# FACULTY OF ENGINEERING

## Scheme of Instruction & Examination

and

## Syllabi

## B.E. III-Semester & IV-Semester

## of

## Four Year Degree Programme

## In

## Electrical & Electronics Engineering

(With effect from the academic year 2017 – 2018)
(As approved in Faculty Meeting held on 26 June 2017)

Issued by
**Dean, Faculty of Engineering**
**Osmania University, Hyderabad**
**July 2017**

## SCHEME OF INSTRUCTION & EXAMINATION
## B.E. III – Semester
## (ELECTRICAL AND ELECTRONICS ENGINEERING)

| S. No. | Course Code | Course Title | Scheme of Instruction | | | | Scheme of Examination | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | Pr/ Drg | Contact Hrs/Wk | CIE | SEE | Duration in Hrs | |
| **Theory Courses** | | | | | | | | | | |
| 1. | BS301MT | Engineering Mathematics – III | 3 | 1 | - | 4 | 30 | 70 | 3 | 3 |
| 2. | ES322EC | Electronic Engineering-II | 3 | - | - | 3 | 30 | 70 | 3 | 3 |
| 3. | ES323ME | Prime Movers & Pumps | 3 | - | - | 3 | 30 | 70 | 3 | 3 |
| 4. | PC301EE | Electrical Circuits – I | 3 | 1 | - | 4 | 30 | 70 | 3 | 3 |
| 5. | PC302EE | Electromagnetic Fields | 3 | 1 | - | 4 | 30 | 70 | 3 | 3 |
| 6. | PC303EE | Digital Electronics & Logic Design | 3 | - | - | 3 | 30 | 70 | 3 | 3 |
| 7. | MC916CE | Environmental Sciences | 3 | - | - | 3 | 30 | 70 | 3 | 3 |
| **Practical / Laboratory Courses** | | | | | | | | | | |
| 8. | ES361ME | Mechanical Engineering Lab. | - | - | 2 | 2 | 25 | 50 | 3 | 1 |
| 9. | ES 362 EC | Electronic Engineering Lab | - | - | 2 | 2 | 25 | 50 | 3 | 1 |
| | | | **21** | **3** | **4** | **28** | **260** | **590** | | **23** |

## Engineering Service Courses offered to other Departments

| S. No. | Course Code | Course Title | Scheme of Instruction | | | | Scheme of Examination | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | Pr/ Drg | Contact Hrs/Wk | CIE | SEE | Duration in Hrs | |
| **Theory Courses** | | | | | | | | | | |
| 1. | ES321EE | Part - A Electrical Technology (For Civil Engg) | 2 | - | - | 2 | 15 | 35 | 2 | 2 |
| 2. | ES323EE | Automotive Electrical and Electronics Engineering (Automobile Engg.) | 3 | - | - | 3 | 30 | 70 | 3 | 3 |
| **Practical /Laboratory Courses** | | | | | | | | | | |
| 3. | ES361EE | Electrical Engineering Lab (For ECE and CSE) | - | - | 2 | 2 | 25 | 50 | 3 | 1 |
| 4. | ES362EE | Electrical Wiring and Microprocessor Lab (AE) | - | - | 2 | 2 | 25 | 50 | 3 | 1 |

BS: Basic Sciences ES: Engineering Sciences MC: Mandatory Course
PC: Professional Course HS: Humanities and Sciences
L: Lectures T: Tutorials Pr : Practicals Drg: Drawing
**CIE:** Continuous Internal Evaluation **SEE:** Semester End Examination (Univ. Exam)

**Note:** 1) Each contact hour is a Clock Hour
2) The practical class can be of two and half hour (clock hours) duration as per the requirement of a particular laboratory.
3) Students admitted into B.E./B.Tech. courses under lateral entry scheme (through ECET) from the academic year 2017-18 should undergo the following bridge course subjects at III Semester (CBCS).
(1) ES 154 CS Computer Programming Lab
(2) MC 156 EG Engineering English Lab

| Course Code | Course Title | | | | | | Core / Elective |
|---|---|---|---|---|---|---|---|
| BS 301 MT | **ENGINEERING MATHEMATICS – III** (Common to all branches) | | | | | | Core |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| NIL | 3 | 1 | - | - | **30** | **70** | **3** |

**Course Objectives**

- To introduce the concept of functions of complex variables and their properties
- To formulate partial differential equations and to introduce a few methods to solve first order linear and non-linear partial differential equations
- To study Fourier series and its applications to partial differential equations

**Course Outcomes**

- Determine the analyticity of a complex functions and expand functions as Taylor and Laurent series
- Evaluate complex and real integrals using residue theorem
- Expand function as a Fourier series
- Find solutions of first order and second order partial differential equations

**UNIT-I**

**Functions of Complex Variables**: Limits and continuity of function, differentiability and analyticity, necessary & sufficient conditions for a function to be analytic, Cauchy- Reimann equations in polar form, harmonic functions, complex integration, Cauchy's integral theorem, extension of Cauchy's integral theorem for multiply connected regions, Cauchy's integral formula, Cauchy's formula for derivatives and their applications.

**UNIT - II**

**Residue Calculus:** Power series, Taylor's series, Laurent's series, zeros and singularities, residues, residue theorem, evaluation of real integrals using residue theorem, bilinear transformation, conformal mapping.

**UNIT - III**

**Fourier series:** Fourier series, Fourier series expansions of even and odd functions, convergence of Fourier series, Fourier half range series.

**UNIT - IV**

**Partial Differential Equations**: Formation of first and second order partial differential equations, solution of first order equations, Lagrange's equation, Nonlinear first order equations, Charpit's method, higher order linear equations with constant coefficients.

**UNIT - V**

**Fourier Series Applications to Partial Differential Equations:** Classification of linear second order partial differential equations, separation of variables method (Fourier method), Fourier series solution of one dimensional heat and wave equations, Laplace's equation.

**Suggested Reading:**

1. R.K.Jain, S.R.K Iyengar, **Advanced Engineering Mathematics**, Narosa Publication, 4th Edition, 2014.
2. B.S.Grewal, **Higher Engineering Mathematics**, Khanna Publications, 43rd Edition, 2014.
3. Gupta, Kapoor, **Fundamentals of Mathematical statistics**, Sultan chand & sons, New Delhi, 2014.
4. Erwin Kreyszig, **Advanced Engineering Mathematics**, 9th Edition, 2012.
5. James Brown, Ruel Churchill, **Complex variables and Applications**, 9th Edition, 2013.

| Course Code | Course Title | | | | | | Core / Elective |
|---|---|---|---|---|---|---|---|
| ES322EC | **ELECTRONIC ENGINEERING – II** | | | | | | Core |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| NIL | 3 | - | - | - | **30** | **70** | **3** |

**Course Objectives**

- Identify the components that effect the frequency response and analyze the single and multi stage amplifiers
- Recognize the type of feedback and analyze its effect on amplifier's characteristics
- Calculate the frequency of oscillation for different types of oscillator circuits suited for various applications using Barkhausen's criterion
- Identify the importance of power amplifiers and calculate the efficiencies of class -A, B, AB and examine the effect on distortion. Identify the linear and non-linear wave shaping circuits for various waveforms & analyze their response

.**Course Outcomes**

- Ability to design feedback amplifiers circuit with its applications
- Ability to analyze and design various oscillators
- Ability to design power amplifier for various applications
- Ability to design various filters required
- Ability to design clipping and clamping circuits and various multi-vibrators

**UNIT-I**

**Multistage amplifiers:** Classification of amplifiers, Low, mid and high Frequency response of single stage RC coupled amplifiers, step response of amplifier. Cascading of amplifier. Interacting and non interacting amplifiers, effect of cascading on gain and Bandwidth.

**UNIT-II**

**Feedback Amplifiers:** The feedback concept, General characteristics of negative feedback amplifier, Effect of negative feedback on input and output impedances, Voltage and current, series and shunt feedbacks. Stability considerations, Local Versus global feedback.

