**SECOND YEAR: ELECTRICAL & ELECTRONICS ENGINEERING**

**SCHEME OF INSTRUCTION AND EXAMINATIONREVISED COURSE 2019-2020**

**SEMESTER - III**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Subject****Code** | **Name of the Subject** | **Scheme of Instruction****Hrs/Week** | **Scheme of Examination** | **Credit** |
| **L** | **T** | **P** | **H** | **ThDuration (Hrs)** | **Marks** |
| **Th** | **S** | **TW\*\*** | **P** | **O** | **Total** |
| EE310 | Mathematics-III | 3 | 1 | 0 | 4 | 3 | 100 | 25 | 25 | 0 | 0 | **150** | **4** |
| EE320 | Electromagnetic Fields | 3 | 0 | 0 | 3 | 3 | 100 | 25 | 0 | 0 | 0 | **125** | **3** |
| EE330 | Digital Electronics  | 4 | 0 | 0 | 4 | 3 | 100 | 25 | 0 | 0 | 0 | **125** | **4** |
| EE340 | Electrical Machines - I  | 4 | 0 | 0 | 4 | 3 | 100 | 25 | 0 | 0 | 0 | **125** | **4** |
| EE350 | Electrical Circuit Analysis | 3 | 1 | 0 | 4 | 3 | 100 | 25 | 25 | 0 | 0 | **150** | **4** |
| EE360 | Digital Electronics Lab | 0 | 0 | 2 | 2 | - | 0 | 0 | 25 | 50 | 0 | **75** | **1** |
| EE370 | Electrical Machines-I Lab | 0 | 0 | 2 | 2 | - | 0 | 0 | 25 | 50 | 0 | **75** | **1** |
| HM001 | Technical Communication | 2 | 0 | 0 | 2 | - | 0 | 0 | 75 | 0 | 0 | **75** | **2** |
| AC390 | Mathematics-I & II (Bridge Course)\* | 2 | 0 | 0 | 2 | - | 0 | 0 | 0 | 0 | 0 | **0** | **0** |
| **TOTAL** | **21** | **2** | **4** | **27** | **--** | **500** | **125** | **175** | **100** | **0** | **900** | **23** |

\*Applicable to direct second year /lateral entry students

\*\*Term Work marks are to be awarded through continuous evaluation

**SECOND YEAR: ELECTRICAL & ELECTRONICS ENGINEERING**

**SCHEME OF INSTRUCTION AND EXAMINATIONREVISED COURSE 2019-2020**

**SEMESTER - IV**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Subject****Code** | **Name of the Subject** | **Scheme of Instruction****Hrs/Week** | **Scheme of Examination** | **Credit** |
| **L** | **T** | **P** | **H** | **ThDuration (Hrs)** | **Marks** |
| **Th** | **S** | **TW\*** | **P** | **O** | **Total** |
| EE410 | Numerical Methods | 3 | 1 | 0 | **4** | 3 | 100 | 25 | 25 | 0 | 0 | **150** | **4** |
| EE420 | Electrical Machines - II | 4 | 0 | 0 | **4** | 3 | 100 | 25 | 0 | 0 | 0 | **125** | **4** |
| EE430 | Analog Electronics | 4 | 0 | 0 | **4** | 3 | 100 | 25 | 0 | 0 | 0 | **125** | **4** |
| EE440 | Fundamentals of Signal Processing  | 3 | 1 | 0 | **4** | 3 | 100 | 25 | 25 | 0 | 0 | **150** | **4** |
| EE450 | Renewable Energy  | 3 | 0 | 0 | **3** | 3 | 100 | 25 | 0 | 0 | 0 | **125** | **3** |
| EE460 | Electrical Machines - II Lab | 0 | 0 | 2 | **2** | - | 0 | 0 | 25 | 50 | 0 | **75** | **1** |
| EE470 | Analog Electronics Lab | 0 | 0 | 2 | **2** | - | 0 | 0 | 25 | 50 | 0 | **75** | **1** |
| HM003 | Economics for Engineers | 3 | 0 | 0 | **3** | - | 100 | 25 | 0 | 0 | 0 | **125** | **3** |
| **TOTAL** | **20** | **2** | **4** | **26** | **--** | **600** | **150** | **100** | **100** | **0** | **950** | **24** |

\*Term Work marks are to be awarded through continuous evaluation

**THIRD YEAR: ELECTRICAL & ELECTRONICS ENGINEERING**

**SCHEME OF INSTRUCTION AND EXAMINATIONREVISED COURSE 2019-2020**

**SEMESTER - V**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Subject****Code** | **Name of the Subject** | **Scheme of Instruction****Hrs/Week** | **Scheme of Examination** | **Credit** |
| **L** | **T** | **P** | **H** | **ThDuration (Hrs)** | **Marks** |
| **Th** | **S** | **TW\*** | **P** | **O** | **Total** |
| EE510 | Control Systems | 3 | 1 | 0 | **4** | 3 | 100 | 25 | 0 | 0 | 0 | **125** | **4** |
| EE520 | Microprocessors  | 4 | 0 | 0 | **4** | 3 | 100 | 25 | 0 | 0 | 0 | **125** | **4** |
| EE531 | Digital Signal Processing | 3 | 0 | 0 | **3** | 3 | 100 | 25 | 0 | 0 | 0 | **125** | **3** |
| EE532 | Illumination Engineering |
| EE533 | Electrical Machines Design |
| EE534 | Hybrid Vehicles |
| EE541 | Testing & Maintenance of Electrical Machines | 3 | 0 | 0 | **3** | 3 | 100 | 25 | 0 | 0 | 0 | **125** | **3** |
| EE542 | Analog and Digital Communicaiton |
| EE543 | Bio-Medical Instrumentation  |
| EE544 | Electrical Energy Conservation & Auditing  |
| EE550 | Control Systems Lab | 0 | 0 | 2 | **2** | - | 0 | 0 | 25 | 50 | 0 | **75** | **1** |
| EE560 | Microprocessor Lab | 0 | 0 | 2 | **2** | - | 0 | 0 | 25 | 50 | 0 | **75** | **1** |
| \*\* | **Open Elective** | 3 | 0 | 0 | **3** | 3 | 100 | 25 | 0 | 0 | 0 | **125** | **3** |
| HM004 | Management & Organizational Behavior | 3 | 0 | 0 | **3** | 3 | 100 | 25 | 0 | 0 | 0 | **125** | **3** |
| **TOTAL** | **19** | **1** | **4** | **24** | **--** | **600** | **150** | **50** | **100** | **0** | **900** | **22** |

Students to select ANY ONE subject from EE531, EE532, EE533 and EE534 as Professional elective Iand ANY ONE subject from EE541, EE542, EE543 and EE544 as Professional elective II

\*Term Work marks are to be awarded through continuous evaluation

**THIRD YEAR: ELECTRICAL & ELECTRONICS ENGINEERING**

**SCHEME OF INSTRUCTION AND EXAMINATIONREVISED COURSE 2019-2020**

**SEMESTER - VI**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Subject****Code** | **Name of the Subject** | **Scheme of Instruction****Hrs/Week** | **Scheme of Examination** | **Credit** |
| **L** | **T** | **P** | **H** | **ThDuration (Hrs)** | **Marks** |
| **Th** | **S** | **TW\*** | **P** | **O** | **Total** |
| EE610 | Power System - I  | 3 | 1 | 0 | **4** | 3 | 100 | 25 | 25 | 0 | 0 | **150** | **4** |
| EE620 | Power Electronics | 4 | 0 | 0 | **4** | 3 | 100 | 25 | 0 | 0 | 0 | **125** | **4** |
| EE631 | Smart Grid | 3 | 0 | 0 | **3** | 3 | 100 | 25 | 0 | 0 | 0 | **125** | **3** |
| EE632 | Power Quality |
| EE633 | Digital Control System |
| EE634 | Artificial Neural Network & Fuzzy Logic |
| EE641 | Power System Protection  | 3 | 0 | 0 | **3** | -3 | 100 | 25 | 0 | 0 | 0 | **125** | **3** |
| EE642 | VLSI |
| EE643 | Electric Drives |
| EE644 | Operation Research |
| EE650 | Measurement & Instrumentation Lab | 0 | 0 | 2 | **2** | - | 0 | 0 | 25 | 0 | 25 | **50** | **1** |
| EE660 | Power Electronics Lab | 0 | 0 | 2 | **2** | - | 0 | 0 | 25 | 50 | 0 | **75** | **1** |
| \*\* | Open Elective  | 3 | 0 | 0 | **3** | 3 | 100 | 25 | 0 | 0 | 0 | **125** | **3** |
| HM005 | Entrepreneurship & Intellectual Property  | 3 | 0 | 0 | **3** | 3 | 100 | 25 | 0 | 0 | 0 | **125** | **3** |
| **TOTAL** | **19** | **1** | **4** | **24** | **--** | **600** | **150** | **75** | **50** | **25** | **900** | **22** |

Students to select ANY ONE subject from EE631, EE632, EE633 and EE634 as Professional elective III and ANY ONE subject from EE641, EE642, EE643 and EE644 as Professional elective IV

