



Department of Electrical Engineering

CURRICULUM AND SYLLABUS **(2021-2025)**

B.Tech. Electrical Engineering



Electrical Engineering

B.Tech. (EE)

CURRICULUM AND SYLLABUS



Vision Statement of University

Be an internationally acclaimed University recognised for its excellent teaching, research, innovation, outreach and creating top class technocrats and professionals who can serve the mankind as multi skilled global citizen.

Mission Statement of University

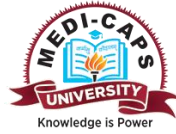
- Establish state-of-the-art facilities for world class education and research.
- Conduct scholarly research and creative endeavours that impact quality of life.
- Attract quality staff and students to cater for diverse needs and preferences and widen participation.
- Build a foundation for students to be successful at all levels through high-quality, innovative programs.
- Collaborate with institute, industry, and society to address current issues through research and align curriculum.
- Involve in societal outreach programs to identify concerns and provide sustainable ethical solutions.
- Encourage life-long learning and team-based problem solving through an enabling environment.

Vision of the Department:

To become centre of excellence in technical education and research to bring innovation and entrepreneurship ethically in the advance fields of electrical and allied engineering to bring intellectual, social, industrial contemporary requirements and innovation to improve performance, productivity and environmental sustainability through lifelong learning.

Mission of the Department:

1. To produce globally competent and skilled electrical engineers by providing exceptional quality education.
2. To develop collaborative and state-of-art research environment to design, interpret, implement and disseminate knowledge in broader horizons.
3. To develop collaborations with educational institutions, R&D organizations, alumni, and industries for distinction in research, teaching and consultancy proceedings in electrical and allied engineering.
4. To provide an academic ambiance of ethical, excellence, environment friendly and lifelong learning to the students of electrical and allied engineering for contribution in energy efficient systems.
5. To attract experienced, highly qualified and expert faculty for an inclusive educational environment.



Department of Electrical Engineering

Program Education Objectives (PEOs)

PEO01	To provide students with the knowledge of Mathematics, Basic Engineering principles and Computing, Basic Sciences and Electrical and allied Engineering in particular so as to develop necessary skill to analyze and synthesize electrical circuits, algorithms and complex apparatus.
PEO02	To prepare students as competent to analyze and provide economically feasible and socially acceptable solutions of real-life technical problems in industry, research and academics related to power, information, science, business and public policy.
PEO03	To prepare students to excel in professionalism and adoptability at the global level, with professional competence and ethical administrative acumen so as to be able to handle critical situations and meet deadlines.
PEO04	To indoctrinate an attitude to prepare and encourage students to undergo research work as well as to involve in scientific innovations for sustainable development in Electrical and allied Engineering.
PEO05	To prepare graduates to communicate effectively, adopt lifelong learning, pursue higher education and act with Integrity and have inter-personal skills needed to engage in, lead and nurture diverse teams, with commitment to their ethical and social responsibilities.

Department of Electrical Engineering

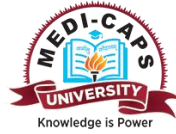
PROGRAMME OUTCOMES (POs)

- PO₀₁** **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering, fundamentals, and an engineering specialization to the solution of complex engineering problem.
- PO₀₂** **Problem analysis:** Identify, formulate, review, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences
- PO₀₃** **Design / development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- PO₀₄** **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- PO₀₅** **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- PO₀₆** **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- PO₀₇** **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- PO₀₈** **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- PO₀₉** **Individual and teamwork:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- PO₁₀** **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- PO₁₁** **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these



to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

- PO12** **Life-long learning:** Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.



Department of Electrical Engineering

PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO₀₁	Graduates will be able to apply the fundamental knowledge of mathematics, science and engineering to formulate, design and analyze and investigate complex power system problems in electrical and allied engineering horizons.
PSO₀₂	Graduates will be industry ready to design, develop and implement electrical and electronics and allied interdisciplinary projects to meet the contemporary demands of industry and provide solutions to the current real time problems related to electric drive systems.
PSO₀₃	Graduates will be aware of the impact of professional engineering solutions in societal, energy efficiency, environmental context, professional ethics and able to demonstrate soft skill proficiency for sustainable global development.
PSO₀₄	Graduates will be able to apply the appropriate techniques and knowledge of modern engineering hardware and software tools in electrical and allied engineering domain to engage in life-long learning and to successfully adapt in multi-disciplinary environment.



Medi-Caps University Indore (M.P.)

Electrical Engineering Department

B.Tech. (Electrical Engineering)

Scheme (2021-2025)

SEMESTER I

Sr. No.	Course Code	Courses	L	T	P	Credit
1	EN3BS11	Engineering Mathematics-I	3	0	0	3
2	EN3BS13	Engineering Physics	3	0	2	4
3	EN3ES17	Basic Electrical Engineering	3	0	2	4
4	EN3NG01	Environmental Science*	2	0	0	2
5	EN3ES19	Engineering Graphics	2	0	2	3
6	EN3ES21	Programming-I	0	0	4	2
7	EN3ES01	Basic Civil Engineering	3	0	2	4
		Total	16	0	12	22
		Total Contact Hours	28			

SEMESTER II

Sr. No.	Course Code	Courses	L	T	P	Credit
1	EN3BS12	Engineering Mathematics-II	3	0	0	3
2	EN3BS14	Engineering Chemistry	2	0	2	3
3	EN3ES18	Basic Mechanical Engineering	3	0	2	4
4	EN3ES22	Programming-II	0	0	4	2
5	EN3HS02	Communication Skills	2	0	2	3
6	EN3ES16	Basic Electronics Engineering	3	0	2	4
7	EN3ES20	Engineering Workshop – I	0	0	2	1
8	EN3HS01	History of Science and Technology	2	0	0	2
		Total	15	0	14	22
		Total Contact Hours	29			



SEMESTER III

Sr. No.	Course Code	Courses	L	T	P	Credit
1	EE3BS01	Engineering Mathematics III	3	0	0	3
2	EE3CO22	Electrical Workshop	0	0	2	1
3	EE3CO27	Signals & Systems	3	0	0	3
4	EE3CO28	Network Analysis	3	1	2	5
5	EE3CO30	Analog Electronics	3	0	0	3
6	EE3CO36	Electrical Machines I	3	1	0	4
7	EE3CO43	Programming for Electrical Engineers	0	0	2	1
8	EN3NG02	Universal Human Values and Professional* Ethics*	2	0	0	2
9	EN3HS04	Fundamentals of Management, Economics and Accountancy	3	0	0	3
10	EN3NG03	Soft Skills I*	2	0	0	2
		Total	22	2	6	27
		Total Contact Hours	30			

SEMESTER IV

Sr. No.	Course Code	Courses	L	T	P	Credit
1	EE3CO29	Electromagnetic Theory	3	0	0	3
2	EE3CO31	Digital Electronics	3	0	0	3
3	EE3CO32	Analog and Digital Electronics Lab	0	0	2	1
4	EE3CO33	Electrical Measurement and Instrumentation	3	0	0	3
5	EE3CO37	Electrical Machines II	3	0	0	3
6	EE3CO42	Power Electronics	3	0	2	4
7	EE3ES01	Python Programming	0	0	2	1
8	EE3CO39	Power System I	3	0	0	3
9	EE3CO38	Electrical Machines Lab	0	0	2	1
10	EE3PC04	Mini Project - I	0	0	4	2
		Total	18	0	12	24
		Total Contact Hours	30			



SEMESTER V

Sr. No.	Course Code	Courses	L	T	P	Credit
1	EE3CO34	Control Systems	3	0	0	3
2	EE3CO35	Electrical Measurement & Control Lab	0	0	2	1
3	EE3CO40	Power System -II	3	0	2	4
4	EE3ES02	Data Analysis using Python	0	0	2	1
5	EE3CO44	Electric Drives	3	0	0	3
6	EE3CO45	Electrical Simulation Lab	0	0	2	1
7	EE3CO41	PLC & Applications Lab	0	0	2	1
8	EE3EL16	Program Elective -I (Digital Signal Processing)	3	0	0	3
9	EE3EI01	Program Elective -II (PLC & Applications)	3	0	0	3
10	EN3NG04	Soft Skills -II	2	0	0	2
11	OE00093	Open Elective -I (Hybrid Electric Vehicles)	3	0	0	3
		Total	20	0	10	25
		Total Contact Hours	30			

SEMESTER VI

Sr. No.	Course Code	Courses	L	T	P	Credit
1	EE3CO53	Microprocessors & Microcontrollers	3	0	2	4
2	EE3CO46	Power System Protection	3	0	0	3
3	EE3CO48	IOT Applications in Electrical Engineering Lab	0	0	2	1
4	EE3EI03	Program Elective -III (IOT Applications in Electrical Engineering)	3	0	0	3
5	EE3EI02	Program Elective-IV (Embedded Systems)	3	0	0	3
6	EE3PC05	Mini Project -II	0	0	4	2
7	EN3NG05	Soft Skills -III	2	0	0	2
8	EE3CO47	Machine Learning for Electrical Engineering	3	0	2	4
9	OE00094	Open Elective -II (Battery Management Systems & Charging Stations)	3	0	0	3
		Total	20	0	10	25
		Total Contact Hours	30			



SEMESTER VII

S. No.	Course Code	Courses	L	T	P	Credit
1	EE3EI04	Program Elective-V (AI Applications in Electrical Engineering)	3	0	0	3
2	EE3EL17	Program Elective-VI (Electric Power Distribution)	3	0	0	3
3	OE00095	Open Elective-III (Renewable & Distributed Energy Technologies)	3	0	0	3
4	EE3PC03	Industrial Training	0	2	0	2
5	EE3PC06	Project-I	0	0	8	4
6	EN3NG06	Open Learning Course	1	0	0	1
		Total	10	2	8	16
		Total Contact Hours	20			

SEMESTER VIII

S. No.	Course Code	Courses	L	T	P	Credit
1	EE3PC07	Project-II	0	0	20	10
		Total	0	0	20	10
		Total Contact Hours	20			

Total Program Credits		171	
Summary of Credits			
S.NO	Course Work	Total Credits	Credits as per Model scheme
1	Basic Sciences (BS)	16	10-15% (16-24)
2	Engineering Sciences (ES)	26	15-20% (24-32)
3	Humanities and Social Sciences (HS)	8	5-10% (8-16)
4	Core (CO)	63	30-40%(48-64)
5	Program Electives (EL)	18	10-15%(16-24)
6	Open Electives (OE)	9	5-10%(8-16)
7	Project work	20	10-15%(16-24)
8	Non Grading	11	
		171	

Choice Based Credit System Scheme- B. Tech EE

Batch 2021-2025

Medi-Caps University Indore (M.P.)