**UNIT-III**

**Oscillators:** Barkhausen's Criterion, RC oscillator, Weinbridge, Phase shift, LC Hartley and colpitts oscillator, Crystal controlled oscillator, (Analysis oscillators using BJTs only) frequency stability of oscillator.

**UNIT-IV**

**Large Signal Amplifiers:** BJTas large signal audio amplifiers. Classes of operation, Harmonic distortion, power dissipation, efficiency calculations. Design considerations of transformer coupled and transform less push-pull audio power amplifiers under Class-A. Class-B, Class D and Class-AB operations

**UNIT-V**

**Wave-Shaping Circuits:** RC Low Pass and High Pass circuit, response to Step, Pulse, Ramp and square wave inputs, Differentiating and Integrating circuits using diode, Clipping Circuits for Single level and two levels, Clamping Circuits.

**Suggested Reading:**

1. Jacob Millman, Christos Halkias, Satyabrata jit, **Electronics Devices and Circuits**, 3rd ed., McGraw Hill Education (India) Private Limited, 2010.
2. Jacob Millman, Christos Halkias, Chetan Parikh, **Integrated Electronics**, 2nd ed., McGraw Hill Education (India) Private Limited, 2011.
3. Donald L Schilling & Charles Belove, **Electronics Circuits, Discrete & Integrated**, 3rd ed., McGraw Hill Education (India) Private Limited, 2002.
4. Jacob Millman and Herbert Taub, Pulse, **Digital and Switching waveforms**, 3rd ed., McGraw Hill Education (India) Private Limited, 2011.

| Course Code | Course Title | | | | | | Core / Elective |
|---|---|---|---|---|---|---|---|
| ES323ME | **PRIME MOVERS AND PUMPS** | | | | | | Core |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| NIL | 3 | - | - | - | **30** | **70** | **3** |

**Course Objectives**

- To acquire fundamental knowledge of fluid mechanics and the governing equations applied to fluid machinery.
- To understand the basic types of hydraulic turbines, their components calculations involved in power output and performance characteristics of turbines.
- To understand the basic differences between positive displacement and roto dynamic pumps, their working principles and performance characteristics of reciprocating and centrifugal pumps.
- To understand the mechanism involved in steam formation, types of steam generators; to understand the basic cycle of steam engines.
- To understand the basic cycles, principles involved in operation of different types of steam turbines and gas turbines.

**Course Outcomes**

- Get a quick look into fundamental aspects of fluid mechanics with basic knowledge acquired to conduct preliminary calculations applied to fluid machinery.
- Understand the basic types of hydraulic turbines, their components, operation and their rated and off design performance characteristics.
- Understand the working principle of reciprocating pumps and centrifugal pumps, their performance over wide range of operations and about the negative effects of cavitation on pump performance.
- Explain basic principles involved in steam formation, types of steam boilers, principle of steam engines.
- Familiarizes basic knowledge of working of steam turbine, gas turbine and methods of improving their efficiency.

**Unit-I**

**Fluid Mechanics:** Newtonian and Non-Newtonian Fluids, viscosity, types of fluid flows, continuity, momentum and energy equations, Bernoulli's equation and its applications, laminar and turbulent flows, Reynolds number and its significance.

**Unit-II**

**Hydraulic Turbines:** Classification and working principles of turbines, Pelton, Francis, and Kaplan turbine, function of draft tube and types of draft tubes, unit quantities, performance and characteristic curves.

**Unit-III**

**Pumps**: Reciprocating pumps, working of single and double acting types, effect of acceleration head and friction, use of air vessels, work done and power required without and with air vessels

**Centrifugal pumps:** Classification and working of centrifugal pumps, need for priming, cavitation and its effect on performance

**Unit-IV**

**Generation of steam:** Dryness fraction and properties of steam, function of boilers, working principle of Lancashire boiler, Babcock and Wilcox boiler, boiler mounting and accessories.

**Steam engines:** Rankine and Modified Rankine cycle for steam engines.

**Unit-V**

**Steam turbines:** Classification of steam turbines, compounding of steam turbines, pressure compounding, velocity compounding, and pressure-velocity compounding.

**Gas turbine:** Classification of gas turbine-constant pressure combustion cycle, closed cycle and constant volume combustion gas turbine plants.

**Suggested Reading:**

1. Ballaney P. L, **Thermal Engineering**, Khanna Publishers, 19th Edn., 1993.
2. Yadav R, **Steam and Gas turbines**, Galgotia Publishers, 6th Edn., 1992.
3. Rajput., **Thermal Engineering**, Laxmi Publications (P) Ltd, New Delhi.
4. Bansal R.K., **Fluid Mechanics and Hydraulic Machines**, Laxmi Publications (P) Ltd, New Delhi.
5. Kumar D.S, **Fluid Mechanics and Fluid Power Engineering**, S.K. Kataria & Sons
6. S.Ramamrutham, **Hydraulic Machines**, Dhanpat Rai and Sons.2004.

| Course Code | Course Title | | | | | | Core / Elective |
|---|---|---|---|---|---|---|---|
| PC301EE | **ELECTRICAL CIRCUITS - I** | | | | | | Core |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| NIL | 3 | 1 | - | - | **30** | **70** | **3** |

**Course Objectives**

- To acquire knowledge in circuits and to understand the fundamentals of derived circuit laws.
- To understand theorems, steady state and transient analysis of single phase and 3-phase circuits.

**Course Outcomes**

- Understand network analysis, techniques using mesh and node analysis.
- Evaluate steady state and transient behavior of single port network for DC and AC excitations.
- Analyze electric circuits using network theorems.
- Understand the concept of coupled circuits and poly-phase circuits.

**UNIT-I**

**Network Elements & Laws:** Active elements, Independent and dependent sources. Passive elements — R, L and C, Energy stored in inductance and capacitance, Kirchhoff's laws, Source transformations, Star-delta transformations, Node voltage method, Mesh current method including super node and super mesh analysis.

**UNIT-II**

**Single-Phase Circuits:** RMS and average values of periodic sinusoidal and non-sinusoidal waveforms, Phasor representation, Steady-state response of series, parallel and series-parallel circuits. Impedance, Admittance, Current locus diagrams of RL and RC series and parallel circuits with variation of various parameters. Resonance: Series and parallel circuits, Band-width and Q-factor.

**UNIT-III**

**Network theorems:** Superposition theorem, Thevinin's theorem, Norton's theorems, Maximum power transfer theorem, Tellegen's theorem, Compensation theorem, Millman's theorem and Reciprocity theorem.(AC & DC)

**UNIT-IV**

**Poly-phase Circuits:** Analysis of balanced and unbalanced 3-phase circuits, Star and delta connections, Measurement of three-phase power for balanced and unbalanced loads.
**Coupled Circuits:** Concept of self and mutual inductance, Dot convention, Coefficient of coupling, Analysis of circuits with mutual inductance.

**UNIT-V**

**Transient analysis:** Transient response of RLC circuits, Formulation of integrodifferential equations, Initial conditions, Response of RL, RC and RLC networks subjected to internal energy, Response to impulse, step, ramp, exponential and sinusoidal excitations

**Suggested Reading:**

1) Van Valkenburg M.E., **Network Analysis**, Prentice Hall of India, 3rd Edition, 2000.
2) William Hayt H, Kimmerly Jack E, Steven Durbin M, **Engineering Circuit Analysis**, McGraw Hill, 6th Edition, 2002.
3) Jagan N.C, Lakshrninarayana C., **Network Analysis**, B.S. Publications, 3rd Ed., 2014.

| Course Code | Course Title | | | | | | Core / Elective |
|---|---|---|---|---|---|---|---|
| PC302EE | **ELECTROMAGNETIC FIELDS** | | | | | | Core |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| NIL | 3 | 1 | - | - | **30** | **70** | **3** |

**Course Objectives**

- To be able to understand the concepts of electrostatic fields, magneto static fields, electromagnetic waves and Maxwell's equation.
- To understand the concepts of electromagnetic wave propagation in different media.