\*Term Work marks are to be awarded through continuous evaluation

**FOURTH YEAR: ELECTRICAL & ELECTRONICS ENGINEERING**

**SCHEME OF INSTRUCTION AND EXAMINATIONREVISED COURSE 2019-2020**

**SEMESTER - VII**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Subject****Code** | **Name of the Subject** | **Scheme of Instruction****Hrs/Week** | **Scheme of Examination** | **Credit** |
| **L** | **T** | **P** | **H** | **ThDuration (Hrs)** | **Marks** |
| **Th** | **S** | **TW\*** | **P** | **O** | **Total** |
| EE710 | Power Systems - II  | 3 | 1 | 0 | **4** | 3 | 100 | 25 | 25 | 0 | 0 | **150** | **4** |
| EE721 | Flexible AC Transmission | 3 | 0 | 0 | **3** | 3 | 100 | 25 | 0 | 0 | 0 | **125** | **3** |
| EE722 | Image Processing  |
| EE723 | Distributed Generation &Microgrids |
| EE724 | PLC & Its Applications |
| EE730 | Power System Lab | 0 | 0 | 2 | **2** | -- | 0 | 0 | 25 | 0 | 25 | **50** | **1** |
| **\*\*** | Open Elective  | 3 | 0 | 0 | **3** | 3 | 100 | 25 | 0 | 0 | 0 | **125** | **3** |
| EE740 | Internship  | 0 | 0 | 6 | **6** | - | 0 | 0 | 50 | 0 | 50 | **100** | **3** |
| EE750 | Project Work - Phase I  | 0 | 0 | 6 | **6** | - | 0 | 0 | 50 | 0 | 75 | **125** | **3** |
| **TOTAL** | **9** | **1** | **14** | **24** | **--** | **300** | **75** | **150** | **0** | **150** | **675** | **17** |

Students to select ANY ONE subject from EE721, EE722, EE723 and EE724 as Professional elective V

\*Term Work marks are to be awarded through continuous evaluation

**FOURTH YEAR: ELECTRICAL & ELECTRONICS ENGINEERING**

**SCHEME OF INSTRUCTION AND EXAMINATIONREVISED COURSE 2019-2020**

**SEMESTER - VIII**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Subject****Code** | **Name of the Subject** | **Scheme of Instruction****Hrs/Week** | **Scheme of Examination** | **Credit** |
| **L** | **T** | **P** | **H** | **ThDuration (Hrs)** | **Marks** |
| **Th** | **S** | **TW\*** | **P** | **O** | **Total** |
| EE810 | High Voltage Engineering | 3 | 0 | 0 | **3** | 3 | 100 | 25 | 0 | 0 | 0 | **125** | 3 |
| EE821 | Embedded Systems | 3 | 0 | 0 | **3** | 3 | 100 | 25 | 0 | 0 | 0 | **125** | 3 |
| EE822 | Power System Operation & Control  |
| EE823 | Reliability of electrical system |
| EE824 | PV & Its Applications |
| EE830 | Elective - NPTEL / MOOC / SWAYAM | 0 | 0 | 0 | **3** | -- | 0 | 0 | 50 | 0 | 50 | **100** | 3 |
| EE840 | Project Work - Phase II  | 0 | 0 | 18 | **18** | -- | 0 | 0 | 200 | 0 | 200 | **400** | 9 |
| **TOTAL** | **6** | **0** | **18** | **24** | **--** | **200** | **50** | **250** | **0** | **250** | **750** | **18** |

Students to select ANY ONE subject from EE821, EE822, EE823 and EE824 as Professional elective VI

\*Term Work marks are to be awarded through continuous evaluation

|  |
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| **BASICS OF ELECTRICAL & ELECTRONICS ENGINEERING** |
| **Course Code** | **FE 130** | **Credits** | **3** |
| **Scheme of Instruction****Hours/ Week** | **L** | **T** | **P** | **TOTAL** |
| **3** | **0** | **0** | **39 hrs/sem** |
| **Scheme of Examination****TOTAL = 125 marks** | **IA** | **TW** | **TH** | **P** | **O** |
| **25** | **0** | **100** | **0** | **0** |

# Course Outcomes:

The student will be able to:

|  |  |
| --- | --- |
| CO1 | understand circuit laws, magnetic circuit quantities, single phase and three phase circuits, diode applications, principles of single phase transformer, Bipolar junction transistor, MOSFET and IGBT. |
| CO2 | Describe the concept of Power generation, magnetic circuits, voltage-current phasor relationships in three phase circuits, working of single phase transformer, Bipolar junction transistor, MOSFET and IGBT |
| CO3 | Use circuit laws to compute electrical quantities in DC, single phase and three phase circuits, rectifier circuits, voltage regulator circuits and transistor biasing circuits. |
| CO4 | Develop phasor diagrams of single phase, three phase ac circuits and single phase transformer and analyse the performance of voltage regulator circuits using Zener diode and phase angle control circuits using SCR. |

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| --- | --- |
| **UNIT -1** |  |
| Introduction to Energy sources, DC Circuit Analysis: Kirchoff’s laws, Thevenin’s theorem, Norton’s theorem, Superposition theorem, Maximum Power transfer theorem. Batteries, series and parallel connection of Batteries, Battery specifications.Magnetism: Related terms, B-H curve, Faraday’s Laws, Lenz’s Law,Analogy between Electrical and magnetic circuits, Solenoid | 10hrs |
| **UNIT** -2 |  |
| A.C Fundamentals: Analysis of R, L, C, R-L, R-C, RLC circuits, Concept of active power, reactive power, apparent power.Three phase systems. Star and Delta connection, current voltage and power relationship.Single phase transformer: Construction, principle of operation, efficiency, voltage regulation | 9 hrs |
| **UNIT -3** |  |
| Diodes and Circuits: PN junction diode, V-I characteristics, Zener diode, breakdown mechanism in diodes, light emitting diode.Diode Applications: Half-wave, Full-wave and Bridge Rectifiers, PIV; DC and r.m.s voltages, Ripple Factor. Voltage regulation using Zener diodes.SCR: construction, V-I characteristics, operation and phase control applications | 10hrs |
| **UNIT -4** |  |
| Bipolar Junction Transistor (BJT): Construction; Operation, Transistor Amplifying Action; Common-Emitter Configuration; Common-Collector Configuration; Limits of Operation.**DC Biasing:** Operating Point, Fixed-Bias Circuit; Emitter-Stabilized Bias Circuit; Voltage-Divider Biasing.**Field Effect Transistors:** Construction and Characteristics of JFETs; Transfer Characteristics; Depletion-Type MOSFET; Enhancement- Type MOSFET, CMOS. IGBT-Construction and characteristics. | 10hrs |

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| **TEXTBOOKS** |
| 1 | Vincent Del Tero; Principles of Electrical Engineeringby; PHI Publication.  |
| 2 | Joseph Administer; Electrical Circuits; Schaum Series Publication.  |
| 3 | Hayt, Kemmerly, Durbin ;Engineering Circuit Analysis; Tata McGraw Hill Publication.  |
| **REFERENCES** |
| 1 | Rajendra Prasad; Fundamentals of Electrical Engineering; PHI Publication. |
| 2 | Boylestad and L. Nashelsky; Electronic Devices and Circuits; PHI |
| 3 | A. Mottershead; Electronic Devices and Circuits; PHI. |
| 4 | N.N.Bhargava; Basic Electronics and Linear Circuits; Tata McGraw-Hill.  |
| 5 | Vijay Baru, RajendraKaduskar, Sunil Gaikwad; Basic Electronics Engineering; Dreamtech Textbooks. |

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| **ELECTRICAL & ELECTRONICS LABORATORY** |
| **Course Code** | **FE 160** | **Credits** |  **1** |
| **Scheme of Instruction****Hours/ Week** | **L** | **T** | **P** | **TOTAL** |
| **0** | **0** | **2** | **26 hrs/sem** |
| **Scheme of Examination****TOTAL = 25 marks** | **IA** | **TW** | **TM** | **P** | **O** |
| **0** | **25** | **0** | **0** | **0** |

# Course Outcomes:

The student will be able to:

|  |  |
| --- | --- |
| CO1 | Understand working of regulators, rectifiers, characteristics of various electronics devices |
| CO2 | Assemble and test different circuit theorems and characteristics |
| CO3 | Analyse and verify power in electric circuit, testing of single phase transformer |
| CO4 | Apply circuit concept in electrical wiring |

|  |  |
| --- | --- |
| **SN** | **Experimental List** |
| 1 | Voltage Regulator  |
| 2 | Half, Full and Bridge Rectifiers |
| 3 | Verification of Kirchoff’s Law |
| 4 | Zener Diode Characteristics |
| 5 | Open and Short Circuit Tests on Single Phase Transformer |
| 6 | Load Test on Single phase Transformer |
| 7 | Verification of Thevenin’s theorem and Norton’s theorem |
| 8 | Verification of Superposition theorem and Maximum power transfer theorem |
| 9 | Silicon-Controlled Rectifier (SCR) Characteristics |
| 10 | FET Characteristics |
| 11 | Transistor Common - Emitter Configuration Characteristics |
| 12 | Measurement of power in single phase circuit |
| 13 | Study of single phase domestic wiring system |