B.Tech. (I year)

Scheme (2021-25 Batch)

SEMESTER I

SNo.	Course Code	Courses	L	T	P	Credit
1	EN3BS11	Engineering Mathematics-I	3	0	0	3
2	EN3BS13	Engineering Physics	3	0	2	4
3	EN3ES17	Basic Electrical Engineering	3	0	2	4
4	EN3NG01	Environmental Science*	2	0	0	2
5	EN3ES19	Engineering Graphics	2	0	2	3
6	EN3ES21	Programming-I	0	0	4	2
7	EN3ES01	Basic Civil Engineering	3	0	2	4
		Total	16	0	12	22
		Total Contact Hours	28			

* Non-gradual Courses



Course Code	Course Name	Hours per week			Total	
		L	T	P	Hours	Credit
EN3BS11	Engineering Mathematics-I	3	0	0	3	3

Course Learning Objectives (CLOs):

CLO₀₁ To impart analytical ability of using concepts of matrices in various fields of engineering.

CLO₀₂ To explain the concept of Differential Calculus.

CLO₀₃ To discuss the concept of Integral Calculus and its applications.

CLO₀₄ To impart analytical ability in solving Ordinary Differential Equations of first and Higher order.

CLO₀₅ To impart basics of complex number and variables including concepts of analytical functions.

Unit I Matrices and Linear Systems

Rank and Nullity of a Matrix by reducing it into Echelon and Normal Forms, Solution of Simultaneous equations by elementary transformation methods, Consistency and Inconsistency of Equations, Eigen Values and Eigen Vectors.

Unit II Differential Calculus

Introduction to limit continuity, differentiability, Rolle's theorem, Mean value theorem, Taylors and Maclaurin's series expansions. Functions of Several variables, Partial differentiation, Euler's Theorem, Total Derivative, Maxima and Minima of function of two variables.

Unit III Integral Calculus

Definite Integral as a limit of sum and its application in summation of series, Beta and Gamma functions (Definitions, Relation between Beta and Gamma functions without proof, Duplication formula without proof). Multiple Integral (Double and Triple Integrals), Change the Order of Integration, Applications of Multiple Integral in Area, Volume.

Unit IV Ordinary Differential Equations

First order differential equations (Separable, Exact, Homogeneous, Linear), Linear differential Equations of second and higher order with constant coefficients, Homogeneous linear differential equations, Simultaneous linear differential equations.

Unit V Complex Variable

Basics of Complex number, Functions of complex variable: Analytic functions, Harmonic Conjugate functions, Cauchy-Riemann Equations, Complex Line Integral, Cauchy's Theorem, Cauchy's Integral Formula.

Text books:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, New Delhi.
2. H.K. Dass, *Higher Engineering Mathematics*, S. Chand & Company Pvt LTD., New Delhi

References:

1. B.V. Ramana, Higher Engineering Mathematics, Tata McGraw Hill Pub. Co. Ltd., New Delhi.
2. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.
3. R.K. Jain and S.K. Iyengar, Advanced Engineering Mathematics, Narosa Pub. House, New- Delhi.

Web Source:

1. <http://nptel.ac.in/courses/111108066/>
2. <http://nptel.ac.in/courses/111104085/>
3. <https://swayam.gov.in/courses/public>
4. <http://nptel.ac.in/course.ph>

Course Outcomes (COs):

After completion of this course the students shall be able to:

- CO01** To illustrate the tools of matrices in solving the system of simultaneous equations,
- CO02** To investigate the tools of differential calculus to relevant fields of engineering and can implement the concept of several variables.
- CO03** To relate the integral calculus to relevant fields of engineering and can translate the concept of multiple integrals in finding area of regions and volume of solids.
- CO04** To solve Ordinary Differential Equations using different methods.
- CO05** To relate the knowledge of complex number and categorize it in solving functions of several complex numbers.



Course Code	Course Name	Hours per Week			Credits
		L	T	P	
EN3BS13	Engineering Physics	3	0	2	4

Course Learning Objectives (CLOs):

- CLO01** They will be able to understand the concept of Laser devices.
- CLO02** An ability to understand the phenomena occurs in optical fibre.
- CLO03** Students came to know about the optical phenomenon like Interference, diffraction, and polarization with their use in daily life.
- CLO04** They will be able to learn about the quantum physics.
- CLO05** They will be able to understand the concept of modern physics
- CLO06** An ability to recognise the crystal structure and their basics.
- CLO07** An ability to adapt the classical concept of oscillations.
- CLO08** They will be able to use the acoustics nature in practical applications.
- CLO09** Students learn the advanced concept of the superconductivity.

Unit-I Laser and Fibre Optics

Lasers: Properties of lasers, Spontaneous and Stimulated emission of radiation, Einstein's A & B co-efficient, Population inversion, Components of Laser, Ruby Laser, He-Ne Laser, Engineering applications of lasers. Fibre Optics: Fundamental idea about optical fibre, propagation of light through optical fibre acceptance angle, numerical aperture, fractional refractive index changes, V number, Classification of fibre, Engineering applications of fibre.

Unit-II Wave Optics

Interference: Fresnel's biprism experiment, Newton's ring experiment. Diffraction of light: Fraunhofer diffraction for single slit, N-slits diffraction (grating), Missing orders and Rayleigh criterion of Resolution. Polarization: General concept of Polarization, double refraction, Engineering Applications of Polarization.

Unit-III Quantum mechanics

Limitations of Classical Mechanics, De-Broglie hypothesis for matter waves, Phase and group velocity, wave packet, Heisenberg's uncertainty principle, Compton scattering, wave function, Schrodinger's Time dependent and time independent wave equation, Particle in a box problem.

Unit-IV Solid State Physics

Crystal Physics: Unit cell, Crystal System, Types of Unit cell: Simple cubic, Face

centered cubic, Body centered cubic Crystal, Number of atoms per unit cell, Packing fraction in different cubical lattices, Miller indices. Band theory of solids: Free Electron model, Band Model, Fermi level for Intrinsic and Extrinsic Semiconductors, Hall effect. Superconductivity: Zero resistance, persistent currents, superconducting transition temperature (T_c), Meissner effect, Type-I and Type-II superconductors, Engineering applications of superconductivity.

Unit- V Oscillations and acoustics

Oscillations: Concept of Simple, Periodic & harmonic Oscillation with illustrations; Differential equation of harmonic oscillator; Kinetic and potential energy of Harmonic Oscillator, compound pendulum. Acoustics: Introduction, Reverberation, Sabine's Formula, Eyring's Formula, Absorption Coefficient, Conditions for good acoustical design, Production and detection of ultrasonic waves and their applications.

Textbooks:

1. A Text book of Optics, N. Subramanyam and Brij Lal, S. Chand , New Delhi, 2010 .
2. Engineering Physics, H. K. Malik and A. K. Singh, Tata McGraw Hill New Delhi, 2010
3. Concepts of Modern Physics A. Beiser, Tata McGraw Hill New Delhi.
4. Engineering Physics, Gaur and Gupta, Dhanpat Rai Publications.

References:

1. An Introduction to Lasers- Theory and Applications. Dr. M N. Avadhanulu, Dr. R. S. Hemne S. Chand Publications.
2. Optics, A. Ghatak: 4th Edition, Tata McGraw-Hill, New Delhi 2009.
3. An Introduction to Fiber Optics, Ghatak and Thiagarajan, Cambridge University Press.
4. Solid State Physics by Kittel, Wiley India
5. A Text book of Physics – N. Gupta & S.K. Tiwary, Dhanpat Rai & Co., Delhi
6. Quantum Mechanics by Ghatak & Loknathan, Macmillian India Ltd-new Delhi Revised Edition 2019.

Course Outcomes (COs):

After completion of this course the students shall be able to:

- CO01** Understand and analyse the different types of lasers and optical fibres, operation, and its characteristics.
- CO02** Understand and apply various phenomenon of Interference, diffraction and polarization and their applications.
- CO03** Understand and apply the concept of Quantum Mechanics.
- CO04** Understand and examine the crystal structures and acquire the basic knowledge of various semiconductor devices.
- CO05** Evaluate and apply the applications of superconductivity in technology and real world.
- CO06** Apply basic concepts of oscillations in harmonic oscillator and compound pendulum.
- CO07** To analyse and design acoustics applications.

List of Practical's

List of suggestive core experiments (Any 10 experiments from the list of 16)

Laser and Fiber Optics

1. To measure the beam divergence and beam waist of laser beam.
2. To measure the numerical aperture of an optical fiber by scanning method.
3. To find the thickness of thin wire using laser.
4. To study the working of laser using PhET simulation module.
5. To establish a fiber optic analog link and study of bending loss in optical fiber.

Wave Optics

6. To determine the radius of curvature of plano convex lens using Newton's ring experiment.
7. To determine wavelength of spectral lines of mercury vapor lamp with the help of grating and spectrometer.
8. To determine the specific optical rotation of sugar solution by biquartz polarimeter.
9. To determine the wavelength of given sodium vapor lamp using Fresnel's Biprism.

Quantum Mechanics

10. Determination of Planck's constant (h) using light emitting diode (LED) of various colors.
11. To study black body Radiation by PhET Simulation.

Solid State Physics

12. To study the Hall Effect experiment and calculate the charge carrier concentration (density) of given semiconductor diode.
13. To determine the energy band gap of semiconductor diode.
14. To study V-I characteristics of semiconductor diode and Zener diode.