**Course Outcomes**

- Formulate problems within electrostatics, magnetostatics and stationary current distributions in linear, isotropic media.
- Derive expressions for the energy for electrostatic and magnetostatic fields, and derive Poyntings theorem.
- Calculate the boundary conditions for electric and magnetic fields between different media.
- Calculate the reflection and refraction coefficients of electromagnetic waves for different conditions.

**UNIT-I**

**Review of Vector Analysis:** Coulomb's Law, Electric field intensity, Electric field due to different charge distributions. Electric field due to line charge, Sheet charge, Volume charge distribution, Electric flux density, Gauss's law, Divergence theorem,. Potential, Potential gradient, Potential field of different charge distributions, Applications of above laws.

**UNIT-II**

Energy in electrostatic field, Poisson's and Laplace equations, Uniqueness theorem, Solution of Laplace's equation, Conductors, Dielectric capacitance, Conductor properties and Boundary conditions, Calculation of capacitance, Boundary conditions for conductors and perfect dielectric materials.

**UNIT-III**

Steady magnetic field, Biot-Savart's law, Ampere's law, Stoke's theorem, Magnetic scalar vector potential Faraday's law, Magnetic boundary conditions, Self and Mutual inductances, Force on moving charge, Force on differential elements, Magnetic circuits, Analogy with electrical circuits, Applications of above laws.

**UNIT-IV**

Maxwell's equations in Integral form, Line and surface integrals, Application to static fields, Boundary conditions, Maxwell's equations in differential forms, Continuity equation, Potential function for static fields, Field equations in vector forms, energy storage in electric and magnetic fields.

**UNIT-V**

EM waves in homogeneous medium solutions for free space conditions, Uniform plane wave propagation, Poisson's and Laplace's equations, Sinusoidally time varying uniform plane waves in free space, Uniform plane waves in dielectrics and conductors, Poynting vector, Power dissipation, Reflection of uniform plane waves, Introduction to method of moments, Method of images.

**Suggested Reading:**

1. Matthew Sadiku N.O., **Elements of Electromagnetics**, Oxford University Press, 4th Edition, 2006.
2. William. Hayt H, Buck John A., **Engineering Electromagnetics**, Tata McGraw Hill, 7th Edition, 2003.
3. Nannapaneni Narayana Rao, **Elements of Engineering Electromagnetics**, PHI, New Delhi, 5th Edition, 2002.

| Course Code | Course Title | | | | | | Core / Elective |
|---|---|---|---|---|---|---|---|
| PC303EE | **DIGITAL ELECTRONICS & LOGIC DESIGN** | | | | | | Core |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| NIL | 3 | - | - | - | **30** | **70** | **3** |

**Course Objectives**

- To be able to understand the principles of digital systems and binary arithmetic circuits
- To study the properties and realization of various logic gates, A/D and D/A converters

**Course Outcomes**

- Differentiate the number system, convert and compare a number system to another number systems used in digital logic design
- Understand Boolean algebra and its application to DeMorgan's theorems and karnaugh map reduction method
- Analyze and design various digital combinational circuits

**UNIT-I**

Boolean algebras and combinational logic, AND, OR and NOT operations. Laws of Boolean algebra, Minimization of Boolean expressions, Truth tables and maps. Sum of products and product of sums, Map method of reduction, Incompletely specified functions, Multiple output minimization.

**UNIT-II**

Tabular minimization, Digital logic families and IC's, Characteristics of Digital IC's, Introduction to RTL, DTL, TTL, CMOS, ECL families, Details of TTL logic family, Totem pole, Open collector outputs, wired AND Operation, Comparison of performance, TTL sub-families, Multiplexer and dc-multiplexer, Encoder and decoder, Code converters, Implementation of combinational logic using standard logic gates and multiplexers.

**UNIT-III**

Binary arithmetic and circuits, Half and Full adder, Subtractor and Magnitude comparator, Number complements, Two's complement arithmetic, Carry look ahead adder, Decimal numbers and their codes, BCD and Excess -3 arithmetic

**UNIT-IV**

Synchronous Sequential Circuits: basic latch circuits, Debouncing switch, SR, JK, D and T flip-flops, Truth table and execution table, Ripple and Synchronous counters, Up/down counters, General BCD counter, Shift registers, ring counters

**UNIT-V**

A/D and D/A Converters: Converter types — Tracking type, Flash type, Successive approximation type: R-2R ladder, Weighed register type, Switched current source type, Switched capacitor type

**Suggested Reading:**

1. Anand Kumar A., **Fundamentals of Digital Circuits**, Prentice Hall of India, 4th Edition, 2003.
2. Morriss Mano M., **Digital Design**, Prentice Hall of India, 3rd Edition, 2002.
3. Zvykohavi, **Switching & Finite Automata Theory**, Tata McGraw Hill, 2nd Edition, 1991.

| Course Code | Course Title | | | | | | Core / Elective |
|---|---|---|---|---|---|---|---|
| MC916CE | **ENVIRONMENTAL SCIENCES** | | | | | | Core |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| NIL | 3 | - | - | - | **30** | **70** | **3** |

**Course Objectives**

- To study the basic concepts, sources of water, floods and their impact on environment
- To know the ecosystems and energy resource systems
- To understand the Biodiversity concepts and their advantages
- To study the different pollutions and their impact on environment
- To know the social and environment related issues and their preventive measures

**Course Outcomes**

- Awareness of effects of hazardous environment.
- Idea about optimum utilization of natural resources.
- Be a catalyst in moving towards Green technologies
- Information about rules and regulations of pollution control

**UNIT-I**

**Environmental Studies:** Definition, scope and importance, need for public awareness. **Natural resources:** Water resources; use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams: benefits and problems. Effects of modern agriculture, fertilizer- pesticide problems, water logging and salinity.

**UNIT-II**

**Ecosystems:** Concept of an ecosystem, structure and function of an ecosystem, producers, consumers and decomposers, energy flow in ecosystem, food chains, ecological pyramids, aquatic ecosystem (ponds, streams, lakes, rivers, oceans, estuaries).
**Energy resources:** Growing energy needs, renewable and non-renewable energy sources. Land Resources, land as a resource, land degradation, soil erosion and desertification.

**UNIT-III**

**Biodiversity:** Genetic species and ecosystem diversity, bio-geographical classification of India. Value of biodiversity, threats to biodiversity, endangered and endemic species of India, conservation of biodiversity.

**UNIT-IV**

**Environmental Pollution:** Causes, effects and control measures of air pollution, water pollution, soil pollution, noise pollution, thermal pollution; solid and liquid waste management.

**Environment Protection Act:** Air, water, forest and wild life Acts, enforcement of environmental legislation.

**UNIT-V**

**Social Issues and the Environment:** Water conservation, watershed management, and environmental ethics. Climate change, global warming, acid rain, ozone layer depletion. **Environmental Disaster Management:** Types of disasters, impact of disasters on environment, infrastructure and development. Basic principles of disaster mitigation, disaster management and methodology. Disaster management cycle and disaster management in India.