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| **SUGGESTED READING BOOKS** |
| 1 | Rajendra Prasad; Fundamentals of Electrical Engineering; PHI Publication. |
| 2 | Boylestad and L. Nashelsky; Electronic Devices and Circuits; PHI |
| 3 | A. Mottershead; Electronic Devices and Circuits; PHI. |
| 4 | N.N.Bhargava; Basic Electronics and Linear Circuits; Tata McGraw-Hill.  |
| 5 | Vijay Baru, RajendraKaduskar, Sunil Gaikwad; Basic Electronics Engineering; Dreamtech Textbooks. |

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| **MATHEMATICS-III** |
| **Course Code** | **EE310** | **Credits** |  **4** |
| **Scheme of Instruction****Hours/ Week** | **L** | **T** | **P** | **TOTAL** |
| **3** | **1** | **0** | **42hrs/sem** |
| **Scheme of Examination****TOTAL = 150 marks** | **IA** | **TW** | **TH** | **P** | **O** |
| **25** | **25** | **100** | **0** | **0** |

**Course Objectives:**

The objective of the course is to make students understand fundamentals of Mathematics necessary to formulate, solve and analyze engineering problems

.Course Outcomes:

The student will be able to:

|  |  |
| --- | --- |
| CO1 | Understand the mathematics of matrices, various transforms used in engineering and basic concepts of partial differential equations |
| CO2 | Compute the rank, eigen values, eigen vectors of a given matrix, transforms of continuous and discrete functions, Fourier series of periodic functions and partial differential equations |
| CO3 | Solve differential equations, integral equations, and difference equations using the various transforms and analyse the consistency of a linear systemof equations |
| CO4 | Model real life problems with matrices, formulate and solve one dimensional wave and heat flow partial differential equations. Propose a value to be substituted in a Fourier series to obtain the given real number series. |

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| --- | --- |
| **UNIT -1** |  |
| **Matrices** : Types of matrices, Determinant, inverse of matrix, Elementary transformations, Elementary matrices, Rank of matrix, Reduction to normal form, Canonical form, Rank using elementary transformation, Linear independence and dependence of vectors, System of the form AX = 0, and AX = B, and their solutions, Eigen values, Eigen vectors with properties, Cayley-Hamilton theorem with its applications, minimal polynomial, Diagonalization | 11hrs |
| **UNIT** -2 |  |
| **Laplace Transforms**: Definition. Existence conditions, properties, inverse Laplace transforms. Laplace transform of periodic functions, Convolution theorem, Laplace transform of Dirac-Delta function, Application of Laplace transforms in solving linear differential equations with initial conditions and system of linear simultaneous differential equations | 10hrs |
| **UNIT -3** |  |
| **Fourier Series** : Periodic functions, Trigonometric series, Euler’s formulae, Dirichlet’s condition, Even and odd functions, Half range series, Parseval’s identity. **Fourier Transforms**: Fourier transforms, Inverse Fourier transforms, Fourier Sine and cosine transforms, convolution and application. | 10hrs |
| **UNIT -4** |  |
| **Partial Differential Equations**: Derivation of equations governing transverse vibration of an elastic string(one dimension). Solution of one dimensional wave equation using separation of variable method. Derivation of heat flow equation in one dimension and solution using separation of variable method.**Z-Transform**: Definition, region of convergence, properties, Z-transform on impulse function, Convolution theorem, application to difference equations. | 11 hrs |

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| **TEXTBOOKS** |
| 1 | B. S. Grewal;Higher Engineering Mathematics; Khanna Publications, New Delhi.  |
| 2 | Veerarajan; Engineering Mathematics; Tata McGraw Hill Publications.  |
| 3 | Erwin Kreyzing; Advanced Engineering Mathematic; New International Limited. |
| **REFERENCES** |
| 1 | P. Kandasamy; Engineering Mathematics; Chand & Co., New Delhi. |
| 2 | Srimanta Pal, Subodh C. Bhunia; Engineering Mathematics; Oxford University Press |
| 3 | D. S. Chandrasekhraiah;Engineering Mathematics- Part III ; Prism Books Pvt. Ltd.  |
| 4 | Montgomery, D. C., Probability and Statistics for Engineers; Prentice Hall of India.  |

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| **ELECTROMAGNETIC FIELDS** |
| **Course Code** | **EE320** | **Credits** | **3** |
| **Scheme of Instruction****Hours/ Week** | **L** | **T** | **P** | **TOTAL** |
| **3** | **0** | **0** | **42hrs/sem** |
| **Scheme of Examination****TOTAL = 125 marks** | **IA** | **TW** | **TH** | **P** | **O** |
| **25** | **0** | **100** | **0** | **0** |

**Course Objectives:**

The objective of the course is to make students understand concept and applications of electric and magnetic field

**Course Outcomes:**

The student will be able to:

|  |  |
| --- | --- |
| CO1 | Explain the concept of Electric field, magnetic field and potential  |
| CO2 | Compute the electric and magnetic fields charge configurations and relate it to potential. |
| CO3 | Determine behavior of dielectric kept in Electric field and Boundary conditions |
| CO4 | Analyse Maxwell’s Equations and apply them for solving electromagnetic problems. |

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| **UNIT -1** |  |
| Vector Calculus :Vector Algebra-addition, subtraction, components of vectors, dot andcross product, triple Products. Representation of vector in three orthogonal coordinate systems (rectangular, cylindrical and spherical). Vector inter-conversion in three co-ordinate systems.Vector operator del, gradient, divergence, curl and their significance.Static Electric Field :Coulomb’s law, Electric field intensity, Electrical field due to point charges. Line, Surface andVolume charge distributions. Gauss law and its applications. Absolute Electric potential, potentialdifference, Calculation of potential differences for different configurations. Electric dipole,Electrostatic Energy and Energy density | 11hrs |
| **UNIT** -2 |  |
| Dielectric material properties, Boundary conditions of perfect dielectric materials. Permittivity of dielectric materials, Polarisation of dielectric.Capacitance, Capacitance of a two wire line.Poisson’s equation, Laplace’s equation, solution of Laplace’s and Poisson’s equations and their applications. | 10hrs |
| **UNIT -3** |  |
| Static Magnetic Fields: Biot-Savart Law Magnetic flux and magnetic flux density. Magnetic field density due to long current elements and coils. Magnetic field due to solenoid.Current and current density, Ohms Law in Point form, Continuity of current, Magnetic potentials. Ampere Law.Magnetic Forces, Materials and Inductance. Force on a moving charge, Force on a differential current element kept in magnetic field, Force between differential currentelements, Nature of magnetic materials, Magnetization and permeability, Magnetic boundaryconditions, Magnetic circuits, inductances and mutual inductances. | 10hrs |
| **UNIT -4** |  |
| Time Varying Fields and Maxwell’s Equations.Faraday’s law for Electromagnetic induction, Displacement current, Point form of Maxwell’sequation, Integral form of Maxwell’s equations, Motional Electromotive forcesElectromagnetic Waves, TEM Wave Equation, waves in free space and in a homogenous material. Skineffect. Poynting theorem. | 11hrs |

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| **TEXTBOOKS** |
| 1 | W. Hayt, “Engineering Electromagnetics”, McGraw Hill Education, 2012. |
| 2 |  M. N. O. Sadiku, “Elements of Electromagnetics”, Oxford University Publication, 2014. |
| 3 | A. Pramanik, “Electromagnetism - Theory and applications”, PHI Learning Pvt. Ltd, New Delhi,2009. |
| **REFERENCES** |
| 1 | G.W. Carter, “The electromagnetic field in its engineering aspects”, Longmans, 1954. |
| 2 | W.J. Duffin, “Electricity and Magnetism”, McGraw Hill Publication, 1980. |
| 3 | W.J. Duffin, “Advanced Electricity and Magnetism”, McGraw Hill, 1968. |
| 4 | E.G. Cullwick, “The Fundamentals of Electromagnetism”, Cambridge University Press, 1966 |

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| **DIGITAL ELECTRONICS** |
| **Course Code** | **EE330** | **Credits** |  **4** |
| **Scheme of Instruction****Hours/ Week** | **L** | **T** | **P** | **TOTAL** |
| **4** | **0** | **0** | **56hrs/sem** |
| **Scheme of Examination****TOTAL = 125 marks** | **IA** | **TW** | **TH** | **P** | **O** |
| **25** | **0** | **100** | **0** | **0** |

**Course Objectives:**

The objective of the course is understand the behaviour of digital logic circuits, Analog to Digital converters, Digital to Analog converters, semiconductor memories and programmable logic devices. Knowledge on optimized design of various digital circuits will also be imparted to the students.