Oscillations and Acoustics

15. To find the frequency of AC Mains using Melde's method in longitudinal and transverse arrangement.
16. To determine the value of acceleration due to gravity (g) using compound pendulum



Course Code	Course Name	Hours per week			Total	
		L	T	P	Hours	Credits
EN3ES17	Basic Electrical Engineering	3	0	2	5	4

Course Learning Objectives (CLOs):

- CLO₀₁** To introduce fundamental concepts and analysis techniques in electrical engineering to students across all disciplines.
- CLO₀₂** To introduce the students about domestic wiring, the functioning of various electrical apparatus and the safety measures. Emphasize the effects of electric shock and precautionary measures.
- CLO₀₃** To impart basic knowledge of electrical quantities such as current, voltage, power, energy, and frequency to understand the impact of technology in a global and societal context.
- CLO₀₄** To provide knowledge about the basic DC and AC electric circuits and magnetic circuits.
- CLO₀₅** To introduce the concepts of power supply, UPS, SMPS, motors, transformers, and their applications.

Unit-I: DC circuit analysis

Elements and characteristics of electric circuits, ideal and practical sources, independent and dependent electrical sources, Ohm's law, source transformation, Kirchhoff's laws. Mesh analysis, nodal analysis, voltage and current division rules, star-delta conversions, Thevenin's and Norton's theorems.

Unit-II: AC Circuit Analysis

Generation of sinusoidal AC voltage, average and RMS values, concept of phasor, analysis of series RL, RC and RLC circuits, power triangle, power factor, series resonance and Q factor. Generation of three phase voltages, advantages of three phase systems, star and delta connections (balanced only), relation between line and phase quantities.

Unit-III: Electrical Machines

Definition, working principle and construction of transformer, construction & working principle of DC motor and three phase induction motor, single phase induction motor, application of rotating machines.

Unit-IV: Industrial Electrical Engineering

Power supply: linear power supply, switch mode power supply (SMPS), block diagram of UPS.

Safety and protection: electric hazards and precautions, earthing, fuses, MCB, types of wires and cables, components of domestic wiring, electricity metering and billing.

Unit-V: Electrical Energy Systems and Utilization

Power generation to distribution through overhead lines and underground cables with single line diagram, block schematic representation of hydroelectric and thermal power plants.

Advantages of electrical heating, induction heating and its applications, dielectric heating and its applications, welding transformer.

Textbooks:

1. V.N. Mittal & Mittle, Basic Electrical Engineering, Tata McGraw - Hill
2. D.P. Kothari and I. J, Nagrath, Basic Electrical Engineering, Tata McGraw - Hill.
3. C. L. Wadhwa, Generation, Distribution and Utilization of Electrical Power, Wiley Eastern Ltd., New Delhi.

References:

1. Ashfaq Hussain, Electrical power systems, CBS, Publication
2. D. C. kulshreshtha, Basic Electrical Engineering, McGraw Hill Education.
3. Hemant Joshi, Residential, commercial and industrial electrical systems, Volume-1 (equipment and selection), Tata McGraw – Hill.

Course Outcomes (COs):

After completion of this course the students shall be able to:

- CO01** Demonstrate an understanding of the basic knowledge of electrical quantities such as current, voltage, power, energy, and frequency to understand the impact of technology in a global and societal context.
- CO02** Demonstrate an understanding of basic concepts of analysis of simple DC and AC circuits used in electrical engineering.
- CO03** Demonstrate an understanding of power supply, UPS, type of motors and their applications.
- CO04** Demonstrate an understanding of basic concepts of transformers, power system components and their application in transmission and distribution of electric power system.
- CO05** Demonstrate an understanding of the effects of electric shock and precautionary measures.

List of Experiments

1. To study various electric hazards and corresponding precautions.
2. To verify KCL and KVL.
3. To verify Thevenin's and Norton's theorem.

4. Determination of resistance, inductance, capacitance and power factor of R-L, R-C & R-L-C series circuits.
5. To measure active power, reactive power & apparent power of a single-phase AC circuit.
6. To verify relation between line and phase quantities in a three-phase system.
7. To determine ratio and polarity of single-phase transformer.
8. To study construction of DC machine and three-phase induction motor.
9. To find out fusing factor and plot characteristic of fuse.
10. Study of different components of domestic wiring.
11. Preparation of energy bill based on energy consumption of residence/ Institute.
12. To study welding transformer and its accessories.



Course Code	Course Name	Hours per Week			Credits
		L	T	P	
EN3NG01	Environmental Science	2	0	0	2

Course Learning Objectives (CLOs):

- CLO₀₁** To impart knowledge of Environment and its basic components.
- CLO₀₂** To build basic understanding of various effects of human activities to the environment.
- CLO₀₃** To understand concepts of water pollution
- CLO₀₄** To understand function of solid waste management
- CLO₀₅** To learn concepts of disaster management

Unit-I Ecosystem and Biodiversity

Concept of Ecosystem, Food Chains, Food Webs, Energy flow in an ecosystem.
Biodiversity: Introduction, Types, Significance and Conservation.

Unit-II Air Pollution

Causes, Effects and Control of Air Pollution, Greenhouse Effect - Climate changes and Global warming, Ozone layer depletion, Acid Rain.
Case studies on recent cases of air pollution and management.

Unit-III Water Pollution

Causes, Effects and Control of Water Pollution, DO, BOD and COD, Water sampling, Municipal water treatment.

Unit-IV Solid Waste Management

Introduction, Types of solid waste, Harmful effects of solid waste, Methods to manage and modern techniques for solid waste management.

Unit-V Disaster Management

Concept of Disaster, Types of Disaster, Pre-disaster risk and vulnerability reduction, Post disaster recovery and rehabilitation.
Case studies on recent disasters and management.

Textbooks:

1. Preeti Jain, S.L.Garg, K.G.Garg, Energy, Environment, Ecology and Society, Variety Publication.
2. Surinder Deswal, Environmental Science, Dhanpat Rai & Co. publication.
3. R. Rajgopalan, Environmental Studies, Oxford IBH Publication.

References:

1. G. M. Masters, Introduction to Environmental Science and Engineering, Pearson Education Pvt. Ltd.
2. K. De, Environmental Chemistry, New Age International.
3. Daniel D. Chiras, Environmental Science, Jones & Bartlett Ltd.

Course Outcomes (COs):

After completion of this course the students shall be able to:

- CO₀₁** Gain knowledge of Ecosystem & Biodiversity.
- CO₀₂** Develop basic understanding of air pollution and its control method
- CO₀₃** Develop basic understanding of water pollution and its control method
- CO₀₄** Gain knowledge of Solid waste management and its importance.
- CO₀₅** Gain knowledge of Disaster Management.



Course Code	Course Name	Total Hours per week			Total	
		L	T	P	Hours	Credits
EN3ES19	Engineering Graphics	2	0	2	4	3

Course Learning Objectives (CLOs):

- CLO₀₁** To familiarize with the construction of geometrical figures.
- CLO₀₂** To familiarize with the projection of 1D, 2D and 3D elements
- CLO₀₃** To familiarize with the projection and sectioning of solids.
- CLO₀₄** To familiarize with the Preparation and interpretation of building drawing.
- CLO₀₅** To familiarize with the Upgraded Drawing Software and their use.

Unit -I

Drawing scales: Engineering scale, graphical scale, plain scale, diagonal scale, scale of chord.

Orthographic Projections: Reference planes, types of orthographic projections–First angle projections, Third angle projections.

Unit-II

Projections of points: Including points in all four quadrants

Projections of lines: Line parallel to reference plane, perpendicular to reference plane, inclined to one reference plane, inclined to both reference planes, traces of line.

Unit-III

Projections of Planes: Projections of Planes in different Positions, Auxiliary planes, Auxiliary Vertical Plane (AVP), Auxiliary Inclined Plane (AIP)

Projection of Solids: Classification of solid. Projections in simple and complex positions of the axis of the solid.

Unit-IV

Sections of Solids: Sectional views and true shape of the section.

Isometric Projections: Isometric view, Isometric scale to draw Isometric projection, non-Isometric lines, construction of isometric view from given orthographic views and to construct Isometric view of a Pyramid, Cone, Sphere.

Unit V

Computer Aided Drawing (CAD): Introduction to AutoCAD ,2D & 3D Basics, Modify & Draw Commands Using AutoCAD, Points, Lines planes and Solids and their projections.

Textbooks:

1. N.D. Bhatt, Elementary Engineering Drawing, Chartor Publishing House.
2. D. N. Johle, Engineering Drawing, Tata McGraw-Hill Publishing Co.Ltd.
3. P.S. Gill, Engineering Graphics, S.K. Kataria and Sons.
4. Warren J. Luzzader, Fundamentals of Engineering Drawing, Prentice Hall of India, New Delhi.
5. F. E. Giesecke, A. Mitchell & others, Principles of Engineering Graphics, Maxwell McMillan Publishing.

6. K.C. John, Engineering Graphics for Degree, PHI Learning Pvt. Ltd.

References:

1. Engineering Drawing- Basant Agarwal, TMH
2. D. M. Kulkarni, A. P. Rastogi, and A. K. Sarkar (2009), Engineering Graphics with AutoCAD, PHI Learning Private Limited, New Delhi
3. Venugopal (2010), Engineering Drawing and Graphics, 2nd edition, New Age Publications, New Delhi.
4. Trymbaka Murthy (2007), Computer Aided Engineering Drawing, I.K. International Publishers, New Delhi.
5. R.B. Choudary (2005), Engineering graphics with Auto CAD, Anuradha Publishers, New Delhi

Course Outcomes (COs):

After completion of this course the students shall be able to:

- CO01** Familiarize with different drawing equipment's and technical standards and Know purpose, procedures, materials and conventional symbols used. Create and read an engineering drawing using standard views and have ability to Convert pictorial (3D) drawings to orthographic (2-D) drawings and vice versa
- CO02** Understand the projection of points, straight lines and have the ability to convert the practical problems in to projections
- CO03** To understand and apply concepts of the projection of simple planes & solids.
- CO04** Understand and apply the concepts of Projection & Sections of solids & development of surfaces
- CO05** Convert simple 2D orthographic projections into 3D isometric projections with the help of auto cad commands

List of Experiments

Preparation of drawing sheets containing the drawings for topics covered in theory.