**Suggested Reading:**

1. A.K. De, **Environmental Chemistry**, Wiley Eastern Ltd.
2. E.P. Odum, **Fundamentals of Ecology**, W.B. Sunders Co., USA.
3. M.N. Rao and A.K. Datta, **Waste Water Treatment**, Oxford and IBK Publications.
4. Benny Joseph, **Environmental Studies**, Tata McGraw Hill, 2005.
5. V.K. Sharma, **Disaster Management**, National Centre for Disaster Management, IIPE, Delhi, 1999.
6. **Green Building Council of India**, Teri Document.

| Course Code | Course Title | | | | | | Core / Elective |
|---|---|---|---|---|---|---|---|
| ES361ME | **MECHANICAL ENGINEERING LAB** | | | | | | Core |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| NIL | - | - | - | 2 | **25** | **50** | **1** |

**Course Objectives**

- To gain knowledge of working of petrol and diesel engines
- To be able to estimate the power developed in the engine
- To understand the working principle of hydraulic turbines and pumps
- To understand the performance of turbines using characteristic curves
- To gain the knowledge of various flow meters and the concept of fluid mechanics

**Course Outcomes**

- Knowledge regarding components and functioning of engines
- Ability to calculate the power developed, losses in the engines
- Understanding of viscosity of oils
- Knowledge of flash and fire point of oils, and its importance
- Knowledge of estimating the power of turbines and pumps

**a) Thermal Engineering Laboratory:**

1. Flash and Fire point test.
2. Performance test on diesel engine
3. Valve timing diagram test on a I.C engine
4. Morse test on multi-cylinder petrol engine.
5. Heat balance test on diesel engine.
6. Performance test on VCR engine

**b) Hydraulic Machinery Laboratory:**

7. Performance test on Pelton wheel turbine.
8. Characteristics curves test on Pelton wheel turbine.
9. Performance test on Francis turbine.
10. Characteristics curves test on Francis turbine.
11. Performance test on Turgo wheel.
12. Characteristics curves test on Turgo wheel.
13. Performance test on Reciprocating pump.

***Note:*** *At least ten experiments should be conducted in the Semester*

| Course Code | Course Title | | | | | | Core / Elective |
|---|---|---|---|---|---|---|---|
| ES362EC | **ELECTRONIC ENGINEERING LAB** | | | | | | Core |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| NIL | - | - | - | 2 | **25** | **50** | **1** |

**Course Objectives**

- Designing basic circuits of rectification with and without filters using diodes
- Designing wave shaping circuit using diodes.
- Designing of single and multistage amplifier circuits.
- Demonstrate negative feedback in amplifier circuits and positive feedback in Oscillators
- Design of Class Power Amplifiers

**Course Outcomes**

- Calculate ripple factor, efficiency and % regulation of rectifier circuits
- Analyze feedback amplifiers and BJT oscillator circuits
- Design single, multi-stage, wave shaping and power amplifier circuits

**List of Experiments:**

1. Characteristics of Silicon, Germanium and Zener Diode in forward bias and reverse bias
2. Application of diode as a full wave rectifier with and without filters. Calculation of Ripple factor, voltage regulation and efficiency with various loads
3. Static characteristics of BJT in CE configuration
4. Static characteristics of JFET in CS configuration
5. Frequency response of Single and two stage BJT amplifier in CE configuration
6. Voltage series amplifier without and with feedback
7. Voltage shunt amplifier without and with feedback.
8. Current shunt amplifier without and with feedback.
9. LC Oscillators: Hartley Oscillator and Colpitts Oscillator.
10. RC Phase Oscillator and Wein Bridge Oscillator.
11. Power Amplifier
12. Clipping circuits
13. Clamping Circuits.

***Note:*** *At least ten experiments should be conducted in the Semester*

**Suggested Reading:**

1. Paul B. Zbar, Albert P. Malvino, Michael A. Miller, **Basic Electronics**, A text-Lab Manual, 7th Edition. Mc- Graw- Hill Higher Education 2001.

| Course Code | Course Title | | | | | | Core / Elective |
|---|---|---|---|---|---|---|---|
| ES321EE | Part A: **ELECTRICAL TECHNOLOGY** (For Civil Engg.) | | | | | | Core |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| NIL | 2 | - | - | - | **15** | **35** | **2** |

**Course Objectives**

- To acquire knowledge in electrical circuits
- To be able to understand the basic principle operation of electrical machines

**Course Outcomes**

- Students will know the basics of Electrical Engineering with good knowledge on underlying principles of operation
- Students can relate these basics with daily experiences

**UNIT I**

**DC Circuits:** Ohm's law, Kirchhoff's laws, Resistance networks, Series, Parallel and Series-parallel circuits, Power loss in resistive elements.

**AC Circuits:** Principles of production of ac waveform, frequency, effective value and form factor, Phasor representation, Behaviour of pure resistance, inductance, and capacitance with ac sinusoidal source, Impedance and simple ac networks with R, L and C elements.

**UNIT II**

**Three Phase Circuits:** Star and Delta connections under balanced conditions, Line & phase Voltages and currents and three phase power.

Working principle of single phase energy meter.

Basic principles of DC generator and motor.

**UNIT III**

**Transformers:** Principle and working of single phase transformer under no-load and load conditions, O.C & S.C tests, Losses & efficiency, voltage regulation.

**Three phase Induction Motors:** Rotating magnetic field, Torque-slip characteristics, Starting methods – DOL starter, Star/Delta starter.

Basic idea and applications of single phase induction motors – Capacitor start 1-phase induction motor.

**Suggested Reading:**

1. Mehta V.K., **Principles of Electrical Engineering and Electronics**, S.Chand & Co., 1999
2. John Bird, **Electrical Circuit theory and Technology**, Routledge Taylor & Francis Group, Fourth Edition, 2012.
3. Naidu M.S, Kamakshiah S., **Introduction to Electrical Engineering**, Tata McGraw Hill, 1995.
4. A.Chakrabarti, Sudipta Nath, Chandan Kumar Chanda, **Basic Electrical Engineering,** Tata McGraw Hill Education PVT LTD, 2009.

| Course Code | Course Title | | | | | | Core / Elective |
|---|---|---|---|---|---|---|---|
| ES323EE | **AUTOMOTIVE ELECTRICAL AND ELECTRONICS ENGG.** (For Automobile Engg.) | | | | | | Core |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| NIL | 3 | - | - | - | **30** | **70** | **3** |

**Course Objectives**

- Understand the principle and construction of batteries and accessories
- To know the working of different starter drive units
- To understand the charging system and the working of its units
- To know the fundamentals of auto motive electronics
- To know working of sensors and activators & microprocessor

**Course Outcomes**

- Explain the principle and construction of batteries and accessories
- Demonstrate the working of different starter drive units
- Distinguish between the different units of charging system
- Apply electronics for different automobile systems
- Apply different sensors and microprocessors for the measurement of operating parameters of an automobile

**UNIT-I**

**Batteries and Accessories:** Principle and construction of lead acid battery, characteristics of battery, rating capacity and efficiency of batteries various tests on batteries, maintenance and charging. Lighting system: insulated and earth return system, details of head light and side light, LED lighting system, head light dazzling and preventive methods – Horn, wiper system and trafficator.

**UNIT-II**

**Starting System:** Condition at starting, behaviour of starter during starting, series motor and its characteristics, principle and construction of starter motor, working of different starter drive units, care and maintenance of starter motor, starter switches.

**UNIT-III**

**Charging System:** Generation of direct current, shunt generator characteristics, armature reaction, third brush regulation, cutout, voltage and current regulators, compensated voltage regulator, alternators principle and constructional aspects and bridge rectifiers, new developments.

**UNIT-IV**

**Fundamentals of Automotive Electronics:** Current trends in automotive electronic engine management system, electromagnetic interference suppression, electromagnetic compatibility, electronic dashboard instruments, onboard diagnostic system, security and warning system.

**UNIT-V**

**Sensors and Activators:** Types of sensors: Sensor for speed, throttled position, exhaust oxygen level, manifold pressure, crankshaft position, coolant temperature, exhaust temperature, air mass flow for engine application. Solenoids, stepper motors relay. Introduction to Microprocessor & Applications in Automobiles.

**Suggested Reading:**

1. Young A.P. & Griffiths. L., **Automotive Electrical Equipment**, ELBS & New Press - 1999.
2. William B. Riddens, **Understanding Automotive Electronics**, 5th edition – Butter worth Heinemann Woburn, 1998.
3. Bechhold, **Understanding Automotive Electronics**, SAE, 1998.
4. Crouse, W.H, **Automobile Electrical Equipment**, McGraw-Hill Book Co., Inc., New York, 3rd edition, 1986.

| Course Code | Course Title | | | | | | Core / Elective |
|---|---|---|---|---|---|---|---|
| ES361EE | **ELECTRICAL ENGINEERING LAB** (Common for ECE & CSE) | | | | | | Core |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| NIL | - | - | - | 2 | **25** | **50** | **1** |

**Course Objectives**

- To learn practical electric AC & DC circuits.
- To learn operation and performance characteristics of electrical machines by conducting various tests practically.

