To review the fundamental concepts relating to Number systems, codes and Boolean algebra and to explain the working and the characteristics of Logic families and Logic packages.
- To bring out the function of logic gates, implementation of Boolean function using logic gates, simplification of Boolean Expression using K-map and implementation of various combinational circuits.
- To illustrate the function of various types of flip-flops and counters with the help of circuit diagram, truth table, state equation and timing diagram.
- To study about operation of A/D and D/A converters.
- To study the classification of semiconductor memories and programmable logic devices.

Unit - I: Fundamentals of Digital Systems and logic families
Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples of IC gates, number systems-binary, signed binary, octal hexadecimal number, binary arithmetic, one’s and two’s complements arithmetic, codes, error detecting and correcting codes, characteristics of digital ICs, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-state logic.

Unit - II: Combinational Digital Circuits
Standard representation for logic functions, K-map representation, simplification of logic functions using K-map, minimization of logical functions. Don’t care conditions, Multiplexer, De-Multiplexer/Decoders, Adders, Subtractors, BCD arithmetic, carry look ahead adder, serial adder, ALU, elementary ALU design, popular MSI chips, digital comparator, parity checker/generator, code converters, priority encoders, decoders/drivers for display devices, Q-M method of function realization.

Unit - III: Sequential Circuits and systems
A 1-bit memory, the circuit properties of Bistable latch, the clocked SR flip flop, J- K-T and D- types flipflops, applications of flipflops, shiftregisters, applications of shiftregisters, serial-toparallel converter, parallel to serial converter, ring counter, sequence generator, ripple(Asynchronous) counters, synchronous counters, counters design using flipflops, special counter IC’s, asynchronous sequential counters, applications of counters.
Unit - IV: A/D and D/A Converters
Digital to analog converters: weighted resistor/converter, R-2R Ladder D/A converter, specifications for D/A converters, examples of D/A converter ICs, sample and hold circuit, analog to digital converters: quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D converter, A/D converter using voltage to frequency and voltage to time conversion, specifications of A/D converters, example of A/D converter ICs

Unit - V: Semiconductor memories and Programmable logic devices.
Memory organization and operation, expanding memory size, classification and characteristics of memories, sequential memory, read only memory (ROM), read and write memory (RAM), content addressable memory (CAM), charge coupled device memory (CCD), commonly used memory chips, ROM as a PLD, Programmable logic array, Programmable array logic, complex Programmable logic devices (CPLDS), Field Programmable Gate Array (FPGA).

Text/References:
4. R. Anandh Digital Electronics – Kendra publishing house

Course Outcomes:
At the end of this course, students will demonstrate the ability to
1. Understand the working of logic families and logic gates.
2. Design and implement Combinational logic circuits.
3. Understand the process of Analog to Digital conversion and Digital to Analog conversion.
4. Able to use PLDs to implement the given logical problem.
5. Design and implement sequential logic circuits.

Course Objectives:
- To introduce the basic functional elements of instrumentation
- To discuss different methods of power and energy measurement.
- To explain various resistance and impedance measurement methods
- To study various storage and display devices
- To study various recorders, transducers and the data acquisition systems

Unit–I : Measurement of Voltage and Current
Units and standards-Dimensional analysis - D'Arsonval Galvanometer-Principle, construction, operation and comparison of moving coil, moving iron meters, dynamometer, induction type - Extension of range and calibration of voltmeter and ammeter – Errors and compensation.

Unit–II : Measurement of Power and Energy
Unit–III : Resistance and Impedance Measurements
Measurement of low, medium & high resistance – Ammeter, voltmeter method
– Wheatstone bridge – A.C bridges – Measurement of inductance, capacitance – Q of
coil – Maxwell Bridge – Wein’s bridge – Schering bridge – Anderson bridge- Kelvin
double bridge – Series and shunt type ohmmeter – High resistance measurement,
Earth resistance measurement.

Unit–IV : Storage and Display Devices
Sampling- CRO dual trace and dual beam oscilloscope- applications-Digital
storage oscilloscope and applications - XY Mode - Phase measurement using
oscilloscope –Null balance method- Phase shift to pulse conversion method
Magnetic disk and tape, digital plotters and printers- CRT display- digital CRO-
LED-LCD.

Unit–V : Recorders, Transducers and Data Acquisition Systems
Recorders - XY recorders. Strip chart recorder – XY plotters - UV recorders-
magnetic tape recording - FM digital recording –interference and screening-
component impurities – electrostatic and electromagnetic interference-practical
aspects of interference reduction. Classification of transducers- Selection of
transducers- Elements of data acquisition system- A/D, D/A converters - Smart
sensors.

Text Books:
1. A.K. Sawhney, A Course in Electrical & Electronic Measurements &
2. E.W. Golding & F.C. Widdis, ‘Electrical Measurements & Measuring

Reference Books
1. J.B. Gupta, ‘A Course in Electronic and Electrical Measurements and
   edn., 2002.
3. R.B. Northrop, Introduction to Instrumentation and Measurements, Taylor &
   Francis, New Delhi, 2008.
4. M.M.S. Anand, Electronics Instruments and Instrumentation Technology,
   Prentice Hall India, New Delhi, 2009.
5. J.J. Carr, Elements of Electronic Instrumentation and Measurement, Pearson
   Education India, New Delhi, 2011.
   New Delhi -1997.