List of Drawing Sheets (Manual)

1. Orthographic Projections
2. Projections of points & Projections of straight lines
3. Projections of planes & Projections of solids
4. Projections of sections of solids & isometric projections
5. Drawing scales

List of CAD Sheets

1. To study about special features, advantages and applications of CAD in detail.
2. To study and practice basic draw commands, modifying commands exist in the CAD.
3. To construct a diagonal scale.
4. To draw orthographic projection of given pictorial views.
5. To construct the isometric views of given geometries.



Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
EN3ES221	Programming-I	0	0	4	2

Course Learning Objectives (CLOs):

- CLO₀₁** Analyse Basics of Computers, programming environment and about different types of Programming languages.
- CLO₀₂** Application of various basic concepts required to create programs, use good problem solving approach.
- CLO₀₃** Use different control structures for conditional programming.
- CLO₀₄** Use of Arrays and string in different problems and also to apply different operations on arrays and strings
- CLO₀₅** Use the functions and procedures to solve different problems..

Unit-I Introduction to Computer and Problem Solving Methodology

Computer System, Computing Environments, Software, Types of Software and Features of Software.

Design Tools (Algorithm, Flow-Chart, Pseudo-Code).Types and Generations of Programming Languages. Compiler, Interpreter, Linker, Loader, Execution of Program. Develop an Algorithm for Simple Problems.

Unit-II Basics of Language

Character set, Identifier, Keywords, Constants, Data Types, Preprocessor Directives, Variables and Declaration, White Space and Escape Sequence, Operators and Expressions, Type Conversions, Operator Precedence and Associativity, Expression Evaluation, Input and Output Functions. Computational Problems Solving Based on above Constructs.

Unit-III Control Statements

Selection (If, Else), Conditional Operator, Iteration (For, While, Do-While), Branching (Switch, Break, Continue, Goto), Nesting of Control Statements. Problem Solving Based on Control Statements.

Unit-IV Arrays and Strings

Defining an Array, One Dimensional Array, Two Dimensional Array, Multi-Dimensional Array. Basic Array Operations and Matrix Manipulation Operations (Addition, Subtraction, and Multiplication).Problem Solving Based on Array.

Strings Definition, String Operations and String Functions. Problem Solving Based on

Strings.

Unit-V Functions

Introduction, Functions Declaration, Definition, Calling, Return Statement, Parameter Passing (By Value), Recursion, Library Functions. Problem Solving Based on Functions.

Text Books:

1. Herbert Schildt, C: The complete Reference, Fourth Edition, Mc-GrawHill.
2. R. Sethi, Programming Language Concepts and Constructs, Pearson Education.
3. V. Rajaraman, Computer Programming in 'C', PHI.
4. M. Sprankle, Programming and Problem Solving, Pearson Education.
5. R.G. Dromey, How to solve it by Computer, Pearson Education.
6. E. Balaguruswamy, Programming in ANSI C by, Tata Mc-GrawHill.
7. Yashavant Kanetkar, Let Us C, BPB.
8. E. Balagurusamy, Fundamentals of Computers, TMH.

References:

1. Kernighan and Ritchie , The 'C' programming language, PHI
2. Programming With C, Schaum Series.
3. A. N. Kamthane, Programming with ANSI and Turbo C, Pearson Education.

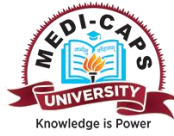
Course Outcomes (COs):

After completion of this course the students shall be able to:

- CO₀₁** Understand Basics of Computers and Programming languages.
- CO₀₂** Understand basic concepts of C programming language required to create programs.
- CO₀₃** Apply different types of control structures in problem solving.
- CO₀₄** Use of Arrays and string in different problems and also to apply different operations on arrays and strings.
- CO₀₅** Apply and use the functions and procedures to solve different problems.

List of Practical

1. Write a program to print hello user on output screen.
2. Write a program to perform arithmetic operation on two numbers.
3. Write a program to find sum of individual digits of any three digits number.
4. Write a program to print any three digit number in reverse order.
5. Write a program to swap any two numbers using third variable and without using third variable.
6. Write a program to check given number is even or odd.
7. Write a program to check given char is vowel or consonant.
8. Write a program to check given number is positive or negative.
9. Write a program to check given year is leap year or not.
10. Write a program to check given number in range of 100-200 or not.
11. Write a program to check given number is palindrome or not.



12. Write a program to print grade of student on the basis of percentage:
 - a. If per greater than or equal to 75 → A grade
 - b. If per between 60-75 → B grade
 - c. If per between 50-60 → C grade
 - d. If per between 40-50 → D grade
 - e. If per less than 40 → Fail
13. Write a program for addition subtraction multiplication division using switch case.
14. Write a program to print table of any number.
15. Write a program to calculate factorial of any number.
16. Write a program to print series of alphabet.
17. Write a program to print Fibonacci series.
18. Write a program to check given number is perfect or not
19. Write a program to check given number is prime or not.
20. Write a program to check given number is Armstrong or not
21. Write a program to print number in word in between 1-5. Like (1 =one)
22. Write a program to check given char is vowel or consonant.
23. Write a program to print name of month according to number.
24. Write a program for convertor
 - a. For currency convertor
 - b. For temperature convertor
 - c. For weight convertor
 - d. For length convertor
 - e. For time convertor
 - f. For energy convertor
25. Write a program to print series of number from 1-100 without using loop.
26. Write a program to find maximum & minimum number from array.
27. Write a program to check how many numbers is prime & not prime in a list
28. Write a program to check how many digits at each index of array.
29. Write a program to check (search) given number is present or not present in list.
30. Write a program to arrange (sort) array elements in ascending or descending order.
31. Write a program to print a 2*2 matrix.
32. Write a program to find sum of two matrix.
33. Write a program to find multiplication of two matrix.
34. Write a program of string functions.
35. Write a function to find sum of two numbers.
36. Write a function to calculate factorial of any number.
37. Write a function for call by value to find sum of two numbers.
38. Write a function to pass an integer array as an arguments and find sum of array elements
39. Write a function to pass a char array as an argument and find length of string.
40. Write a recursive function to calculate factorial of any number.
41. Write a program to find the no of char no of word and no of lines from given text input.



Course Code	Course Name	Hours per Week			Credits
		L	T	P	
EN3ES01	Basic Civil Engineering	3	0	2	4

Course Learning Objectives (CLOs):

- CLO₀₁** To give the knowledge of various building and general construction materials such as bricks, stones, timber, cement, steel and concrete & their properties and application.
- CLO₀₂** To provide basic understanding of the forces and its components, stresses, strains and the modulus of elasticity of the different construction materials.
- CLO₀₃** To understand the components of the building such as beams, columns, foundations, slabs and different types of soils and their bearing capacities.
- CLO₀₄** To provide basic knowledge about principles of surveying for a location, and its application in execution of engineering projects, various instruments used for surveying such as chains, tapes, compass, theodolite and auto level.
- CLO₀₅** To understand various aspects of structural members and application of loads, shear force & bending moment in the field of civil engineering.

Unit I Building Construction Material

Role of Civil Engineer in the construction of buildings, dams, expressways, and infrastructure projects for 21st century. Importance of an inter- disciplinary approach in engineering Building Materials: Bricks composition, classifications, properties and uses. Stone classification of rocks, quarrying, and Dressing properties uses. Timber properties uses plywood. Cement: grades, types, properties, uses. Steel: types, mild steel, medium steel, hard steel, properties, uses, market forms. Concrete: grade designation, properties, uses.

Unit II Surveying and levelling

Surveying-classification, general principles of surveying–Basic terms and definitions of chain, Chain survey, Compass survey and Levelling, Uses of surveying, Contours their characteristics and uses.

Unit III Building Components

Site selection, General Classification and building components. Soils: types and bearing capacity of soils, Foundation: functions and classifications. Flooring: requirements and selection types, Roof - types and requirements.

Unit IV Forces & Properties of Material

Forces and its components, Resolution and summation of forces, Lami’s Theorem, Stress, Strain types, Hook’s law, Three moduli of elasticity, poissons ratio, relationship, factor of safety.

Unit V Shear force and Bending moment

Introduction of shear force and bending moment and their sign conventions, Types of loads, Types of beams, Types of supports; Shear force and bending moment diagrams for simply supported, overhang and cantilever beams subjected to any combination of point loads,

uniformly distributed load and point moment; Relationship between load, shear force and bending moment.

Text Books:

1. S.C. Rangwala, Building materials, Charotar Publishing House, Pvt. Limited.
2. S.Ramamrutham , Basic Civil Engineering and Engineering Mechanics, Dhanpat Rai.
3. K.K.Dwivedi & K.K. Shukla, Basic Civil Engineering & Engineering Mechanics, Dhanpat Rai & Co.(Revised).

References:

1. I.K.V.B. Raju and P.T. Ravichandran, Basics of Civil Engineering, Ayyappa Publications, Chennai.
2. S.Gopi, Basic Civil Engineering, Pearson Publishers.
3. M.S. Palanichamy, Basic Civil Engineering, Tata Mc Graw Hill

Course Outcomes (COs):

After completion of this course the students shall be able to:

- CO₀₁** Students will be able to recognize the civil engineering works and conversant about different construction materials and their uses.
- CO₀₂** Student will be able to differentiate force, pressure and stresses.
- CO₀₃** Students will be able to know the different building component and its importance.
- CO₀₄** Students will be conversant about vertical and horizontal variation of different terrains.
- CO₀₅** Students will be able to apply the theoretical knowledge about structural elements in practical manner.

List of Experiments

1. To determine particle size distribution & fineness modulus of coarse and fine aggregates.
2. To determine standard consistency of cement paste. -
3. To determine initial and final setting times for cement by using Vicat's apparatus.
4. To determine the workability of fresh concrete of given proportion by slump cone test.
5. To determine the area of land by chain surveying.
6. To perform traverse surveying with prismatic compass check for local attraction and determine corrected bearing and to balance the traversing by Bowditch's rule.
7. To perform levelling by height of Instrument method.
8. To perform levelling by rise and Fall method.
9. To perform Plane Table Surveying work by (A) Radiation method and (.B) Intersection methods.
10. To measure horizontal and vertical angle in the field by using Theodolite.