**Course Outcomes**

- Awareness about various electric safety rules to be followed while working with electrical equipments
- Explore themselves in designing basic electric circuits
- Identify requirements for electric machines for domestic and industrial purpose

**List of Experiments:**

1. Verification of Kirchhoff's Laws.
2. Verification of Thevinin's and Norton's Theorems.
3. Study of Three-Phase Balanced Circuits.
4. Measurement of Power by Two-Wattmeter Method.
5. Study of Single-Phase RLC Series Circuits.
6. Magnetization Curve of a Separately Excited DC Generator.
7. Load Characteristics of Shunt Generator.
8. Performance Characteristics of Shunt Motor.
9. Speed Control of DC Shunt Motor.
10. O.C and S.C Tests on Single-Phase Transformer.
11. Load Test on Single-Phase Transformer.
12. Load Test on Three-Phase Induction Motor.

*Note: At least ten experiments should be conducted in the Semester.*

| Course Code | Course Title | | | | | | Core / Elective |
|---|---|---|---|---|---|---|---|
| ES362EE | **ELECTRICAL WIRING AND MICROPROCESSOR LAB** (For Automobile Engg) | | | | | | Core |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| NIL | - | - | - | 2 | **25** | **50** | **1** |

**Course Objectives**

- To learn the testing and maintenance of batteries, starting motors, generators and regulator
- To know the diagnosis of Ignition System and automobile electrical wiring
- To understand the Block Transfer, 8 bit addition & Subtraction Stepper Motor Interfacing

**Course Outcomes**

- Awareness about testing and maintenance of batteries, starting of motors, generators and regulator
- Diagnosis of Ignition System and automobile electrical wiring
- Explore the microprocessor basics and interfacing the stepper motor

**List of Experiments:**

**Electrical Laboratory**

1. Testing of batteries and battery maintenance
2. Testing of starting motors and generators
3. Testing of regulators and cut –outs
4. Diagnosis of ignition system faults
5. Study of Automobile electrical wiring

**Microprocessor**

6. Block Transfer
7. 8 bit Addition, Subtraction
8. Multiplication and Division
9. Maximum and Minimum of block of data
10. Sorting
11. Stepper Motor Interfacing

*Note: At least ten experiments should be conducted in the Semester.*

## SCHEME OF INSTRUCTION & EXAMINATION
## B.E. IV – Semester
## (ELECTRICAL AND ELECTRONICS ENGINEERING)

| S. No. | Course Code | Course Title | Scheme of Instruction | | | | Scheme of Examination | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | Pr/ Drg | Contact Hrs/Wk | CIE | SEE | Duration in Hrs | |
| **Theory Courses** | | | | | | | | | | |
| 1. | BS401MT | Engineering Mathematics-IV | 3 | 1 | - | 4 | 30 | 70 | 3 | 3 |
| 2. | PC401EE | Electrical Circuits - II | 3 | 1 | - | 4 | 30 | 70 | 3 | 3 |
| 3. | PC402EE | Electrical Machines-I | 3 | 1 | - | 4 | 30 | 70 | 3 | 3 |
| 4. | PC403EE | Power Systems-I | 3 | - | - | 3 | 30 | 70 | 3 | 3 |
| 5. | PC404EE | Power Electronics | 3 | 1 | - | 4 | 30 | 70 | 3 | 3 |
| 6. | PC405EE | Linear Integrated Circuits | 3 | - | - | 3 | 30 | 70 | 3 | 3 |
| 7. | HS401BM | Managerial Economics & Accountancy | 3 | - | - | 3 | 30 | 70 | 3 | 3 |
| **Practical / Laboratory Courses** | | | | | | | | | | |
| 8. | PC451EE | Digital Electronics and Integrated Circuits Lab | - | - | 2 | 2 | 25 | 50 | 3 | 1 |
| 9. | PC452EE | Computer Aided Electrical Drawing Lab. | - | - | 2 | 2 | 25 | 50 | 3 | 1 |
| | | | **21** | **04** | **04** | **29** | **260** | **590** | | **23** |

## Engineering Service Courses Offered to other Departments

| S. No. | Course Code | Course Title | Scheme of Instruction | | | | Scheme of Examination | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | Pr/ Drg | Contact Hrs/Wk | CIE | SEE | Duration in Hrs | |
| **Theory Courses** | | | | | | | | | | |
| 1. | ES422EE | Electrical Circuits & Machines (For ME & PE) | 3 | - | - | 3 | 30 | 70 | 3 | 3 |
| **Practical / Laboratory Courses** | | | | | | | | | | |
| 2. | ES461EE | Electrical Circuits & Machines Lab (For ME & PE) | - | - | 2 | 2 | 25 | 50 | 3 | 1 |

BS: Basic Sciences ES: Engineering Sciences MC: Mandatory Course
PC: Professional Course HS: Humanities and Sciences
L: Lectures T: Tutorials Pr : Practicals Drg: Drawing
**CIE:** Continuous Internal Evaluation **SEE:** Semester End Examination (Univ. Exam)

**Note:** 1) Each contact hour is a Clock Hour
2) The practical class can be of two and half hour (clock hours) duration as per the requirement of a particular laboratory.

| Course Code | Course Title | | | | | | Core / Elective |
|---|---|---|---|---|---|---|---|
| BS401MT | **ENGINEERING MATHEMATICS - IV** (Common to all branches) | | | | | | Core |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| NIL | 3 | 1 | - | - | **30** | **70** | **3** |

**Course Objectives**

- To introduce transforms like Laplace, Fourier, Z-transforms and their properties
- To introduce a few numerical methods to solve certain types of problems
- To understand curve fitting, correlation and regression

**Course Outcomes**

- Solve differential equations using Laplace and Fourier transforms
- Solve difference equation using Z-transforms
- Find numerical solution of algebraic, transcendental equations and ordinary differential equations.
- Perform a regression analysis and compute and interpret the coefficient of correlation

**UNIT- I**

**Laplace transforms**: Introduction of Laplace transforms, sufficient condition for existence of Laplace transform, Laplace transform of Derivatives, Laplace transform of integrals, Translation theorems (I & II shifting theorems), Differentiation of Laplace transform ( Multiplication by t), Integration of Laplace transform( Division by t ), convolution theorem, Solving initial value problems using Laplace transform.

**UNIT- II**

**Fourier transforms:** Introduction, Fourier integrals, Fourier sine and cosine integrals, Complex form of Fourier integral, Fourier transform, Fourier sine and cosine transforms, Finite Fourier sine and cosine transforms, Properties of Fourier transforms, Convolution theorem for Fourier transforms.

**UNIT- III**

**Z-Transforms:** Introduction, basic theory of Z-transforms, Z-transforms of standard sequences, existence of Z-transform, linearity property, translation theorem, scaling property, initial and final value theorems, differentiation of Z-transform, convolution theorem, solution of difference equations using Z-transforms.

**UNIT- IV**

**Numerical methods:** Solution of Algebraic and Transcendental equations**:** Bisection method, Newton-Raphson method, Solution of linear system of equations: Gauss elimination method, Gauss- Seidel iteration method, Interpolation: Lagrange's interpolation, Newton's divided difference interpolation, Newton's Forward and Backward difference interpolations, Numerical differentiation, Numerical solutions of ordinary differential equations : Taylor's series method, Euler method, Runge-Kutta method of $4^{th}$ order.

**UNIT- V**

**Curve fitting:**

Curve fitting by method of least squares**,** correlation and regression, types of correlations, Karl Pearson's coefficient of correlation, Spearman's rank correlation coefficient, equal ranks, equations to the lines of regression.