**Course Outcomes:**

The student will be able to:

|  |  |
| --- | --- |
| CO1 | Understand the behaviour of logic gates, combinational and sequential logic circuits, Analog to Digital converters, Digital to Analog converters, semiconductor memories and programmable logic devices  |
| CO2 | Apply the knowledge to implement logic circuits and interpret the output of digital logic circuits |
| CO3 | Compare between different implementations and arrive at the most optimum implementation and experiment with the working. |
| CO4 | Design, Assemble and Test various combinational and sequential logic circuits  |

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| --- | --- |
| **UNIT -1** |  |
| **Fundamentals of Digital Systems and logicfamilies** Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations,Boolean algebra, examples ofICgates, number systems-binary, signed binary, octal hexadecimalnumber, binaryarithmetic,one’s and two’s complements arithmetic, codes, error detecting andcorrectingcodes, characteristics of digital ICs, digital logic families, TTL, Schottky TTL and CMOSlogic, interfacing CMOS and TTL, Tri-statelogic. | **14 Hours** |
| **UNIT -2** |  |
| **Combinational DigitalCircuits** Standard representation for logic functions, K-map representation, and simplification oflogicfunctionsusing K-map, minimization of logical functions. Don’t care conditions, Multiplexer,De-Multiplexer/Decoders, Adders, Subtractors, BCD arithmetic, carry look ahead adder,serialadder,ALU, elementary ALU design, popular MSI chips, digital comparator,paritychecker/generator, codeconverters, priority encoders, decoders/drivers for display devices,Q-M method offunctionrealization. | **14 Hours** |
| **UNIT -3** |  |
| **Sequential circuits and systems** A 1-bit memory, the circuit properties of bistable latch, the clocked SR flip flop, J- K-T andDtypesflipflops,applicationsofflipflops,shiftregisters,applicationsofshiftregisters,serialtoparallelconverter, parallel to serial converter, ring counter, sequence generator,ripple(Asynchronous)counters, synchronous counters, counters design using flip flops,specialcounter ICs, asynchronoussequential counters, applications ofcounters. | **14 Hours** |
| **UNIT -4** |  |
| **D/A Converters**Weighted resistor D/A converter, R-2R Ladder D/Aconverter,specificationsfor D/A converters, examples of D/A converter ICs, **A/D Converters** Sample and hold circuit, quantization and encoding, A/D converter types,specificationsofA/Dconverters, example of A/DConverterICs**Semiconductor memories and Programmable logic devices**Memory organization and operation, expanding memory size, classification andcharacteristicsofmemories, sequential memory, read only memory (ROM), read and write memory(RAM), contentaddressable memory (CAM), charge coupled device memory (CCD), commonly used memorychips, ROM as a PLD, Programmable logic array, Programmable array logic, complexProgrammable logic devices (CPLDS), Field Programmable Gate Array (FPGA). | **14 Hours** |

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| **TEXTBOOKS** |
| 1. | Donald P. Leach/ Albert Paul Malvino, "Digital principles and Applications ", Tata McGraw |
| 2. | M. M. Mano, "Digital logic and Computer design", Pearson Education India, 2016. |
| 3. | Robert L Morris / John R. Miller, "Designing with TTL integrated Circuits ", McGraw Hill international |
| 4. | Sung mo Kang, "CMOS digital Integrated circuits Analysis and Design", Tata McGraw |
| **REFERENCES** |
| 1. | R. P. Jain, " Modern Digital Electronics ", McGraw Hill Education, 2009. |
| 2. | A. Kumar, "Fundamentals of Digital Circuits", Prentice Hall India, 2016. |

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| **ELECTRICAL MACHINES-I** |
| **Course Code** | **EE340** | **Credits** |  **4** |
| **Scheme of Instruction****Hours/ Week** | **L** | **T** | **P** | **TOTAL** |
| **4** | **0** | **0** | **56hrs/sem** |
| **Scheme of Examination****TOTAL = 125 marks** | **IA** | **TW** | **TH** | **P** | **O** |
| **25** | **0** | **100** | **0** | **0** |

**Course Objectives:**

The objective of this course is to understand the basic principle, construction, characteristics and operating modes of dc machines, performance analysis and applications of dc machines. Students will also learn basic principle, construction, performance analysis and applications of single phase and three phase transformers

**Course Outcomes:**

The student will be able to:

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| CO1 | Recall electromagnetic laws, magnetic circuits, electromechanical energy conversion principle, draw the characteristics of dc motors, dc generators, draw and write three equivalent circuit of single phase and three phase transformer  |
| CO2 | Explain the construction and working of dc machines , single phase and three phase transformers  |
| CO3 | Determine the performance of dc machines and transformers by conducting suitable tests |
| CO4 | Analyze, evaluate performance parameters of dc machines, transformers. Calculate force/torque produced in an electromechanical system and obtain load shared by transformers operating in parallel |

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| **UNIT -1** |  |
| **Electromechanical Energy Conversion:** Review of magnetic circuits - MMF, flux, reluctance, inductance, concept of leakage flux. Review of Amperes circuital law and Lenz’s law. Flow of Energy in Electromechanical Devices, Energy in magnetic systems- concepts of field energy, co-energy and mechanical force, Torque equation, singly and multiply excited systems, Energy stored in Magnetic field, Dynamic equation of Electromechanical systems. Elementary machines, generated emf in Machines, Distribution factor, Pitch factor. MMF produced by distributed Windings, MMF of a coil, MMF waveform of commutator machines, and torque in round rotor machines | **14 Hours** |
| **UNIT -2** |  |
| **DC Machines** Basic construction of a DC machine, magnetic structure - stator yoke, stator poles, pole-faces or shoes, air gap and armature core, excitation with armature winding open, air gap flux density distribution, flux perpole, induced EMF in an armature coil. Armature winding and commutation – Elementary armature coil and commutator, lap and wave windings, construction of commutator, linear commutation. Derivation of back EMF equation, derivation of torque equation, armature reaction, air gap flux density distribution with armature reaction. Armature circuit equation for motoring and generation, Types of field excitations – separately excited, shunt and series. Open circuit characteristic of separately excited DC generator, Voltage build-up in a shunt generator, critical field resistance and critical speed. V-I characteristics and torque-speed characteristics of separately excited, shunt and series motors. Speed control through armature voltage. Losses, load testing and back-to-back testing of DC machines. | **14 Hours** |
| **UNIT -3** |  |
| **Single Phase Transformers**Principle, construction and operation of single-phase transformers, equivalent circuit, phasor diagram, voltage regulation, losses and efficiency Testing - open circuit and short circuit tests, polarity test, back-to-back test, separation of hysteresis and eddy current losses, per unit representation. Autotransformers - construction, principle, applications and comparison with two winding transformer | **14 Hours** |
| **UNIT -4** |  |
| **Three Phase Transformers** Three-phase transformer - construction, types of connection and their comparative features, Magnetizing current, effect of nonlinear B-H curve of magnetic core material, harmonics in magnetization current, Phase conversion - Scott connection, three-phase to six-phase conversion, Tap-changing transformers - No-load and on-load tap-changing of transformers, Three-winding transformers. Cooling of transformers, Transformer Accessories. | **14 Hours** |

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| **TEXTBOOKS** |
| 1. | P. S. Bimbhra, “Electrical Machinery”, Khanna Publishers, 2011 |
| 2. |  I. J. Nagrath and D. P. Kothari, “Electric Machines”, McGraw Hill Education, 2010 |
| **REFERENCES** |
| 1. | M. G. Say, “Performance and design of AC machines”, CBS Publishers, 2002. |
| 2. | A. E. Fitzgerald and C. Kingsley, "Electric Machinery”, McGraw Hill Education, 2013. |

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| **ELECTRICAL CIRCUIT ANALYSIS** |
| **Course Code** | **EE350** | **Credits** |  **4** |
| **Scheme of Instruction****Hours/ Week** | **L** | **T** | **P** | **TOTAL** |
| **3** | **1** | **0** | **42hrs/sem** |
| **Scheme of Examination****TOTAL = 150 marks** | **IA** | **TW** | **TH** | **P** | **O** |
| **25** | **25** | **100** | **0** | **0** |

**Course Objectives:**

The objective of this course is to understand the basic principle, construction, characteristics and operating modes of dc machines, performance analysis and applications of dc machines. Students will also learn basic principle, construction, performance analysis and applications of single phase and three phase transformers

**Course Outcomes:**

The student will be able to:

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| CO1 | Understand various network theorems and various types of electrical circuits and analysis tools. |
| CO2 | Analyse various electrical circuits and their steady state and transient state response for DC and AC excitations |
| CO3 | Demonstrate use of various mathematical tools in evaluating electrical circuits |
| CO4 | Apply network theorems for the analysis of electrical circuits |

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| **UNIT -1** |  |
| Network Theorems: Superposition theorem, Thevenin theorem, Norton theorem, Maximum power transfer theorem, Reciprocity theorem, Compensation theorem. Analysis with dependent current and voltage sources. Node and Mesh Analysis. Concept of duality and dual networks. | **11 Hours** |
| **UNIT -2** |  |
| Network Theorems: Superposition theorem, Thevenin theorem, Norton theorem, Maximum power transfer theorem, Reciprocity theorem, Compensation theorem. Analysis with dependent current and voltage sources. Node and Mesh Analysis. Concept of duality and dual networks.  | **10 Hours** |
| **UNIT -3** |  |
| 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. Review of Laplace Transform, Analysis of electrical circuits using Laplace Transform for standard inputs, convolution integral, inverse Laplace transform, transformed network with initial conditions | **10 Hours** |
| **UNIT -4** |  |
| Electrical Circuit Analysis Using Laplace Transforms: Transfer function representation. Poles and Zeros. Frequency response (magnitude and phase plots), series and parallel resonances, 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.  | **11 Hours** |

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| **TEXTBOOKS** |
| 1. | M. E. Van Valkenburg, “Network Analysis”, Prentice Hall, 2006. |
| 2. | D. Roy Choudhury, “Networks and Systems”, New Age International Publications, 1998.  |
| **REFERENCES** |
| 1. | W. H. Hayt and J. E. Kemmerly, “Engineering Circuit Analysis”, McGraw Hill Education, 2013.  |
| 2. | C. K. Alexander and M. N. O. Sadiku, “Electric Circuits”, McGraw Hill Education, 2004.  |
| 3. | K. V. V. Murthy and M. S. Kamath, “Basic Circuit Analysis”, Jaico Publishers, 1999. |

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| **DIGITAL ELECTRONICS LABORATORY** |
| **Course Code** | **EE 360** | **Credits** |  **1** |
| **Scheme of Instruction****Hours/ Week** | **L** | **T** | **P** | **TOTAL** |
| **0** | **0** | **2** | **28hrs/sem** |
| **Scheme of Examination****TOTAL = 75 marks** | **IA** | **TW** | **TH** | **P** | **O** |
| **0** | **25** | **0** | **50** | **0** |

**Course Objectives:**

The objective of the course is to provide practical experience in assembling and testing various digital electronic circuits.