SEMESTER II

SNo.	Course Code	Courses	L	T	P	Credit
1	EN3BS12	Engineering Mathematics-II	3	0	0	3
2	EN3BS14	Engineering Chemistry	2	0	2	3
3	EN3ES18	Basic Mechanical Engineering	3	0	2	4
4	EN3ES22	Programing-II	0	0	4	2
5	EN3HS02	Communication Skills	2	0	2	3
6	EN3ES16	Basic Electronics Engineering	3	0	2	4
7	EN3ES20	Engineering Workshop – I	0	0	2	1
8	EN3HS01	History of Science and Technology	2	0	0	2
		Total	15	0	14	22
		Total Contact Hours	29			



Course Code	Course Name	Hours per week			Total	
		L	T	P	Hours	Credit
EN3BS12	Engineering Mathematics-II	3	0	0	3	3

Course Learning Objectives (CLOs):

- CLO₀₁** To illustrate knowledge of Laplace Transform and investigate its application.
- CLO₀₂** To explain the concept of Fourier Series and Fourier Transform.
- CLO₀₃** To illustrate the concept of Partial Differential Equations.
- CLO₀₄** To impart the knowledge of Vector Calculus.
- CLO₀₅** To discuss numerical methods and to outline its application in solving algebraic, transcendental equations and system of linear equations.

Unit I Laplace Transform

Introduction of Laplace Transform, Laplace Transform of elementary functions, properties of Laplace Transform, Inverse Laplace transform and its properties, Convolution theorem, Applications of Laplace Transform to solve the Ordinary Differential Equation, Laplacetransform of Unit step function and Impulse function.

Unit II Fourier Series and Fourier Transform

Introduction of Fourier series, Fourier series for Discontinuous functions, Fourier series for Even and Odd function, Half range series, Fourier Transform, Sine and Cosine Transform.

Unit III Partial Differential Equations

Definition, Formulation, Solution of Partial Differential Equations (By Direct Integration Method and Lagrange's Method), Non-Linear Partial Differential Equations of First order (Standard form I, II, III & IV), Charpit's method. Partial Differential Equations with Constant Coefficients (Higher Orders Homogeneous), Method of Separation of Variables.

Unit IV Vector Calculus

Scalar and Vector fields, Vector Differentiation, Laplacian operator, Gradient, Divergence and Curl, Line and surface integrals, Green's theorem, Gauss Divergence theorem, Stoke's theorem.

Unit V Numerical Analysis

Errors and Approximations, Solution of Algebraic and Transcendental Equations (Regula Falsi, Newton-Raphson and Iterative methods), Solution of Simultaneous linear equations by Gauss Elimination, Gauss Jordan, Jacobi's and Gauss-Siedel Iterative methods.



Textbooks:

1. B.S. Grewal, *Higher Engineering Mathematics*, Edition-43, Khanna Publishers, New Delhi.
2. H. K. Dass, *Higher Engineering Mathematics*, S. Chand & Company Pvt LTD., New Delhi

References:

1. B.V. Ramana, *Higher Engineering Mathematics*, Tata McGraw Hill Publishing Company Ltd., New Delhi.
2. Shanti Narayan, *A textbook of Vector Calculus*, S. Chand & Co., New Delhi.
3. Erwin Kreyszig, *Advanced Engineering Mathematics*, John Wiley & Sons 1999.

Web Source:

1. nptel.ac.in/courses/111103021/15
2. nptel.ac.in/courses/111105035/22
3. <https://swayam.gov.in/courses/public>
4. <http://nptel.ac.in/course.php>

Course Outcomes (COs):

After completion of this course the students shall be able to:

- CO1** To impact mathematical models involving ordinary and partial differential equations with given boundary condition which is helpful in all engineering and research work.
- CO2** To examine the general mathematical concepts required for the field regarding Laplace and Fourier Transform.
- CO3** To compare and contrast importance of partial differential equations in physical problems.
- CO4** To prioritize derivatives of vector- point functions, gradient functions, evaluate integral of functions over curves, surfaces and domains in two and three dimensional.
- CO5** To examine numerical techniques and investigate its application in solving algebraic and transcendental equations.



Course Code	Course Name	Hours per Week			Credits
		L	T	P	
EN3BS14	Engineering Chemistry	2	0	2	4

Course Learning Objectives (CLOs):

- CLO₀₁** To gain fundamental knowledge of the principles related to, so as to meet the challenging requirements of students in chemistry studies.
- CLO₀₂** To attain awareness in students about current & new issues in the fields of chemistry.
- CLO₀₃** To make students understand about the present needs without compromising on the ability of future generations to meet their own needs for proper engineering, relevant education efficient management of resources.
- CLO₀₄** To increase curiosity and give them awareness about practical knowledge of various laboratory methods among the students regarding the course.

Unit-I Lubricants

Introduction, Classification of lubricants, Mechanism of lubrication, Properties and Testing of lubricating oils (Flash and Fire point, Cloud and Pour point, Viscosity and Viscosity Index, Neutralization number, Saponification Number, Steam Emulsification Number, Aniline Point, Iodine Value), Numerical problems based on testing methods.

Unit -II Polymer

Introduction and Classification of polymer, Preparation, Properties and Uses of the following- Polythene, PVC, Teflon, Nylon 66, Bakelite, Silicone resin, Natural and Synthetic Rubber, Vulcanization of Rubber, Biopolymers, Biodegradable polymers.

Unit -III New Engineering Materials

Introduction, Properties and Applications of - Superconductors, Optical Fiber, Fullerenes, Graphene, Carbon nanotubes, Nanowires.

Unit -IV Instrumental Techniques in Chemical Analysis

Spectroscopy, Electromagnetic spectrum, Beer & Lambert's Law and its limitations, Principle, Instrumentation and Applications of-UV-Visible Spectroscopy, IR Spectroscopy, Gas Chromatography.

Unit- V Electrochemistry

Concept of Enthalpy, Entropy and Free energy, EMF, Applications of EMF measurements, Corrosion- Definition, Types, Causes and Protection from corrosion.

Text Books:

1. Preeti Jain, Anjali Soni, Jeetendra Bhaswar, A text book of Engineering Chemistry, 1st edition, Manthan Publication, 2016.
2. Preeti Jain, S L Garg, Engineering Chemistry, 4th edition, Variety Publication.
3. Shashi Chawla, Engineering Chemistry, 11th edition, Dhanpati Rai Publications.

References:

1. P C Jain, Monika Jain, Engineering Chemistry, Dhanpat Rai Publications.
2. S. S. Dara, A Text Book of Engineering Chemistry, S. Chand & Company.

Course Outcomes (COs):**After completion of this course the students shall be able to:**

- CO₀₁ To Understand the lubricants, their mechanism and practically analyze the properties of lubricants.
- CO₀₂ Will acquire betterment in lifestyle by understanding the need of bio polymers in the current scenario and replacing synthetic polymers with its bio-polymer substitute.
- CO₀₃ Will get familiarised with new engineering materials and their commercial applications.
- CO₀₄ Will get knowledge of using instrumental techniques and their applications for determination of chemical structure of any compound.
- CO₀₅ Identify various types of corrosion and methods to protect the metallic structures from corrosive environment.

List of Practical's:**Volumetric Analysis:**

1. To determine Hardness of given water sample by Complexometric titration.
2. To determine total and mixed Alkalinity of given water sample using phenolphthalein and methyl orange as indicator.
3. To determine strength of unknown FAS solution by Redox titration using N-Phenyl anthranilic acid as internal indicator.
4. To determine strength of unknown CuSO₄ solution by Iodometric titration using Starch as internal indicator.
5. To determine Chloride content of water sample by Mohr's method (Argentometric titration).

Fuel Testing:

1. To determine moisture content of given sample of coal by proximate analysis.
2. To determine volatile content of given sample of coal by proximate analysis.
3. To determine ash content of given sample of coal by proximate analysis.
4. To determine percentage carbon content of coal by proximate analysis.



Lubricant Testing:

1. To determine penetration number of grease by Cone Penetrometer apparatus.
2. To determine flash and fire point of given oil sample by Cleveland's open cup apparatus.
3. To determine flash point of given oil sample by Penskey Marten's close cup apparatus.
4. To determine flash point of given oil sample by Abel's Close-up apparatus.
5. To determine Steam emulsification number of given lubricant.
6. To determine Aniline point of given oil sample.
7. To determine Cloud and Pour point of given lubricating sample.
8. To study rate of change of viscosity with temperature of the given lubricating oil by means of Redwood Viscometer no.1
9. To study rate of change of viscosity with temperature of the given lubricating oil by means of Redwood Viscometer no.2.

Electrochemistry:

Variation of cell potential in $Zn/Zn^{2+}/Cu^{2+}/Cu$ with change in concentration of electrolytes ($CuSO_4$ or $ZnSO_4$) at room temperature.

Kinetics:

Effect of concentration and temperature on the rate of reaction between sodium thiosulphate and hydrochloric acid.



Course Code	Course Name	Hours per Week			Total	
		L	T	P	Hours	Credits
EN3ES18	Basic Mechanical Engineering	3	0	2	5	4

Course Learning Objectives (CLOs):

- CLO₀₁** To understand the properties of materials and their behavior with variation in temperature and Load. To understand different measuring instruments used in engineering applications.
- CLO₀₂** To understand the basic laws of thermodynamics and their applications in engineering, refrigeration cycles and properties of refrigerants.
- CLO₀₃** To understand Construction and Working of I. C. Engines.
- CLO₀₄** To understand Construction and Working of Steam Generators
- CLO₀₅** To understand the concepts of Centroid & Moment of Inertia and of plane areas and different theorems of moment of Inertia

Unit-I Materials & their mechanical properties

Classification of Engineering material and their mechanical properties, Composition of cast iron and carbon steels and their application. Stress-strain diagram, Hooks law and modulus of elasticity. Tensile, shear, hardness, and fatigue testing of materials.

Unit-II Thermodynamics

Thermodynamic properties and systems, First of thermodynamics, thermal processes at constant pressure, volume. Second law of thermodynamic, enthalpy, entropy, heat engine, heat pump, refrigerator and their numerical.

Unit-III I.C. Engines

Description and working of four stroke petrol engines, two stroke petrol engines, four stroke diesel engines and two stroke diesel engines, and its efficiency relative merits and demerits.