**Suggested Reading:**

1. R.K.Jain, S.R.K Iyengar, **Advanced Engineering Mathematics**, Narosa Publication, $4^{th}$ Edition, 2014.
2. B.S.Grewal, **Higher Engineering Mathematics**, Khanna Publications, $43^{rd}$ Edition, 2014.
3. Vasishtha, Gupta, **Integral Transforms**, Krishnan Prakashan Publications, 2014.
4. Erwin Kreyszig, **Advanced Engineering Mathematics**, $9^{th}$ Edition, 2012.

| Course Code | Course Title | | | | | | Core / Elective |
|---|---|---|---|---|---|---|---|
| PC401EE | **ELECTRICAL CIRCUITS – II** | | | | | | Core |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| NIL | 3 | 1 | - | - | **30** | **70** | **3** |

**Course Objectives**

- To acquire knowledge in circuits and to understand the Fourier series and Laplace transformation.
- To be able to understand the techniques of electric network synthesis.

**Course Outcomes**

- Examine the behavior of linear circuits using Fourier transform, Laplace transforms and transfer function of single port network.
- Obtain two port network parameters and applications of graph theory to electric circuits.
- Synthesize a network in terms of RL, RC and RLC parameters.

**UNIT I**

**Fourier Series and Integral:** Fourier series representation of periodic functions, Symmetry conditions, Exponential Fourier series, Discrete spectrum, Fourier integral and its properties, Continuous spectrum, Application to simple networks

**UNIT II**

**Laplace Transform Method of Analysis of Networks**: Definition of Laplace pair, Evaluation of Laplace transform of common time function, Laplace properties and theorems, Convolution theorem, Waveforms synthesis, Partial fraction method of inverse transforms, Application to networks, Transfer functions.

**UNIT III**

**Two port network parameters:** Open circuit impedance, Short circuit admittance, Transmission, Hybrid parameters & inter-relationships, Series, parallel and cascade connection of two port networks, System function, Impedance and admittance functions

**UNIT IV**

**Topological Description of Networks:** Graph, tree, chord, cut-set, incident matrix, circuit matrix and cut-set matrix, Formulation of node equations, loop equations, cut-set equations for RLC networks.

**Network synthesis** of driving point functions, Positive real function, properties of PR functions, Testing of PR functions,

**UNIT V**

**Synthesis** of LC, RC, RL functions, Properties of LC, RC and RL networks, Minimum functions, Synthesis of RLC networks, Brune's method, Properties of networks in terms of poles and zeros.

**Suggested Reading:**

1. Van Valkenburg M.E, **Network Analysis**, Prentice Hall of India, 3rd Edition, 2000.
2. William Hayt H, Kimmerly Jack E., and Steven Durbin M, **Engineering Circuit Analysis**, McGraw Hill, 6th Edition, 2002.
3. Jagan N.C, Lakshminarayana C., **Network Analysis**, B.S. Publications, 3rd Ed. 2014.
4. Chakravarthy A., **Circuit Theory**, Dhanpat Rai & Co., First Edition, 1999.

| Course Code | Course Title | | | | | | Core / Elective |
|---|---|---|---|---|---|---|---|
| PC402EE | **ELECTRICAL MACHINES - I** | | | | | | Core |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| NIL | 3 | 1 | - | - | **30** | **70** | **3** |

**Course Objectives**

- To learn and understand electromechanical energy conversion devices.
- To be able to understand in detail about DC machines. Construction, principle, performance characteristics and testing.

**Course Outcomes**

- Understand construction, operating principle and characteristics of different types of DC motors and generators
- Test and calculate performance parameters of DC motors and generators
- Select appropriate DC machines for a specific application

**UNIT I**

**Electromechanical energy conversion:** Principle of energy conversion, Flow of energy in electromechanical devices, Coupling-field reaction, Singly excited magnetic system – Electric energy input, Magnetic field energy stored, Mechanical work done – with slow, instantaneous and transient movement of armature, Calculation of mechanical force, Doubly excited magnetic systems, electromagnetic and reluctance torques.

**UNIT II**

**DC Machines:** Simple loop generator, Essential parts of DC machine, Details of Lap winding & Wave winding, EMF equation, Armature reaction — Remedies, Ampere turns, Commutation — reactance voltage, Methods of improving commutation — High resistance brushes, shifting of brushes, Interpoles, Compensating winding.

**UNIT III**

**DC Generators;** Classification & types of DC generators, Open circuit, Internal & External characteristics — Critical resistance & critical speed, Voltage regulation, Conditions for self excitation, Causes of failure of voltage buildup, Parallel operation Series, Shunt and Compound generators, Applications.

**UNIT IV**

**DC Motors:** Classification & Types of DC motors, Back emf, Speed regulation, Armature torque, Armature reaction, Operating characteristics, Performance curves, Basic speed control methods Shunt and Series motors, Three & four-point starters, Calculation of step resistances, Applications.

**UNIT V**

**Testing, Losses and Efficiency:** Power losses — Copper losses and Rotational losses, Power flow, Efficiency, Testing - Brake Test and Swinburne's test, Hopkinson's test, Field's test, Retardation test, Heat run test.

**Suggested Reading:**

1. D.P. Kothari, I.J. Nagrath, **Electric Machines**, Tata McGraw Hill, 4th Edition, 2010
2. Bhimbra P.S., **Electrical Machinery**, Khanna Publications, 2000
3. Gupta J.B., **Theory and Performance of Electrical Machines**, S.K. Kataria & Sons, Delhi, 2005.
4. AE Clayton and NN Hancock, **The Performance and Design of Direct Current Machines**, 3rd edition, 1959.

| Course Code | Course Title | | | | | | Core / Elective |
|---|---|---|---|---|---|---|---|
| PC403EE | **POWER SYSTEMS - I** | | | | | | Core |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| NIL | 3 | 1 | - | - | **30** | **70** | **3** |

**Course Objectives**

- To be able to learn and understand the conventional and renewable generating power stations and economics of generation
- To be able to understand design concepts of transmission lines and cables

**Course Outcomes**

- Acquire knowledge in conventional renewable generating power stations and economics of generation
- Acquire knowledge regarding the design concepts of transmission lines and cables

**UNIT I**

**Economics of Power Generation:** Load Curve, Load Demand and Diversified factors, Base Load and Peak load operation, Types of costs and depreciation fund calculations, Methods of power factor improvement, Economics of power factor improvement, Tariffs, Distribution: 2 wire and 3 wire distributors, Ring mains, AC distribution calculations.

**UNIT II**

**Steam Power Stations:** Choice of site, Layout & various parts of station, Boilers, Turbines, Super Heaters, Economizers, Air pre-heaters etc. and their Pulverized fuel, Coal handling.

**Hydro-Electric Power plants:** Estimation Hydrograph, Flow duration curve, Mass curve, Storage and pondage, Types electric plants and layouts, Prime movers for hydro-electric plants.

**UNIT III**

**Nuclear Power Plants:** Fissile materials, working principle of nuclear plants and reactor control, Shielding, Types of reactors.

**Non-Conventional Energy Sources** – Basic principles of Wind, solar and gas turbines..

**UNIT IV**

**Over-Head Lines:** Supports sag and tension calculations, Effect of wind and ice, Erection conditions, Insulators: Types of insulators, Potential distribution over a string of suspension insulators, Methods of equalizing the potential, Testing of insulators. Insulated Cables: Conductors for cables, Insulating materials, Mechanical protection, Low voltage cables, Grading of cables, Three phase high voltage cables and Super voltage cables, Capacitance of three-core cables.

**UNIT V**

**Inductance and Capacitance of Transmission Lines:** Inductance and capacitance of overhead line conductors, Single phase and three phase with symmetrical composite conductors, GMR and GMD Spacing, Transposition, Bundled conductors, Effect of earth capacitance.