# Course Outcomes:

The student will be able to:

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| CO1 | Understand the behaviour of logic gates, combinational and sequential logic circuits |
| CO2 | Apply the knowledge to implement logic circuits and interpret and verify the output of digital logic circuits.  |
| CO3 | Compare between different implementations practically and experiment with the working |
| CO4 | Design, assemble and test various combinational and sequential logic circuits |

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| **SN** | **Experimental List** |
| 1 | Verification of De-Morgan’s Theorems.  |
| 2 |  Logic Gates.  |
| 3 | Design and Verification of Adder Circuits.  |
| 4 | Design and Verification of Subtractor Circuits.  |
| 5 | Design and Verification of 2’s Complement Converter.  |
| 6 | Design and Verification of Parity Generator and Checkers.  |
| 7 | Design and Verification of Code Converters.  |
| 8 | Verification of Encoders.  |
| 9 | Verification of Seven Segment Decoder.  |
| 10 | Design and Verification of 4digit Multiplexed seven segment display |
| 11 | Study of Multiplexers &Demultiplexers.  |
| 12 | Design using Multiplexer  |
| 13 | Design using Decoder  |
| 14 | Verification of Flip-Flops.  |
| 15 | Verification of Binary Ripple Counter.  |
| 16 | Verification of Shift Registers. |

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| **SUGGESTED READING BOOKS** |
| 1 | Donald P. Leach/ Albert Paul Malvino, "Digital principles and Applications ", Tata McGraw |
| 2 | M. M. Mano, "Digital logic and Computer design", Pearson Education India, 2016. |
| 3 | Robert L Morris / John R. Miller, "Designing with TTL integrated Circuits ", McGraw Hill international |
| 4 | Sung mo Kang, "CMOS digital Integrated circuits Analysis and Design", Tata McGraw |
| 5 | R. P. Jain, " Modern Digital Electronics ", McGraw Hill Education, 2009. |
| **ELECTRICAL MACHINES-I LABORATORY** |
| **Course Code** | **EE 370** | **Credits** |  **1** |
| **Scheme of Instruction****Hours/ Week** | **L** | **T** | **P** | **TOTAL** |
| **0** | **0** | **2** | **28hrs/sem** |
| **Scheme of Examination****TOTAL = 75 marks** | **IA** | **TW** | **TH** | **P** | **O** |
| **0** | **25** | **0** | **50** | **0** |

**Course Objectives:**

The objective of the course is to allow students to perform various tests on electrical machines to analyse their performance.

# Course Outcomes:

The student will be able to:

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| CO1 | Understand the practical operation of DC generator. Motor and transformer |
| CO2 | Assemble, Test and verify the performance of DC machines and transformers |
| CO3 | Analyse the experimental results  |
| CO4 | Design the testing circuit to evaluate the performance of these machines  |

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| **SN** | **Experimental List** |
| 1 | OCC of separately excited DC generator.  |
| 2 | Performance characteristics of DC machine |
| 3 | Speed Control of DC motors |
| 4 | Hopkinson’s test |
| 5 | Load test on DC series motor |
| 6 | Speed-Torque characteristics of DC Shunt Motor |
| 7 | OC and SC test on single phase transformer |
| 8 | Load test on single phase transformer |
| 9 | Sumpner’s Test |
| 10 | Parallel operation of Single phase transformers |
| 11 | Study of vector group and vector group test of three phase transformers |
| 12 | Load Test on Three Phase Transformers |
| 13 | Simulation on DC Machines |
| 14 | Simulation on Transformer |

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| **SUGGESTED READING BOOKS** |
| 1 | P. S. Bimbhra, “Electrical Machinery”, Khanna Publishers, 2011 |
| 2 | I. J. Nagrath and D. P. Kothari, “Electric Machines”, McGraw Hill Education, 2010 |
| 3 | M. G. Say, “Performance and design of AC machines”, CBS Publishers, 2002. |
| 4 | A. E. Fitzgerald and C. Kingsley, "Electric Machinery”, McGraw Hill Education, 2013. |

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| **TECHNICAL COMMUNICATION** |
| **Course Code** | **HM001** | **Credits** |  **2** |
| **Scheme of Instruction****Hours/ Week** | **L** | **T** | **P** | **TOTAL** |
| **2** | **0** | **0** | **28 hrs/sem** |
| **Scheme of Examination****TOTAL = 75 marks** | **IA** | **TW** | **TH** | **P** | **O** |
| **0** | **75** | **0** | **0** | **0** |

**Course Objectives:** To make students aware and conversant with oral, written communication and work on their personality and career development.

**Course Outcomes:**

The student will be able to:

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| CO1 | Demonstrate precise language skills with suitable vocabulary and apt style. |
| CO2 | Develop life skills/interpersonal skills to progress professionally. |
| CO3 | Apply traits of suitable candidature for a job/higher education. |
| CO4 | Deliver formal presentations and effectively implementing the verbal and non-verbal skills. |

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| UNIT -1 | 7 |
| **Communication****Oral Communication**Listening, Speaking, Reading, Writing (LSRW), Conversational Dialogues, Role Play, Barriers to Oral Communication, Effective Oral Communication, Principles of Communication, Dos and Don’ts of Group Discussion**Global Communication**Social Media, People Analytics, Models of Culture, Cross-Cultural Communication, Compare Cultures of the World, Impact of Cultural Differences on Managerial Communication, Effective Communicator in a Cross-Cultural setting |  |
| UNIT -2 | 7 |
| **Personality Development**Social Etiquette, Email Etiquette, Table Etiquette, Telephone Etiquette, SWOC Analysis, Life Coaching, Emotional Intelligence, Leadership, Time Management, Motivation, Goal Setting, Team Work and Collaboration, Critical Thinking and Problem Solving, Professional Attitude, Persuasion, Anxiety and Stress Management, Social Responsibility |  |
| UNIT -3 | 7 |
| **Career Development**Resume Building, Interviewing Skills, Job Search, Personal Networking and Branding, Personal Finance, Build Professional Portfolio |  |
| UNIT -4 | 7 |
| **Public Speaking**Methods to overcome anxiety, Build Confidence, Use of Media Aids, Craft an Impactful Speech, Design Impactful Presentations, Effective Presentation Delivery |  |

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| **TEXTBOOKS** |
| 1 | Meenakshi Raman and Sangeeta Sharma; Technical Communication: Principles and Practice, 3rded; Oxford University Press |
| 2 | Meenakshi Raman, Prakash Singh; Business Communication; 2nd ed.; Oxford University Press |
| 3 | Dr. K. Alex; Soft Skills: Know Yourself and Know The World; 3rded; S. Chand Publishing |
| **REFERENCES** |
| 1 | Nicky Stanton; Mastering Communication; 5th ed.; Palgrave Master Series; Red Globe Press |
| 2 | Ghosh, B. N.; Managing Soft Skills for Personality Development; Tata McGraw Hill; 2012 |
| 3 | Wallace and Masters; Personal Development for Life and Work;10thedition; Thomson Learning  |
| 4 | Lehman, Dufrene, Sinha; BCOM : A South-Asian Perspective with CourseMate; 2ndedition; Cengage Learning |
| 5 | Ashraf Rizvi; Effective Technical Communication; Tata McGraw-Hill; 2005 |
| 6 | MolefiKete Asante, William B. Gudykunst, Bella Mody; Handbook of International and Intercultural Communication; 2nd ed.; Sage Publications |

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| **MATHEMATICS-I& II (BRIDGE COURSE)** |
| **Course Code** | **AC390** | **Credits** | **0** |
| **Scheme of Instruction****Hours/ Week** | **L** | **T** | **P** | **TOTAL** |
| **2** | **0** | **0** | **28 hrs/sem** |
| **Scheme of Examination****TOTAL = 0 marks** | **IA** | **TW** | **TM** | **P** | **O** |
| **0** | **0** | **0** | **0** | **0** |

# Course Outline:

This is an audit course.