Course Outcomes:
At the end of this course, students will demonstrate the ability to
1. Ability to understand and apply basic science, circuit theory, control theory
   and signal processing concepts to engineering problems.
2. Acquire knowledge about of display instruments, amplifier measurements and CRO
3. Able distinguish recorders, transducers, data acquisition systems and display
devices.
4. Understand frequency and periodic measurements.
5. Obtain knowledge on data acquisition systems.

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Course Objectives:
- To Study the architectures of 8085 microprocessor and 8051 microcontroller
- To study the addressing modes and instruction set
- To gain knowledge about interrupt, I/O and communication interface

Unit - I: Fundamentals of Microprocessors:

Unit - II: The 8051 Architecture:
Internal Block Diagram, CPU, ALU, address, data and control bus, Working registers, SFRs, Clock and Reset circuits, Stack and Stack Pointer, Program Counter, I/O ports, Memory Structures, Data and Program Memory, Timing diagrams and Execution Cycles.

Unit - III: Instruction Set and Programming:

Unit - IV: Memory, I/O and communication Interfacing:
Memory and I/O expansion buses, control signals, memory wait states. Interfacing of peripheral devices such as General Purpose I/O, ADC, DAC, timers, counters, memory devices. Synchronous and Asynchronous Communication. RS232, SPI, I2C. Introduction and interfacing to protocols like Blue-tooth and Zig-Bee.

Unit - V: Application:
LED, LCD and Keyboard interfacing, stepper motor interfacing, D.C motor interfacing, sensor interfacing, introduction to 16-bit microcontroller - 8097

Text / References:

Course Outcomes:
At the end of this course, students will demonstrate the ability to
1. Do assembly language programming.
2. Do interfacing design of peripherals like I/O, A/D, D/A, timer etc.
3. Develop systems using different microcontrollers.
4. Interface the memory and peripheral devices design the microprocessors controller systems of various applications.
5. Understand the microprocessor based automation system.

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Course Objectives:
- To develop a mathematical model for physical systems – translational and rotational system block diagram reduction techniques for obtaining transfer function.
- To study time response analysis of various standard inputs for first order and second order systems.
- To study frequency response analysis and frequency domain specification by bode plot and polar plot.
- To analyze stability of system and application of controllers
- To study the concept of controllability and observability and state space analysis. (Obtaining state equation for physical, phase and canonical variable)

Unit - I: Introduction to control problem
Industrial Control examples. Mathematical models of physical systems. Control hardware and their models. Transfer function models of linear time-invariant systems.


Unit - II: Time Response Analysis

Unit - III: Frequency-response analysis

Unit - IV: Introduction to Controller Design

**Unit - V: State variable Analysis**


**Text/References:**

**Course Outcomes:**
1. Understand the modeling of linear-time-invariant systems using transfer function and state-space representations.
2. Understand the concept of stability and its assessment for linear-time invariant systems.
3. Design simple feedback controllers.
4. Acquire knowledge about state variable analysis.

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**Course Objectives:**
- To impart a wide knowledge about the components of industrial, residential and Commercial Electrical systems.
- To enable the student to acquire thorough knowledge about the automation of Industrial Electrical systems.

**Unit - I: Electrical System Components**

LT system wiring components, selection of cables, wires, switches, distribution box, metering system, Tariff structure, protection components- Fuse, MCB, MCCB, ELCB, inverse current characteristics, symbols, single line diagram (SLD) of a wiring system, Contactor, Isolator, Relays, MPCB, Electric shock and Electrical safety practices.

**Unit - II: Residential and Commercial Electrical Systems**

Types of residential and commercial wiring systems, general rules and guidelines for installation, load calculation and sizing of wire, rating of main switch, distribution board and protection devices, Earthling system calculations,
requirements of commercial installation, deciding lighting scheme and number of lamps, Earthing of commercial installation, selection and sizing of components.

Unit - III: Industrial Electrical Systems

HT connection, industrial substation, Transformer selection, Industrial loads, motors, starting of motors, SLD, Cable and Switchgear selection, Lightning Protection, Earthing design, Power factor correction – kVAR calculations, type of compensation, Introduction to PCC, MCC panels. Specifications of LT Breakers, MCB and other LT panel components.

Unit - IV: Industrial Electrical System and Automation

DG Systems, UPS System, Electrical Systems for the elevators, Battery banks, Sizing the DG, UPS and Battery Banks, Selection of UPS and Battery Banks. Study of basic PLC, Role of in automation, advantages of process automation, PLC based control system design, Panel Metering and Introduction to SCADA system for distribution automation.

Unit - V: Illumination Systems

Understanding various terms regarding light, lumen, intensity, candle power, lamp efficiency, specific consumption, glare, space to height ratio, waste light factor, depreciation factor, various illumination schemes, Incandescent lamps and modern luminaries like CFL, LED and their operation, energy saving in illumination systems, design of a lighting scheme for a residential and commercial premises, floodlighting.

Text/Reference Books

4. Web site for IS Standards.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the electrical wiring systems for residential, commercial and industrial consumers, representing the systems with standard symbols and drawing single line diagram.
2. Understand various components of industrial electrical systems.
3. Analyze and select the proper size of various electrical system components.
4. Understand the design of illumination system.
5. Acquire knowledge about various automation system.