**Suggested Reading:**

1. Wadhwa C.L., **Electrical Power Systems**, New Age International (P) Ltd., 4th Edition, 2007.
2. Wadhwa C.L., **Generation, Distribution and Utilization of Electrical Energy**, New Age International (P) Ltd., 4th Edition, 2006.
3. Singh S.N., **Electrical Power Generation, Transmission and Distribution**, Prentice Hall of India, Pvt. Ltd., New Delhi, 2003.
4. V.K.Mehta, **Principles of Power Systems**, S. Chand and Co., 2007.

| Course Code | Course Title | | | | | | Core / Elective |
|---|---|---|---|---|---|---|---|
| PC404EE | **POWER ELECTRONICS** | | | | | | Core |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| NIL | 3 | 1 | - | - | **30** | **70** | **3** |

**Course Objectives**

- To be able to understand various power switching devices, characteristics and applications.
- To learn and understand the various converters like rectifiers, choppers and inverters principle operation, characteristics and applications.

**Course Outcomes**

- Explain the characteristics of power semiconductor devices and their applications
- Select a triggering circuit and commutation method to turn on and turn off the devices
- Select controlled rectifier to control the voltage as well as speed of the DC machines
- Explain the operation of Switch mode regulators and select appropriate converter as required
- Describe principle of operation of Inverters and select a method to control the inverters

**UNIT-I**

**Power Semiconductor Diodes and Transistors:** Types of power diodes - General purpose diodes -Fast recovery diodes -Their characteristics and applications. Bipolar Junction transistors, Power MOSFETs P-Channel, N- Channel. IGBTs – Basic structure and working, Steady state and switching characteristics- Comparison of BJT, MOSFET and IGBT -Their applications. SCRs-Static and dynamic characteristics, Two transistor analogy.

**UNIT-II**

**Turn on and turn off mechanisms**: BJT, Power MOSFET, IGBTs .SCR trigger circuits- R, RC and UJT triggering circuits. Triggering circuits for Single phase bridge rectifier and Choppers. Driver Circuits for MOSFET, IGBT and BJT. Protection of SCR's, Difference between forced and line commutation

**UNIT-III**

**Principles of controlled rectification** -Study of Single phase and three-phase half controlled and full controlled bridge rectifiers with R, RL, RLE loads. Effect of source inductances. Dual converters- circulating current mode and circulating current free mode-control strategies.

**UNIT-IV**

**Classification of Choppers**: Class A, B, C, D and E, Switching mode regulators - Study of Buck, Boost and Buck-Boost regulators, Cuk regulators. Principle of operation of Single phase bridge type Cyclo converters and their appl.ications. Single phase AC Voltage Controllers with R, L and RL loads.

**UNIT-V**

**Principle of operation of Single phase Inverters** -Three phase bridge Inverters (1800 and 1200 modes)-voltage control of inverters-Single pulse width modulation- multiple pulse width modulation, sinusoidal pulse width modulation. Comparison of Voltage Source Inverters and Current source Inverters, Elementary Multilevel Inverters.

**Suggested Reading:**

1. Singh. M.D and Khanchandani. K.B, **Power Electronics**, Tata McGraw Hill, 2nd Edition, 2006.
2. Rashid. M.H, **Power Electronics Circuits Devices and Applications**, Prentice Hall of India, 2003.
3. M.S. Jamil Asghar, **Power Electronics**, Prentice Hall of India, 2004.
4. Bimbra. P.S, **Power Electronics**, Third Edition, Khanna Publishers, 1999.
5. Mohan, Undeland, Robbins, **Power Electronics**, John Wiley, 1996.

| Course Code | Course Title | | | | | | Core / Elective |
|---|---|---|---|---|---|---|---|
| PC405EE | **LINEAR INTEGRATED CIRCUITS** | | | | | | Core |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| NIL | 3 | - | - | - | **30** | **70** | **3** |

**Course Objectives**

- To familiarize and able to understand Op-amps.
- To understand the different linear and non-linear applications of op-amp
- To understand the voltage regulators and active filters by using op-amps.

**Course Outcomes**

- Design and use op-amps for various linear and non-linear applications.
- Ability to design and use voltage regulators and active filters

**UNIT – l**

**Operational amplifiers :** Characteristics, Open loop voltage gain, Output impedance, Input impedance, Common Mode Rejection Ratio - Offset balancing techniques - Slew rate, Frequency response - Basic applications - Inverter summer, Analog integrator, Differentiator, Current to voltage converter, Voltage to current converter, Voltage follower, a.c. amplifier.

**UNIT – II**

**Circuits using Op-amps :** Voltage limiter, Clipper and damper, Precision rectifier-full wave and half wave, Peak detector, Comparator, Zero crossing detector, Schmitt trigger, Monostable, astable and bistable multivibrators, Multiplier, Divider, Difference amplifier, Instrumentation amplifier.

**UNIT – III**

**Waveform generation using Op-amps:** Sine, Square, Triangular and Quadrature oscillators, 555 timer - Functional diagram, Operation as monostable and astable, Voltage to frequency converter using 555, 565.

**UNIT – IV**

**Voltage regulators using Op-amp :** Series voltage regulators - Shunt regulators using Op-amp - Switching regulators using Op-amp, Buck, Boost, Buck-boost regulators- Regulators using IC 723 - Dual voltage regulator - Fixed voltage regulators - Current sensing and current fold back protection.

**UNIT – V**

**RC active filters :** Butterworth - First order - Second order for low pass - High pass - Band pass - Band reject - Notch - State variable filter - Switched capacitor filter - Universal filter - Power amplifiers - Power boosters, Monolithic power amplifier features.

**Suggested Reading:**

1. Gayakwad W.A., **Op-Amps and Linear Integrated Circuits**, 4th Edition, Prentice Hall of India, 2002.
2. Malvino Albert Paul, **Electronic Principles**, 6th Edition, Tata McGraw Hill, 1999.
3. Roy Choudhury, Shail Jam, **Linear integrated Circuits**, New Age International, 2nd Edition, 2003.
4. William D. Stanley, **OP Amps with Linear Integrated Circuits**, Pearson, 2000.

| Course Code | Course Title | | | | | | Core / Elective |
|---|---|---|---|---|---|---|---|
| HS401BM | **MANAGERIAL ECONOMICS AND ACCOUNTANCY** (Common to all branches) | | | | | | Core |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| NIL | 3 | - | - | - | **30** | **70** | **3** |

**Course Objectives**

- To learn important concepts of Managerial Economics and apply them to evaluate business decisions.
- To understand various parameters that determines the consumers' behavior.
- To evaluate the factors that affect production.
- To understand the concepts of capital budgeting and payback period.
- To study the concepts of various book-keeping methods.

**Course Outcomes**

- Determine the objectives, nature, scope, role & responsibilities of a manager of a business undertaking.
- Predict the demand for a product or product mix of a company & to analyze various factors influencing demand elasticity.
- Forecast & compute the future sales level of a product by using various quantitative & qualitative techniques and with the help of past sales data.
- Discuss the process & principles of accounting and prepare Journal, Ledger, Trial Balance, Manufacturing A/c, Trading A/c., Profit & Loss A/c. and Balance Sheet of an enterprise

**Unit-I**

**Meaning and Nature of Managerial Economics:** Managerial Economics and its usefulness to Engineers, Fundamental Concepts of Managerial Economics-Scarcity, Marginalism, Equimarginalism, Opportunity costs, Discounting, Time Perspective, Risk and Uncertainty, Profits, Case study method.

**Unit-II**

**Consumer Behavior:** Law of Demand, Determinants, Types of Demand; Elasticity of Demand (Price, Income and Cross-Elasticity); Demand Forecasting, Law of Supply and Concept of Equilibrium. (Theory questions and small numerical problem can be asked)

**Unit - III**

**Theory of Production and Markets:** Production Function, Law of Variable Proportion, ISO quants, Economics of Scale, Cost of Production (Types and their measurement), Concept of Opportunity Cost, Concept of Revenue, Cost-Output relationship, Break-Even Analysis, Price - Output determination under Perfect Competition and Monopoly (theory and problems can be asked)

**Unit-IV**

**Capital Management:** Significance, determination and estimation of fixed and working capital requirements, sources of capital, Introduction to capital budgeting, methods of payback and discounted cash flow methods with problems. (Theory questions and numerical problems on estimating working capital requirements and evaluation of capital budgeting opportunities can be asked)

**Unit-V**

**Book-keeping:** Principles and significance of double entry book keeping, Journal, Subsidiary books, Ledger accounts, Trial Balance, concept and preparation of Final Accounts with simple adjustments, Analysis and interpretation of Financial Statements through Ratios.