Unit-IV Steam generators

Definition, Classification, general study of Cochran, Lancashire and Locomotive boilers, boilers mountings and accessories. Steam properties and boiler performance. Draught Classification, Calculation of Chimney height, boiler efficiency and numerical. Unit V: Centroid & Moment of Inertia Location of centroid and Moment of Inertia of plane areas, Perpendicular Axis, and Parallel Axis theorems.

Unit V Centroid & Moment of Inertia

Location of centroid and Moment of Inertia of plane areas, Perpendicular Axis, and Parallel Axis theorems.

Textbooks:

1. R.K. Rajput, Basic Mechanical Engineering, Laxmi Publication.
2. P.K. Nag, Engineering Thermodynamics, McGraw Hill.

3. R.K. Bansal, Engineering Mechanics, Laxmi publications.

References:

1. Anand K Bewoor, Vinay A Kulkarni, Ist edition, Metrology & Measurement, McGraw Hill.
2. Cengel and Boles, Thermodynamic, An Engineering Approach in S.I Unit, McGraw Hill.
S.S. Bhavikatti and K.G.Rajashekarappa, Engineering Mechanics, New age international limited.

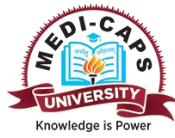
Course Outcomes (COs):

After completion of this course the students shall be able to:

- CO01** Students will be able to understand the engineering materials, their properties, Iron-Carbon Diagram and Stress-Strain Curve, Measuring Equipment's and Testing Machines.
- CO02** Student will be thorough with the basic laws of thermodynamics and their applications in engineering also know about Refrigeration cycles and properties of refrigerants.
- CO03** Students will be able to understand the construction and working of I.C. Engines .
- CO04** Students will be able to understand the construction and working of Steam Generators
- CO05** Students will be able to determine the Centroid & Moment of Inertia of areas/composite sections.

List of Experiments

1. Measurements using Vernier calliper & micrometer.
2. Measurements using dial gauges and combination set.
3. Measurements using slip gauges & sine-bar.
4. Tensile Testing of standard mild steel specimen on UTM.
5. To determine the hardness number by using Brinell Hardness Testing Machine.
6. Study of 2-stroke petrol and diesel engine.
7. Study of 4-stroke petrol and diesel engine.
8. Study of different type of boilers.
9. Study of different type of boilers mounting & accessories.
10. To find the centroid of different plane laminas.



Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
EN3ES22	Programming-II	0	0	4	2

Course Learning Objectives (CLOs):

- CLO₀₁** Understand Pointer variables. Declaring and dereferencing pointer variables. Pointer Arithmetic. Accessing arrays, strings through pointers.
- CLO₀₂** Declaration and use structures, perform operations on structures, passing structures as function arguments. type defining structures.
- CLO₀₃** Use Function declaration, function definition, function call, Passing arguments to a function, by value, by reference. Scope of variable names, creation of header files
- CLO₀₄** Use calloc, malloc, realloc dynamic memory.
- CLO₀₅** Apply Input-output using files in C, Opening, closing and reading from files. Programming for command line arguments.
- CLO₀₆** Apply graphics functions to create pictorial representation and animations

Unit-I Pointers

Introduction to Pointers (Declaration and Initialization), Double Pointer, Pointers and Array, Pointers and Functions, Operations on Pointers.

Unit-II User Defined Data Types

Defining a Structure, Declaration of Structure Variables, Initialization of Structure Variables, Accessing Structure Members, Storage of Structures in Memory Array within a Structure, Array of Structure, Pointer Structure, Passing Structure to a Function, Structure within a Structure. Define Union, Structure versus Union, Working with Union, Initializing Union, Enumerated Data Type.

Unit-III Pre-processor and Memory Allocation

Pre-processor Directives, Macro and Macro Expansions, File Inclusions, Conditional Compilation, Stringification (#) and Token Passing Operator (##), Type Def, Command Line Argument, Dynamic Memory Allocation. malloc(), calloc(), realloc(), free(), Core Dump, Memory Leak, Dynamic 1D and 2D Arrays. Header Files and Their Creations.

Unit-IV File Handling

File Concept, File Pointer and File Handling Operations Using files in C, Buffer and Streams, Working with Text Files and Binary Files, File Operations using std. Library and System Calls, File Management I/O Functions, Random Access Files.

Unit-V Graphics Programming



C Header Files for handling graphics and initializing graphics mode, Understand Coordinate system, Function to Draw Lines, Circle, Arc, Ellipse, pie slice, sector, Rectangle, Bar, 3-D Bars & Polygon, Color Spraying: filling Ellipse, polygons and flooding the fills, Filling Styles and Patterns, Understand Animation, Function to create Animation, Traffic Light and Moving Car Simulation.

Text Books:

1. Herbert Schildt, C: The complete Reference, Fourth Edition, Mc-Graw Hill.
2. R. Sethi, Programming Language Concepts and Constructs, Pearson Education.
3. V. Rajaraman, Computer Programming in 'C', PHI.
4. M. Sprankle, Programming and Problem Solving, Pearson Education.
5. R.G. Dromey, How to solve it by Computer, Pearson Education.
6. E. Balguruswamy, Programming in ANSI C by, Tata Mc-Graw Hill.
7. Yashavant Kanetkar, Let Us C, BPB.
8. E. Balagurusamy, Fundamentals of Computers, TMH.
9. AL Stevens, C Database Development, MIS Press.

References:

1. Kernighan and Ritchie, The 'C' programming language, PHI.
2. Programming With C, Schaum Series.
3. A. N. Kamthane, Programming with ANSI and Turbo C, Pearson Education.

Course Outcomes (COs):

After completion of this course the students shall be able to:

- CO₀₁** Apply Pointers, Pointer Arithmetic and Accessing arrays, strings through pointers.
- CO₀₂** Use different user defined data types like structures, union and enum.
- CO₀₃** Understand and Use of dynamic memory allocation and preprocessor directives.
- CO₀₄** Use the concepts of file handling.
- CO₀₅** Use Graphics programming to draw and use different shapes.

List of Practical

1. Program to create, initialize, assign and access a pointer variable.
2. Program to swap two numbers using pointers.
3. Program to change the value of constant integer using pointers.
4. Program to print a string using pointer.
5. Program to count vowels and consonants in a string using pointer.
6. Program to find sum of elements of array using pointer.
7. Program to swap two numbers using pointers.
8. Compare strings using pointer
9. Find smallest number in array using pointer.
10. Find largest element in array using pointer.



11. Find sum of all matrix elements using pointer.
12. Program to create a pointer array store elements in it and display.
13. Program to demonstrate function pointers.
14. Program to perform Addition Subtraction Multiplication Division using array of function pointers.
15. Program to display details of student two (Name, roll no, marks) using structure.
16. Program to display details of employee using array of structure.
17. Program to access member of structures using pointers.
18. Program for passing structure to a function.
19. Program for returning a structure from a function.
20. Program to display details of student two (Name, roll no, marks) with the help of union.
21. Program to demonstrate the memory allocation in structure and union.
22. Program to demonstrate malloc and calloc.
23. Program to allocate memory of array at run time.
24. Program to print the day of week.
25. Program to print month of a year.
26. Program to calculate area of circle using macro.
27. Program to calculate area of circle using macro function.
28. Program to create a header file and use it in a program.
29. Program to demonstrate file operation.
 - a. Creating a new file
 - b. Opening an existing file
 - c. Closing a file
 - d. Reading from and writing information to a file
30. Program to count number of words, number of character and number of lines from a given text file.
31. Program in C to delete a specific line from a file.
32. Write a program in C to append multiple lines at the end of a text file.
33. Write a program in C to copy a file in another name.
34. Write a program in C to merge two files and write it in a new file.
35. Write a program in C to encrypt a text file.
36. Write a program in C to decrypt a previously encrypted file.
37. Write a program in C to remove a file from the disk.
38. Write a program to draw a circle and fill blue color in it.
39. Write a program to draw a rectangle with diagonal and fill different colors in both halves.
40. Write a program to move a circle using suitable animations.
41. Write a program to implement traffic signal.
42. Write a program to simulate a moving car. Draw car using simple shapes like line, circle and polygon.



Course Code	Course Name	Hours per Week			Credits
		L	T	P	
EN3HS02	COMMUNICATION SKILLS	2	0	2	3

Course Learning Objectives (CLOs):

- CLO₀₁** To develop, enhance and demonstrate LSRW Skills.
- CLO₀₂** To enable students to acquire oral presentation skills.
- CLO₀₃** To prepare students to become more confident and active participants in all aspects of their undergraduate programs
- CLO₀₄** To enable students with good vocabulary, grammar and writing skills.
- CLO₀₅** To enable students to distinguish between general and technical communication and understand its importance

Unit-I

Grammar and Vocabulary Development: Applied Grammar and usage, Parts of Speech, Articles, Tenses, Subject-Verb Agreement, Prepositions, Active and Passive Voice, Clauses, modals, Reported Speech: Direct and Indirect, Sentence Structure, Punctuations, common errors.

Unit-II

Using Dictionaries and Thesaurus, Synonyms, Antonyms, Homophones, One Word Substitution, Affixation: Prefixes & Suffixes, Basic Grammar & Vocabulary Practice, Synonyms, Antonyms, Analogies, Sentence Completion, Correctly Spelt Words, Idioms, Proverbs, and Derivation from root words, Jargon, Scientific Jargon, Vocabulary Practice.

Unit-III

Developing Reading and Listening Skills: Reading Comprehension, Process, Active & Passive Reading, Reading Speed Strategies, Benefits of effective reading, notemaking, note - taking, Reading comprehension of technical material and SQ3R reading technique. Listening Skills: Meaning, process hearing and listening, types, barriers, importance.

Unit-IV

Developing Writing Skills: Planning, Drafting & Editing, Writing with style, rightwords selection, writing effective sentences, developing logical paragraphs, art of condensation, précis, essay, technical definition and technical description. Formal and Informal Letters: Letter to the Editors, Municipal corporation, Bank Managers etc.

Unit-V

Speaking Skills Oral Presentation: Preparation, Delivery using Audio – Visual Aids with stress on body language and voice modulations. (Topics to be selected by the Instructor.) Phonetic Symbols, Pronunciations.