This course is compulsory to direct second year/lateral entry students. It is introduced to reduce the knowledge gap in the students.

The syllabus is selected topics from FE110 Mathematics I and FE120 Mathematics II.

The Text books and References are same as shown in FE110 Mathematics I and FE120 Mathematics II.

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| **NIMERICAL METHODS** |
| **Course Code** | **EE410** | **Credits** |  **4** |
| **Scheme of Instruction****Hours/ Week** | **L** | **T** | **P** | **TOTAL** |
| **3** | **1** | **0** | **42hrs/sem** |
| **Scheme of Examination****TOTAL = 150 marks** | **IA** | **TW** | **TH** | **P** | **O** |
| **25** | **25** | **100** | **0** | **0** |

**Course Objectives:**

The objective of the course is to impartadequate knowledge of numerical methods in order to be able to implement them whenever required in their engineering course.Also to adequate knowledge of probability theory so as to enable them to comprehend its application in their engineering studies.

.**Course Outcomes:**

The student will be able to:

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| CO1 | Understand the mathematics of polynomial interpolation, numerical solutions of algebraic equations and linear systems of equations, numerical solutions of differential equations, numerical integration and basic concept of probability |
| CO2 | Compute the interpolating polynomial;for a given data set., compute numericallyan integral and calculate probabilities. |
| CO3 | Solve an algebraic equationand system of equations and analyse the solution, numerical solve differential equations to the desired accuracy |
| CO4 | Modern real life problems and estimate using interpolation, numerical integration |

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| **UNIT -1** |  |
| **Finite Difference and Interpolation:** Operators: Forward Difference operator- , backward difference operator- , Taylor’s operator-D, shift operator-E, averaging operator –μ, Central Difference operator-δ   Differences: Forward and backward difference, Central differences, Divided differences, Difference tables, Interpolating polynomials, factorial polynomials , Newton Forward & Backward difference interpolation formula. Newton’s Divided difference interpolation formulae: Lagrange’s interpolation formula: Derivation, Central Difference interpolation formula: Stirling’s and Bessel’s interpolation formula  | 11hrs |
| **UNIT** -2 |  |
| **Solutions of Equations:** Solutions of non-linear equations of single variables using Bisection method, Regula- Falsi method, Secant method and Newton- Raphson method. Order of convergence of these methods, comparison of these methods. **Solution of Linear Algebraic Equations:** Direct methods: Gauss Elimination method, Partial & Complete pivoting, Gauss- Jordan method. Iterative methods: Jacobi’s method, Gauss-Siedel method. Condition for convergence of above methods, Ill conditioned & well-conditioned systems. | 10hrs |
| **UNIT -3** |  |
| **Numerical Integration:** Newton-Cotes formula, Trapezoidal rule, Simpson’s 1/3 rule, Simpson’s 3/8 rule, Weddle’s rule, Romberg’s integration Richardson extrapolation), Truncation errors for these rules. **Numerical Solution of Differential Equations**: Picard’s method & Taylor series method, Euler’s method & Modified Euler’s method, Second order Runge- Kutta method, Fourth order Runge- Kutta method, Milne’s Predictor-Corrector method. | 10hrs |
| **UNIT -4** |  |
| **Probability:** Definition, properties ,Axioms of probability, conditional probability, theorem on total probability, Baye’s theorem; Random variables-discrete & continuous; Expectation, Variance, Standard deviation, Moment Generating Function & properties, Standard distributions: discrete-Binomial, Geometric & Poisson; continuous- Uniform, Normal, exponential, Gamma, Chi-square.  | 11hrs |

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| **TEXTBOOKS** |
| 1 | B. S. Grewal ;Numerical Methods; Khanna Publications.  |
| 2 | Douglas C. Montgomery, George C. Runger; Applies Statistics & Probability for Engineers; Wiley  |
| **REFERENCES** |
| 1 | P. Kandasamy ; Numerical Methods ; S. Chand & Co., New Delhi.  |
| 2 | E. Balagurusamy ; Numerical Methods ; Tata McGraw, PHI.  |
| 3 | Srimanta Pal, Subodh C. Bhunia; Engineering Mathematics; Oxford University Press  |

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| **ELECTRICAL MACHINES-II** |
| **Course Code** | **EE420** | **Credits** |  **4** |
| **Scheme of Instruction****Hours/ Week** | **L** | **T** | **P** | **TOTAL** |
| **4** | **0** | **0** | **56hrs/sem** |
| **Scheme of Examination****TOTAL = 125 marks** | **IA** | **TW** | **TH** | **P** | **O** |
| **25** | **0** | **100** | **0** | **0** |

**Course Objectives:**

The objective of this course is to understand the basic principle, construction, characteristics and operating modes of induction machines, construction, operation and performance of synchronous machines performance analysis and applications of dc machines.

**Course Outcomes:**

The student will be able to:

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| CO1 | Recall magnetic field concepts, Understanding the working of three phase and single phase induction motors , synchronous generator and motors and do draw the phasor diagram of these machines |
| CO2 | Explain and predetermine the performance of induction motors using equivalent circuit and circle diagrams and voltage regulation of alternator. Explain working principle of PMSM, BLDC, SRM and PMDC motor  |
| CO3 | Determine the different starting methods, braking methods and speed control techniques of induction motors. Determine performance characteristics of Special motors. |
| CO4 | Analyze operation of synchronous machine on infinite bus and interpret and analyze the dynamic behavior of machines. |

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| **UNIT -1** |  |
| **Fundamentals of AC machines**Physical arrangement of windings in stator and cylindrical rotor; slots for windings; single turn coil - active portion and overhang; full-pitch coils, concentrated winding, distributed winding, Air-gap MMF distribution with fixed current through winding, Constant magnetic field, pulsating magnetic field - alternating current in windings with spatial displacement, Magnetic field produced by a single winding - fixed current and alternating current. Pulsating fields produced by spatially displaced windings, Windings spatially shifted by 90 degrees, Addition of pulsating magnetic fields, Three windings spatially shifted by 120 degrees (carrying three-phase balanced currents), revolving magnetic field | **14 Hours** |
| **UNIT -2** |  |
| **Induction Machines**Construction, Types (squirrel cage and slip-ring), Torque slip characteristics, Starting and maximum torque. Equivalent circuit, Phasor Diagram, Losses and Efficiency.Effect of parameter variation on torque speed characteristics (variation of rotor and stator resistances, stator voltage, frequency). Methods of starting, braking and speed control for induction motors. Generator operation, Self-excitation, Doubly-Fed Induction Machines. | **14 Hours** |
| **UNIT -3** |  |
| **Single Phase Machines** Constructional features double revolving field theory, equivalent circuit, and determination ofparameters. Split-phase starting methods and applications.Constructional features, EMF, Torque equation and Torque speed characteristics of PMDC motor, BLDC motor, Switched reluctance motor and Permanent magnet synchronous motor | **14 Hours** |
| **UNIT -4** |  |
| **Synchronous Machines**Constructional features, cylindrical rotor and salient pole synchronous machine - generated EMF, equivalent circuit and phasor diagram, armature reaction, synchronous impedance, voltage regulation.Operating characteristics of synchronous machines, Excitation characteristics of synchronous machines (Alternator and Synchronous motor), Concept of two reaction theory, analysis of phasor diagram, Reactive power capability, power angle characteristics. Parallel operation of alternators, synchronization and load division. | **14 Hours** |

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| **TEXTBOOKS** |
| 1. | P. S. Bimbhra, “Electrical Machinery”, Khanna Publishers, 2011. |
| 2. | I. J. Nagrath and D. P. Kothari, “Electric Machines”, McGraw Hill Education, 2010. |
| **REFERENCES** |
| 1. | M. G. Say, “Performance and design of AC machines”, CBS Publishers, 2002. |
| 2. | A. E. Fitzgerald and C. Kingsley, "Electric Machinery”, McGraw Hill Education, 2013. |

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| **ANALOG ELECTRONICS** |
| **Course Code** | **EE430** | **Credits** |  **4** |
| **Scheme of Instruction****Hours/ Week** | **L** | **T** | **P** | **TOTAL** |
| **4** | **0** | **0** | **56hrs/sem** |
| **Scheme of Examination****TOTAL = 125 marks** | **IA** | **TW** | **TH** | **P** | **O** |
| **25** | **0** | **100** | **0** | **0** |

**Course Objectives:** Tofamiliarize the students with a thorough understanding of various electronic devices and its application circuits.