(Theory questions and numerical problems on preparation of final accounts, cash book, petty cash book, bank reconciliation statement, calculation of some ratios)

**Suggested Reading:**

1. Mehta P.L., **Managerial Economics – Analysis, Problems and Cases**, Sulthan Chand & Sons Educational Publishers, 2011.
2. Maheswari S.N., **Introduction to Accountancy**, Vikas Publishing House, 2005.
3. Pandey I.M., **Financial Management**, Vikas Publishing House, 2009.

| Course Code | Course Title | | | | | | Core / Elective |
|---|---|---|---|---|---|---|---|
| PC451EE | **DIGITAL ELECTRONICS AND INTEGRATED CIRCUITS LAB** | | | | | | Core |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| NIL | - | - | - | 2 | **25** | **50** | **1** |

**Course Objectives**

- To Train the Students for acquiring practical knowledge in time response and frequency response of series / parallel RC, RL and RLC Circuits.
- To prepare the students for finds out parameters of a given two port network.
- To make the students for understanding the verification of theorems.

**Course Outcomes**

- Evaluate the time response and frequency response characteristics of R,L,C series and parallel circuits.
- Able to validate the network theorems.
- Able to find various parameters of a two-port network.
- Able to simulate electrical circuits using spice.
- Able to synthesize networks from a given transfer function

**LIST OF EXPERIMENTS:**

1. Generation of triangular, sine and square wave using IC's.
2. Voltage regulator IC **(Included instead of PLL)**
3. Design of astable multivibrator using 555 timer.
4. Active filters.
5. Instrumentation amplifier Sample and hold circuit.
6. Design of integrator and differentiator using Op-Amp.
7. Multiplexer application for logic realization and parallel to serial Conversions.
8. Synchronous counters.
9. Asynchronous counters.
10. Clippers and clampers using Op-Amps.
11. Monostable operation using IC's.
12. Bootstrap sweep circuit using Op-Amp.
13. Half adder, full adder and subtractor and realization of combinational logic.
14. A / D converters.
15. D / A converters.

*Note: At least ten experiments should be conducted in the Semester.*

| Course Code | Course Title | | | | | | Core / Elective |
|---|---|---|---|---|---|---|---|
| PC452EE | **COMPUTER AIDED ELECTRICAL DRAWING LAB.** | | | | | | Core |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| NIL | - | - | - | 2 | **25** | **50** | **1** |

**Course Objectives**

- To understand the terminology of electric circuit and electrical components.
- To be able to familiarize with electrical machines, apparatus and appliances.
- To acquire knowledge on various Electrical Engineering software.

**Course Outcomes**

- Identify and draw different components of electrical systems
- Draw different control and wiring diagrams
- Draw winding diagrams of electrical machines.

Drawing of the following using Electrical CADD / Corel Draw / MS Word / PPT/Visio

1. Lines, Arcs, Curves, Shapes, Filling of objects, Object editing & Transformation.
2. Electrical, Electronic & Electro – Mechanical symbols.
3. House – wiring diagrams and layout.
4. Simple power and control circuit diagrams.
5. Electrical machine winding diagrams. (A.C & D.C)
6. Transmission tower, Over head lines – ACSR conductors, Single circuit, Double circuit, Bundle conductor.
7. Constructional features of D.C motors, AC motors and Transformers.
8. D.C and A.C motor starter diagrams.
9. Lamps used in illumination
10. Single line diagram of Power System

**Suggested Reading:**

1. KB. Raina, S.K. Bhattacharya, **Electrical Design, Estimating and Costing**, Wiley Eastern Ltd., 1991.
2. Nagrath, Kothari, **Electrical Machines**, Tata McGraw Hill Publishing Company Ltd., 2000.
3. A.K. Sawhney, **A Course in Electrical Machines Design**, Dhanpat Rai and Sons, 1996.

| Course Code | Course Title | | | | | | Core / Elective |
|---|---|---|---|---|---|---|---|
| ES422EE | **ELECTRICAL CIRCUITS AND MACHINES** (For ME & PE) | | | | | | Core |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| NIL | 3 | - | - | - | **30** | **70** | **3** |

**Course Objectives**

- To acquire knowledge in electrical circuits.
- To be able to understand the basic principle operation and performance of electrical machines.

**Course Outcomes**

- Know the basics of Electrical Engineering with good knowledge on underlying principles of operation.
- Relate these basics with daily experiences.

**UNIT I**

**DC Circuits:** Ohm's law, Network elements, Kichhoff's laws, Power in DC circuits, Series & parallel resistances, Thevinin's and Norton's theorems.

**AC Circuits:** Sinusoidal sources, Phasor representation of sinusoidal quantities, Average and RMS values, Form factor, Analysis of RLC circuits to sinusoidal inputs, Power factor, Active & reactive powers, energy stored in inductance and capacitance, Mutual inductance.

**UNIT II**

**Three-Phase Circuits:** Production of 3-phase voltages, balanced star and delta connections, Measurement of power by Two-wattmeter method.

**Single Phase Transformers:** Principle of operation, Transformer on No-load and Load, Equivalent circuit, Efficiency & regulation, O.C and S.C tests, Principle of autotransformer.

**UNIT III**

**DC Machines:** Construction and working principle of generator and motor, EMF in generator, Types of excitation, Characteristics of series and shunt generators, Applications, Torque in a DC motor, Characteristics of shunt and series motors, Speed control of dc shunt motors, Losses & efficiency, Three point starter.

**UNIT IV**

**Three-Phase Induction Motors:** Production of rotating magnetic field, Construction and principle of Induction motors, Torque-slip characteristics, Star delta and Autotransformer starters, Speed control by Stator voltage and Rotor resistance methods.

**UNIT V**

**Single-Phase Motors:** Capacitor start and Capacitor run motor, Universal motors. **Three - Phase alternators:** Construction, emf equation, Regulation by synchronous impedance method.

**Suggested Reading:**

1. Naidu M.S, Kamakshiah S, **Introduction to Electrical Engineering**, Tata McGraw Hill, 1995
2. John Bird, **Electrical Circuit theory and Technology**, Routledge Taylor & Francis Group, Fourth Edition, 2012.
3. Mehta V.K., **Principles of Electrical Engineering and Electronics**, S.Chand & Co., 1995
4. A.Chakrabarti, Sudipta Nath, Chandan Kumar Chanda, **Basic Electrical Engineering**, Tata McGraw Hill Education PVT LTD, 2009.

| Course Code | Course Title | | | | | | Core / Elective |
|---|---|---|---|---|---|---|---|
| EE 461EE | **ELECTRICAL CIRCUITS & MACHINES LAB** (For ME & PE) | | | | | | Core |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| NIL | - | - | - | 2 | **25** | **50** | **1** |

**Course Objectives**

- To learn practical electric AC & DC circuits
- To learn operation and performance characteristics of electrical machines by conducting various tests practically

**Course Outcomes**

- Aware of various electric safety rules to be followed while working with electric circuits and equipments
- Explore themselves in designing basic electric circuits
- Identify requirements for electric machines for domestic and industrial purpose

**List of Experiments:**

1. Verification of Kirchhoff's Laws.
2. Verification of Thevenin's and Norton's Theorems.
3. Study of Three-Phase Balanced Circuits.
4. Measurement of Power by Two-Wattmeter Method.
5. Study of Single-Phase RLC Series Circuits.
6. Magnetization Curve of a Separately Excited DC Generator.
7. Load Characteristics of Shunt Generator.
8. Performance Characteristics of Shunt Motor.
9. Speed Control of DC Shunt Motor.
10. O.C and S.C Tests on Single-Phase Transformer.
11. Load Test on Single-Phase Transformer.
12. Load Test on Three-Phase Induction Motor.

*Note: At least ten experiments should be conducted in the Semester.*