Text Books:

1. P.C,Wren and N.D.V. Prasada Rao, High School English Grammar & Composition, S Chand and Co Pvt Ltd.
2. S. Kumar and P. Lata, English for Effective Communication, Oxford UP, New Delhi.
3. A.J. Thompson and A. V. Martinet, A Practical English Grammar, Oxford UP, New Delhi.
4. U. S. Rai and S.M, Rai, Effective Communication, Himalaya Publishing House.

References:

1. A.C. Gimson, An introduction to the Pronunciation of English, ELBS.
2. S. Greenbaum, Thw Oxford English Grammer, Oxford University Press.
3. K.Mohan and M. Raman, Effective English Communication, Tata Mc-Graw Hill.

Course Outcomes (COs):

After completion of this course the students shall be able to:

- CO01** The students will be able to enhance confidence in their ability to read, comprehend, organize, and retain written and oral information.
- CO02** The students will be able to distinguish between general and technical communication and understand its importance
- CO03** The students will be able to improve upon their language skills, communication skills, group discussion, and personality development and confidence level.
- CO04** The students will be able to bridge the language gap which is vital to their success
- CO05** Students will be able to communicate effectively.

List of Experiments (if applicable): List of Practicals:

- JAM
- Debates
- Role plays
- GDs
- Extempore
- Story writing
- Picture description
- Symposium
- Oral presentation
- Phonetics practice
- Book Reviews



Course Code	Course Name	Hours per Week			Credits
		L	T	P	
EN3ES16	Basic Electronics Engineering	3	0	2	5

Course Learning Objectives (CLOs):

- CLO₀₁** To learn the basics of semiconductor materials and their usage in variety of PN junction diodes and applications of diodes
- CLO₀₂** To study transistor in different modes of configuration and basic biasing techniques, FET.
- CLO₀₃** To study of the fundamental concepts and various types of analog communication systems
- CLO₀₄** To study of the concept of number systems and Boolean Algebra, minimization, Logic gates and other Combinational circuits and their designing.
- CLO₀₅** To learn about basic Measurement & Instrument components.

Unit-I SEMICONDUCTOR DIODE

Semiconductor basics, PN Junction diode construction & working, Volt-amp characteristics, Diode current equation, Half wave rectifier, Full wave rectifier: Bridge and center tapped rectifier, Clipper and Clamper. Zener diode and zener diode-based voltage regulator, LED

Unit-II BIPOLAR JUNCTION TRANSISTOR

Construction and working of transistor, characteristics of transistor, transistor as an amplifier and switch, transistor configurations, transistor biasing and biasing methods, basic amplifier configurations, Basic principle and working of FET and MOSFET

Unit-III BASICS OF COMMUNICATION SYSTEMS

Block schematic of communication system, Simplex and duplex systems, Modes of communication: Broadcast and point to point communication, Necessity of modulation, Classification of modulation: Amplitude, phase, frequency modulation, sampling theorem and pulse amplitude modulation.

Unit-IV DIGITAL SYSTEM

Number Systems – Decimal, Binary, Octal, Hexadecimal, 1's and 2's complements, Codes – Binary, BCD, Excess 3, Gray, Boolean theorems, Minterms and Maxterms, Sum of products and products of sums, Karnaugh map Minimization, Logic gates: NOT, AND, OR, NAND, NOR, EX-OR and EX-NOR, half adder and full adder. Function and Structure of a Computer System, Von Neumann Architecture, and modern computers.

Unit-V ELECTRONICS MEASUREMENT

Introduction, Basics of Measurements, Ammeter, Voltmeter, multimeter, Signal Generators, Cathode Ray Oscilloscope: Block diagram of CRO, Construction of CRT, Deflection sensitivity and various controls, Measurement of voltage, current frequency and phase angle using CRO



Textbooks:

1. Millman and Halkias: Integrated electronics, TMH.
2. D Roy Choudhury, Digital Electronics, Vol-I & II, TMH Publication.
3. A.K.Sawhney, A Course in Electrical and Electronic Measurements and Instrumentation, Dhanpat Rai.
4. Simon Haykins, Communication System, John Willy.
5. Andrew S. Tanenbaum, Structured Computer Organization, Upper Saddle River.

References:

1. Sedra and Smith: Microelectronics, Oxford Press.
2. Millman and Taub, Pulse, Digital and Switching Waveforms, MGM.
3. A.Anand Kumar: Digital Circuits, PHI.
4. Salivahanan: Electronic Circuits Analysis and Design, TMH
5. Boylestad and Nashelsky: Electronic Devices and Circuit Theory, Pearson Education.
6. B.P.Lathi, Modern Digital & Analog Communication System, TMH

Course Outcomes (COs):

After completion of this course the students shall be able to:

- CO01** Should have the knowledge of basic semiconductor materials and their usage in variety of PN junction diodes and applications of diodes
- CO02** Should be able to understand the concept operation of transistors and its configuration.
- CO03** Understand and identify the fundamental concepts and various components of analog communication systems
- CO04** Should have the knowledge of number systems and Boolean Algebra, minimization, Logic gates and other Combinational circuits and their designing.
- CO05** Should have understood the basics of Measurement & Instrument components.

List of Experiments:

1. To verify V-I characteristic of semiconductor & Zener diode.
2. To verify input and output waveform of half wave rectifier.
3. To verify input and output waveform of full wave rectifier.
4. To verify Input and output characteristic of BJT in CB and CE configurations.
5. Implementation of basic logic gates using Universal gates (NAND, NOR).
6. To verify half adder & full adder.
7. Study of computer system structure and main peripheral devices.
8. Study of Frequency Division Multiplexing with sinusoidal inputs / audio inputs.
9. Study of CRO and its demonstration kit.
10. Study of voltmeter and multimeter.



Course Code	Course Name	Total Hours per week			Total	
		L	T	P	Hours	Credits
EN3ES20	Engineering Workshop -I	0	0	2	2	1

Course Learning Objectives (CLOs):

- CLO₀₁** To familiar with Lathe, Drilling, Milling and shaping machines.
- CLO₀₂** The basic law of physics and their utilization in engineering.
- CLO₀₃** To understand different primary manufacturing process.
- CLO₀₄** To understand different metal joining process.
- CLO₀₅** To identify different tools used in basic manufacturing process.

Unit-I Introduction and Demonstration: - Introduction to various shops / sections and workshop layouts. Safety norms to be followed in a workshop.

Carpentry Shop: Introduction of Tools & operations, Types of woods & their applications, Types of Carpentry tools and their uses, Carpentry Joints, carpentry operations such as marking, sawing, planing, chiseling, grooving, boring, joining, types of woods and carpentry hardware.

Unit-II Fitting Shop: Introduction of Tools & operations, Types of Marking tools & their uses, Types of fitting cutting tool & their uses, fitting operations such as chipping, filing, scraping, grinding, sawing, marking, drilling, tapping

Unit-III Foundry Shop: Pattern Making: Study of Pattern materials, pattern allowances and types of patterns. Core box and core print. Use and care of tools used for making wooden patterns.

Molding: Properties of good mould & Core sand, Composition of Green, Dry and Loam sand. Methods used to prepare simple green sand mould using single piece and split patterns.

Black Smithy Shop: Use of various smithy tools. Forging operations: Upsetting, drawing down, Fullering Swaging and Cutting down.

Unit-IV: Welding Shop: Study and use of tools used for Brazing, Soldering, Gas & Arc welding. Preparing Lap & Butt joints using gas and arc welding methods, Study of TIG & MIG welding processes. Safety precautions.

Unit V: Machine Shop: Study of machine tools in particular Lathe machine (different parts, different operations, study of cutting tools). Demonstration of different operations on Lathe machine, Practice of Facing, Plane Turning, step turning, taper turning, knurling, and parting. Demonstration and applications of drilling machine, Demonstration of CNC Machines

Textbooks:

1. B.S. Raghuvanshi, Workshop Technology Vol. I & II, Dhanpath Rai & Sons.
2. R.S. Khurmi, Workshop Technology, S. Chand and Co.
3. S.K. Hajra Choudhary, A.K. Hajra Choudhary and Nirjhar Roy, Elements of Workshop Technology, vol. I Media promoters and Publishers Pvt. Ltd
4. R.K. Bansal, Engineering Mechanics, Laxmi publications.

Reference Books:

1. W. A.J. Chapman, Workshop Technology, 1998, Part -1, 1st South Asian Edition, Viva Book Pvt. Ltd.
2. P.N. Rao, 2009, Manufacturing Technology, Vol.1, 3rd Ed., Tata McGraw Hill Publishing Company.
3. Dr. S.K. Sinha , CNC programming — Golgotia publication.

Course Outcomes (COs):

After completion of this course the students shall be able to:

- CO01** Understand the engineering materials, their properties, and their utilization in manufacturing tool and other equipment's.
- CO02** Understand the primary manufacturing process.
- CO03** Understand the basic operation involve in casting.
- CO04** Understand the basic process of forging.
- CO05** Basic knowledge of simple cutting, holding. Marking and striking tool.



Course Code	Course Name	Hours per Week			Credits
		L	T	P	
EN3HS01	History of Science and Technology	3	0	0	2

Course Learning Objectives (CLOs):

- CLO01** To know the historical perspective of science and technology in India, its roots and its role.
- CLO02** To know how research and development field is progressing in India.
- CLO03** To know what were the policies and plans are proposed after independence to be technologically sound.
- CLO04** To Know what were the developments done in major areas of science & technology.
- CLO05** To know the relationship between the technologies.

Unit-I Historical Perspective

Nature of science and technology, Roots of science and technology in India, Role of Science and Scientists in society, Science and Faith.

Unit-II Research and Development (R&D) in India

Science and Technology Education, Research activities and promotion of technology development, Technology mission, Programs aimed at technological self-reliance, activities of council of scientific and industrial research (CSIR).

Unit-III Policies and Plans after Independence

Nehru's vision of science for independent India, Science and technology developments in the new era, science and technology developments during the Five-Year Plan Periods and science and technology policy resolutions.

Unit-IV Science and Technological Developments in Major Areas

Space – Objectives of space programs, Geostationary Satellite Services – INSAT system and INSAT services remote sensing applications, Launch Vehicle Technology. Ocean Development. Objectives of ocean development, marine research. Biotechnology - Applications of biotechnology in medicine, agriculture, food, and fuel. Energy – Research and development in the field of nonconventional energy resources, India's nuclear energy program.