**Course Outcomes:**

The student will be able to:

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| CO1 | Acquire the basic knowledge of working and characteristics of Diode, transistor, MOSFET and building blocks of an Operational Amplifier. |
| CO2 | Develop the ability to analyze the behavior of BJT, MOSFET as an amplifier circuit using small signal equivalent circuit, Determine gain, frequency response of Op amp.  |
| CO3 | Design, construct and test the circuit as an amplifier, rectifier ,oscillator, multivibrator and interpret their results. |
| CO4 | Realize the applications of semiconductor devices to build non linear applications such as log/antilog opamp, Special application as ADC/DAC and Phase locked loop. |

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| **UNIT -1** |  |
| **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. **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. | **14 Hours** |
| **UNIT -2** |  |
| **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, transconductance, high frequency equivalent circuit. Transistor AC Equivalent Circuits: H-parameter model, r-e model, ac equivalent circuit of small signal BJT and FET amplifiers. Design of a single stage voltage amplifier using BJT and FET. Different types of coupling (RC, transformer and direct) and their frequency response. Lag-Lead networks | **14 Hours** |
| **UNIT -3** |  |
| **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)**Linear Applications**:- Amplifier circuit, Summing and Subtracting amplifier, Differentiator, Integrator, Instrumentation amplifier, V-I and I-V converters, voltage follower and inverter. | **14 Hours** |
| **UNIT -4** |  |
| **Filter and Oscillator circuits** : 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.**Nonlinear applications of op-amp** : Hysteretic Comparator, Zero Crossing Detector, Square-wave and triangular-wave generators. Precision rectifier, peak detector. **Multivibrators:** Astable and MonostableMultivibrators using 555 Timer and its applications. Phased Locked Loop: Operating principle, applications of LM565.  | **14 Hours** |

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| **TEXTBOOKS** |
| 1. | Donald A Neaman; Semiconductor Physics and Devices; Third Edition, Tata McGraw Hill Inc.; 2007.  |
| 2. | Khetan and Goyal; A Monograph of Electronic Design Principles; KhannaPublicatio |
| 3. | Robert Boylestad and Louis Nashelsky; Electron Devices and Circuit Theory; Pearson Prentice Hall; 10th edition; July 2008. |
| **REFERENCES** |
| 1. | S. Salivahanan; Electronic devices & circuits; Vikas Publication |
| 2. | RamakantGayakwad ; Operational amplifier and Linear Integrated Circuits; Pearson |
| 3. |  K R Botkar; Integrated Circuits; Khanna Publishers |

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| **FUNDAMENTALS OF SIGNAL PROCESSING** |
| **Course Code** | **EE440** | **Credits** |  **4** |
| **Scheme of Instruction****Hours/ Week** | **L** | **T** | **P** | **TOTAL** |
| **3** | **1** | **0** | **42hrs/sem** |
| **Scheme of Examination****TOTAL = 150 marks** | **IA** | **TW** | **TH** | **P** | **O** |
| **25** | **25** | **100** | **0** | **0** |

**Course Objectives:**

The objective of the course is to provide knowledge of time-domain representation, analysis of signals and systems and fundamentals of sampling. It will also enable them to perform frequency-domain representation and analysis using Fourier tools, Laplace transform and Z transforms.

**Course Outcomes:**

The student will be able to:

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| CO1 | Understand the fundamental concepts of signals and system, Behaviour of continuous and discrete LTI systems, sampling, reconstruction, and representation of system in state space, Fourier tools, Laplace transforms and Z-transforms. |
| CO2 | Apply the mathematical relations to determine signal and system properties ,impulse response and state response, state space properties, Fourier, Laplace and Z-transform properties. |
| CO3 | Analyse the systems in time domain and frequency domain. |
| CO4 | Compute the convolution, correlation, solution to differential equation using Fourier, Laplace , Z transforms. |

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| UNIT-1 |  |
| **Introduction to Signals and Systems** Signals and systems as seen in everyday life, and in various branches of engineering and science.Signal properties: periodicity, absolute integrability, determinism and stochastic character. Somespecial signals of importance: the unit step, the unit impulse, the sinusoid, the complex exponential, some special time-limited signals; continuous and discrete time signals, continuous and discrete amplitude signals. System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability, realizability. Examples.**Behavior of continuous and discrete-time LTI systems :**Impulse response and step response, convolution, input-output behavior with aperiodic convergent inputs, cascade interconnections. Characterization of causality and stability of LTI systems. System representation through differential equations and difference equations. | 11Hrs |
| UNIT-2 |  |
| **State Space Representation and Fourier Series** State-space Representation of systems. State-Space Analysis, Multi-input, multi-output representation. State Transition Matrix andits Role. Periodic inputs to an LTI system, the notion of a frequency response and its relation to the impulse response.Fourier series representation of periodic signals, Waveform Symmetries, Calculation of FourierCoefficients. Fourier Transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Fourier domain duality. | 10Hrs |
| UNIT-3 |  |
| **Fourier, Laplace and z- Transforms** The Discrete-Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT). Parseval's Theorem. Review of the Laplace Transform for continuous time signals and systems, system functions, poles and zeros of system functions and signals, Laplace domain analysis, solution to differential equations and system behavior. The z-Transform for discrete time signals and systems, system functions, poles and zeros of systems and sequences, z-domain analysis. | 10Hrs |
| UNIT-4 |  |
| **Sampling and Reconstruction** The Sampling Theorem and its implications. Spectra of sampled signals. Reconstruction: ideal interpolator, zero-order hold, first-order hold. Aliasing and its effects. Relation between continuous and discrete time systems. Introduction to the applications of signal and system theory: modulation for communication, filtering, feedback control systems. | 11Hrs |

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| **TEXTBOOKS** |
| 1 |  A. V. Oppenheim, A. S. Willsky and S. H. Nawab, “Signals and systems”, Prentice Hall India, 1997. |
| 2 | A. V. Oppenheim and R. W. Schafer, “Discrete-Time Signal Processing”, Prentice Hall, 2009. |
| 3 | S. Haykin and B. V. Veen, “Signals and Systems”, John Wiley and Sons, 2007. |
| **REFERENCES** |
| **1** | J. G. Proakis and D. G. Manolakis, “Digital Signal Processing: Principles, Algorithms, andApplications”, Pearson, 2006. |
| **2** | H. P. Hsu, “Signals and systems”, Schaum’s series, McGraw Hill Education, 2010. |
| **3** | M. J. Robert “Fundamentals of Signals and Systems”, McGraw Hill Education, 2007. |
| **4** | B. P. Lathi, “Linear Systems and Signals”, Oxford University Press, 2009. |

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| **RENEWABLE ENERGY** |
| **Course Code** | **EE450** | **Credits** | **3** |
| **Scheme of Instruction****Hours/ Week** | **L** | **T** | **P** | **TOTAL** |
| **3** | **0** | **0** | **42hrs/sem** |
| **Scheme of Examination****TOTAL = 125 marks** | **IA** | **TW** | **TH** | **P** | **O** |
| **25** | **0** | **100** | **0** | **0** |

**Course Objectives:**

The objective of the course is to understand types and applications of various forms of renewable energy and its environmental impacts. It will assist students to identify the new methodologies / technologies for effective utilization of renewable energy sources and analyse environmental and cost economics of using renewable energy sources compared to fossil fuels.

**Course Outcomes:**

The student will be able to:

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| CO1 | understand different forms of Renewable Energy sources |
| CO2 | Analyse environmental, economic assessment of the resources used. |
| CO3 | identify the new methodologies / technologies for effective utilization of renewable energy sources. |
| CO4 | design the renewable energy systems for power generation and other energy uses for domestic and industrial applications |

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| UNIT-1 |  |
| **Introduction:**World energy use, reserves of energy resources, environmental aspects of energy utilization, concepts of non conventional energy sources, criteriafor assessing the potential of NCES, renewable energy scenario in India and around the world, potentials, achievements / applications, classification of NCES, solar, wind, geothermal, biomass, ocean, tidal, wave energy sources, comparison of these energy sources, economics of renewable energy systems, comparative analysis of renewable and non renewable energy sources, limitations of renewable energy systems. | 11Hrs |
| UNIT-2 |  |
| **Solar Energy:**Energy available from sun, solar radiation data, solar radiation on tilted surface, instruments for measuring solar radiation, solar energy conversion into heat, flat plate and concentrating collectors, principle of natural and forced convection, orientation and thermal analysis of solar collectors.**PhotoVoltaics:** P-N junctions. solar cells, PV systems, calculation of energy through photovoltaic power generation. Standalone and grid connected solar PV systems.Photovoltaic applications: Battery charger, domestic lighting, street lighting, water pumping and power generation schemes.  | 10Hrs |
| UNIT-3 |  |
| **Wind Energy:** Energy available from wind, general formula, lift anddrag. Basics of wind energy conversion, effect of density, frequency variances, angle of attack, wind speed estimation, Betz limit. Horizontal axis and vertical axis rotors, aerodynamics of wind turbine rotor, determination of torque coefficient, site selection, wind resource assessment. **Wind Turbine Generators:** Induction, synchronous machines, constant V & F and variable V & F generations, reactive power compensation,integration of wind energy converters into grid, working principle of wind power plant. | 10Hrs |
| UNIT-4 |  |
| **Other Types of Energy resources:** Fuel cell :- Principle of working, various types , construction and applications. Mini and Microhydel Power (MHP) Generation: Classification of hydel plants, concept of micro hydel, merits. MHP plants: Components, design and layout, turbines, efficiency, integrated energy systems and their cost benefit analysis.Principles of ocean and tidal energy conversion. Biomass resources and their classification, biomass conversion processes, thermo chemical conversion, direct combustion, gasification, pyrolysis and liquefaction. | 11Hrs |

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| **TEXTBOOKS** |
| 1 | G. D. Rai; Non Conventional Energy Sources; Khanna Publishers. |
| 2 | J. W. Twidell and A. Weir; Renewable Energy Sources; Taylor & Francis, CRC press. |
| **REFERENCES** |
| **1** | S. P. Sukhatme; Solar energy; Tata McGraw Hill Publishing Company Ltd, PHI Learning Private Limited. |
| **2** | Chetan Singh Solanki; Solar Photovoltaics Fundamentals, Technologies and Applications; Prentice hall India ltd. |
| **3** | D. P. Kothari & K. C. Singhal; Renewable energy sources and emerging technologies; Prentice hall India ltd. |

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| **ELECTRICAL MACHINES-II LABORATORY** |
| **Course Code** | **EE 450** | **Credits** |  **1** |
| **Scheme of Instruction****Hours/ Week** | **L** | **T** | **P** | **TOTAL** |
| **0** | **0** | **2** | **28hrs/sem** |
| **Scheme of Examination****TOTAL = 75 marks** | **IA** | **TW** | **TH** | **P** | **O** |
| **0** | **25** | **0** | **50** | **0** |

**Course Objectives:**

The objective of the course is to impart hand on knowledge of Electrical machines.

# Course Outcomes:

The student will be able to:

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| CO1 | Understand the practical operation of AC generators and Motors |
| CO2 | Assemble, Test and verify the performance of single phase and three phase AC machines. |
| CO3 | Analyse the experimental results  |
| CO4 | Design the testing circuit to evaluate the performance of these machines  |

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| **SN** | **Experimental List** |
| 1 | No load and Blocked rotor Test on Three Phase Induction Machine.  |
| 2 | Performance characteristics of Induction machine |
| 3 | Speed Control of Induction motor |
| 4 | Direct load test on three phase Induction Motor |
| 5 | No Load and blocked rotor test on single phase Induction motor |
| 6 | Load Test on single phase Induction motor |
| 7 | OC and SC test on three phase alternator |
| 8 | Load test on three phase alternator  |
| 9 | Slip test on three phase alternator |
| 10 | Parallel operation of three phase alternator |
| 11 | To determine V curves of synchronous motor |
| 12 | Performance characteristics of PMDC/ BLDC motor |
| 13 | Simulation experiment on Induction Motor |
| 14 | Simulation experiment on Synchronous Machine |

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| **SUGGESTED READING BOOKS** |
| 1 | P. S. Bimbhra, “Electrical Machinery”, Khanna Publishers, 2011. |
| 2 | I. J. Nagrath and D. P. Kothari, “Electric Machines”, McGraw Hill Education, 2010. |
| 3 | M. G. Say, “Performance and design of AC machines”, CBS Publishers, 2002. |
| 4 | A. E. Fitzgerald and C. Kingsley, "Electric Machinery”, McGraw Hill Education, 2013. |

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| **ANALOG ELECTRONICS LABORATORY** |
| **Course Code** | **EE 460** | **Credits** |  **1** |
| **Scheme of Instruction****Hours/ Week** | **L** | **T** | **P** | **TOTAL** |
| **0** | **0** | **2** | **28 hrs/sem** |
| **Scheme of Examination****TOTAL = 75 marks** | **IA** | **TW** | **TM** | **P** | **O** |
| **0** | **25** | **0** | **50** | **0** |

**Course Objectives:**

The objective of the course is to provide hands on working experience on various electronics devices and analog circuits.

# Course Outcomes:

The student will be able to:

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| CO1 | Measure and understand the input and output characteristics of transistor, zener diode, MOSFET, operation amplifier. |
| CO2 | Realize half wave, full wave rectifier circuits, zener diode as regulator |
| CO3 | Design filters, oscillators, astable and monostablemultivibrators as per the specifications |
| CO4 | Evaluate the performance of circuits using simulation software |

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| **SN** | **Experimental List** |
| 1 | Design of Half Wave Rectifier.  |
| 2 | Design of Full Wave Rectifier |
| 3 | Input-Output characteristics of transistor biasing circuits. |
| 4 | MOSFET Characteristics. |
| 5 | Zener diode Characteristics & Regulator using Zener diode. |
| 6 | UJT relaxation oscillator. |
| 7 | RC coupled amplifier |
| 8 | Operational Amplifiers (IC741)-D.C and A.C Characteristics.  |
| 9 | Opamp as differentiator and Integrator |
| 10 | Design of Active filters: Low and High pass Filter |
| 11 | Waveform generation using IC741: Square wave and Triangular wave, Sawtooth wave.  |
| 12 | Design of Schmitt Trigger and Zero crossing Detector |
| 13 | Wein bridge oscillators |
| 14 | IC voltage regulators |

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| **SUGGESTED READING BOOKS** |
| 1 | Donald A Neaman; Semiconductor Physics and Devices; Third Edition, Tata McGraw Hill Inc.; 2007. |
| 2 | Khetan and Goyal; A Monograph of Electronic Design Principles; Khanna Publications |
| 3 | Robert Boylestad and Louis Nashelsky; Electron Devices and Circuit Theory; Pearson Prentice Hall; 10th edition; July 2008. |
| 4 | S. Salivahanan; Electronic devices & circuits; Vikas Publication |
| 5 | RamakantGayakwad ; Operational amplifier and Linear Integrated Circuits; Pearson |

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| **ECONOMICS FOR ENGINEERS** |
| **Course Code** | **EE 470** | **Credits** | **3** |
| **Scheme of Instruction****Hours/ Week** | **L** | **T** | **P** | **TOTAL** |
| **3** | **0** | **0** | **42hrs/sem** |
| **Scheme of Examination****TOTAL = 125 marks** | **IA** | **TW** | **TH** | **P** | **O** |
| **25** | **0** | **100** | **0** | **0** |

 **Course Objectives:**

The course objective is to expose students to basic economic concepts and apply economic reasoning to real world problems of business. The students will be able to apply the concepts learned in their profession.

**Course Outcomes:**

After the successful completion of the course, the student will be able to:

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| CO1 | Understand the basic principles of economics, micro behaviour of consumer & firms in different market structures, various macroeconomic policies, aspects of financial market & measures of Economic Growth and Development.  |
| CO2 | Apply the basics of economics, costs concepts in decision making. Calculate the National Income terms to analyze the progress of the economy.  |
| CO3 | Analyze the macroeconomic concepts & their relation to microeconomic concept & how they affect the business and economy. Assess the measures of Economic Growth and Development. |
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| CO4 |  Evaluate economic theories, principles of economics, cost concepts, market structures, measures of National Income and assess its impact on economic growth and development. Make economically sound decision. |

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| **UNIT 1** |  |
| Central concepts of Economics- Definitions of Economics , Scarcity and Efficiency, Nature of Economics: Positive and normative economics, Microeconomics and Macroeconomics Basic Elements of Supply and Demand- The Demand Schedule, The Demand Curve, Market Demand , Forces behind the Demand Curve, Shifts in Demand. The Supply Schedule The Supply Curve, Forces behind the Supply Curve , Shifts in Supply. Equilibrium of Supply and Demand, Effect of a Shift in Supply or Demand. Supply and Demand: Elasticity and Applications to major economic issues**Estimation/Forecasting of Demand:** Meaning, importance, methods – trend, exponential smoothing, regression analysis | **11 Hours** |
| **UNIT 2** |  |
| Microeconomics: Demand & Consumer Behaviour- Choice & Utility Theory. Production and Business Organization, Theory of Production and Marginal Products Basic Concepts, The Nature of the Firm, Big, Small, and Infinitesimal Businesses. Economic Analysis of Costs, Total Cost: Fixed and Variable. Production, Cost Theory, and Decisions of the Firm. Market structures.Perfect and imperfect competition, oligopoly, monopoly.  | **10 Hours** |
| **UNIT 3** |  |
| Macroeconomics: Key Concepts of Macroeconomics. Objectives and Instruments of Macroeconomics. Aggregate Supply and Demand. **National Income Terms:** -Gross Domestic Product: The Yardstick of an Economy’s Performance. Real vs. Nominal GDP. Net Domestic Product, GNP, National Income, Per capita income, Disposable Income, Price Index, Inflation.Consumption and Investment- Consumption, Income, and Saving, Investment. Determinants of Investment.Monetary Policy and the Economy .Government Control of the Economy- The Tools of Government Policy | **10 Hours** |
| **UNIT 4** |  |
| Economic Growth and Development: Economic Growth- The Long-Term Significance of Growth, The Four Wheels of Growth. Economic Development- meaning, criteria, measures of development- Per Capita Income, Index of Human Development .Financial markets- Structure, Participants, functions. Capital market- Instruments, Players, trading - Primary and secondary market - Role of stock exchanges and stock indices. Money market | **11 Hours** |

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|  | **Textbooks** |
| 1 | P.A. Samuelson  & W.D. Nordhaus, Economics, 19th Edition  McGraw  Hill, New York, 1995.  |
| 2 | A. Koutsoyiannis, Modern Microeconomics, Macmillan, 1975. |
| 3 | O.P. Khanna , Economics for Engineers,VK Global Publications Private Limited. |
|  | **References** |
| 1 | Chandra P., Fundamentals of Financial Management, Tata McGraw Hill Education Private Limited, New Delhi |