Unit-V Nexus between Technologies

Transfer of Technology – Types, Methods, Mechanisms, Process, Channels and Techniques, Appropriate technology, Technology assessment, Technological forecasting, Technological innovations and barriers of technological change.

Textbooks:

1. K. Rajaram, Science and Technology in India, Published and Distributed by SpectrumBooks (P) Ltd., New Delhi.
2. M. Srinivasan, Management of Science and Technology (Problems & Prospects), East- West Press (P) Ltd., New Delhi.
3. G.R. Kohili, The Role and Impact of Science and Technology in the Development of India, Surjeet Publications.
4. Government of India, Five Year Plans, Planning Commission, New Delhi.
5. K.D. Sharma, and M.A. Qureshi, Science, Technology and Development, Sterling Publications (P) Ltd., New Delhi.

References:

1. Suvobrata Sarkar , History of Science, Technology, Environment, and Medicine in India, Published by Routledge India.
2. Sabareesh P.A. , A Brief History Of Science In India. Published by Garuda rakashan.
3. G. Kuppuram, K. Kumudamani, History of Science and Technology in India, Published by Sundeep Prakashan.

Course Outcomes (COs):

After completion of this course the students shall be able to:

- CO01** Student will be aware about the ancient India & the existence of science & technology in that era & how it is reciprocated.
- CO02** Student will be aware about the upliftment done in the field of R & D after independence.
- CO03** Student will come to know about the plans and policies that brought about radical changes for the growth of science in India.
- CO04** Student will come to know about the major areas of the applied science and their existence. And can set the relationship between the technologies.
- CO05** Students will understand the need of technology transfer, its types and processes.



SEMESTER – III

Sr. No.	Course Code	Courses	L	T	P	Credit
1	EE3BS01	Engineering Mathematics III	3	0	0	3
2	EE3CO22	Electrical Workshop	0	0	2	1
3	EE3CO27	Signals & Systems	3	0	0	3
4	EE3CO28	Network Analysis	3	1	2	5
5	EE3CO30	Analog Electronics	3	0	0	3
6	EE3CO36	Electrical Machines I	3	1	0	4
7	EE3CO43	Programming for Electrical Engineers	0	0	2	1
8	EN3NG02	Universal Human Values and Professional Ethics	2	0	0	2
9	EN3HS04	Fundamentals of Management, Economics and Accountancy	3	0	0	3
10	EN3NG03	Soft Skills I	2	0	0	2
		Total	22	2	6	27
		Total Contact Hours	30			



Course Code	Course Name	Hours per Week			Total Credits
		L	T	P	
EE3BS01	Engineering Mathematics -III	3	0	0	3

Unit I: Summarizing Data using Statistical Measures:

Descriptive Statistics – Measure of central tendency - Mean: Arithmetic mean, Geometric mean and Harmonic mean with its Mathematical properties, Properties of Median and Mode and relationship among Mean, Median and Mode, Measure of dispersion –types, Variance, standard deviation, Covariance and its properties, Coefficient of variation, Quartiles, Quartile deviation and Mean deviation.

Unit II: Theory of Random variables and Probability:

Random variables- Discrete and Continuous random variables, Probability Mass and Density function (pmf, pdf), Cumulative Distribution function, Expectation of random variables, Introduction to probability Theory: Trial and Event, law of probability theory (addition theorem, multiplication theorem), Introduction to Conditional probability.

Unit III: Probability Distribution:

Discrete Distribution: Binomial and Poisson distribution: Mean Variance, Moment generating function.

Continuous Distribution: Normal and Exponential Distribution: Mean Variance, Moment generating function.

Unit IV: Curve fitting, Correlation, Regression:

Curve fitting (Method of Least Square), linear and nonlinear curves, Correlation: Karl Pearson’s Coefficient of Correlation, Spearman’s Rank Correlation Coefficient, Linear Regression, Regression coefficients and their properties.

Unit V: Testing of Hypothesis:

Introduction to testing of hypothesis, Statistical assumptions, Level of significance, Confidence level, Type I Error, Type II error, Critical value, Critical region, Sampling distribution, Chi-Square test, small sample test – t test for one and two sample mean, F test, Large Sample test- Z test for equality of single mean, Equality of two sample.

Text Books

1. S.C. Gupta and V.K. Kapoor, “Fundamentals of Mathematical Statistics”, Sultan Chand & Sons Publication.
2. Ravichandran, Probability and Statistics, Wiley India.

Reference Books

1. Sheldon M. Ross, “Introduction to Probability Models”, Elsevier Publication, Academic Press, UK
2. Sheldon M. Ross, “Introduction to Probability and Statistics for Engineers and Scientists”, Elsevier Publication, Academic Press, UK.



Course Code	Course Name	L	T	P	C
EE3CO22	Electrical Workshop	0	0	2	1

Unit-I

Exposure to different types of electrical accessories like types of switches, types of lamps, wires and cables

Unit-II

Identification and use of Electrical and electronics components and laboratory tools

Unit-III

Fabrication of general-purpose PCB and bread board.

Unit-IV

Different faults in domestic appliances like automatic iron, mixture, Application of Tester and Test Lamp for fault finding in Electrical Systems.

Unit-V

Design of voltage regulators and power supplies.

List of experiments:

1. Identify different types of cables/wires and switches and their uses.
2. Identify different types of fuses & fuse carriers, MCB and ELCB, MCCB with ratings and usage.
3. To carry out pipe/plate earthing for a small house and 3-phase induction motor. Testing the earthing using earth test
4. To make connections of single phase and 3-phase motors through an appropriate starter and to change their direction of rotation
5. To do re-winding of a fan (ceiling and table) and tube light choke
6. Soldering and de-soldering practice (soldering and de-soldering of electronic components on PCB)
7. Dismantling/assembly of star-delta/DOL
8. Starter and slip ring induction motor starter
9. Design of voltage supplies.
10. Wiring of light/fan circuit using Two-way switches (Staircase wiring).
11. Wiring of fluorescent lamps and light sockets (6 A).
12. Measurement of voltage, current, resistance, inductance, and capacitance in a given RLC circuit using LCR meter and Multimeter.
13. Measurement of voltage, current and power in single phase circuit using voltmeter, ammeter and wattmeter.
14. Demonstration and measurement of power consumption of electric iron, mixer grinder, single phase pump, exhaust fan, etc.



Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
EE3CO27	Signals and Systems	3	0	0	3

Course Learning Objectives (CLOs):

- CLO₀₁** To understand the basic signals, different signal operations, classification of signals and systems in different categories.
- CLO₀₂** To analyze the time-domain and frequency-domain behaviour of continuous time & discrete-time signals with the help of different transform technique.
- CLO₀₃** To understand System properties and find the response of the system by using convolution.
- CLO₀₄** To understand the characteristics of the discrete-time system with the help of Convolution sum and difference equation along with the types of discrete-time system.
- CLO₀₅** To know the characteristics, like Causality & Non-causality etc, of a discrete-time and continuous time system.

Unit I

Introduction to Signal and System- Basic definition of signals, Classification of Signals- Energy and power signal, Periodic and aperiodic signal, Signal operations & properties, Exponential and Sinusoidal signals, Concepts of Impulse function, Unit Step function, Signum function.

Unit II

Analysis of Signals-Representation of Fourier series, Continuous time periodic signals, Properties of Fourier Series, Dirichlet's conditions, Trigonometric Fourier Series and Exponential Fourier Series. Laplace Transforms (L.T), Inverse Laplace Transform, Concept of Region of Convergence (ROC) for Laplace Transforms, Properties of L.T. Fourier Transform of Periodic Signals, Properties of Fourier Transform, Fourier Transforms involving Impulse function and Signum function.

Unit III

Continuous Time System-Basic of systems, system properties: Linearity, Static and dynamic, stability and causality, time invariant and variant system, invertible and non-invertible, representation of continuous systems. Continuous Time LTI System:- Impulse response and convolution integral, properties of convolution, signal responses to Continuous LTI system,

Unit IV

Discrete Time System-Introduction, Properties of discrete time systems, Impulse response characterization and convolution sum, Properties of convolution sum, Discrete systems described by difference equation, solution of difference equation, Impulse response of DT-LTI system.

Unit V

Z-Transform-Concept of Z-Transform of a Discrete Sequence, Region of Convergence in Z-Transform, Z-transforms of unit impulse sequence, unit step sequence. ROC of finite duration sequences, Properties of Z-transform, Inverse z-transform, Stability analysis.

Text Books:

1. Alan V. Oppenheim, Alan S. Willsky and Nawab, Signal & system, Pearson, Education.
2. Simon Haykin and Barry Van Veen, Signal & System, Wiley- India Publications.
3. B. P. Lathi, Linear Signal & System, Oxford University Press.

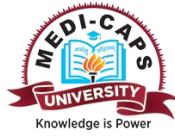
References Books:

1. H P Hsu, Rakesh Ranjan, Signal and System, Schaum's Outlines, Tata Mc Graw H Indian Reprint.
2. Michel J. Robert, "Fundamentals of Signals and Systems" MGH International Edition.
3. Anand Kumar, "Signal & System", PHI Learning.

Course Outcomes (COs):

After completion of this course the students shall be able to:

- CO01 Describe the basic signals, categorize the signals and systems and perform signal operations.
- CO02 Analysis of signals in frequency domain using Fourier series and Fourier transform and understand the conversion of continuous time signal to discrete time signal.
- CO03 Classify continuous time system based on their properties and determine the response using convolution.
- CO04 Describe the properties of discrete time system and analyze discrete time system.
- CO05 Analyze signal and system properties like stability and causality using Z transforms.



Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
EE3CO28	Network Analysis	3	1	2	5

Course Learning Objectives (CLOs):

- CLO₀₁** To classify various circuit elements and their behaviour in various circuit diagram.
- CLO₀₂** Solving circuit networks using different theorems.
- CLO₀₃** To study Steady and Transients analysis of electrical circuits in time domain
- CLO₀₄** To study Steady and Transients analysis of electrical circuits in frequency domain.
- CLO₀₅** Study different network functions and their behaviour.

Unit-I Circuit elements

R, L, C, classification of circuit elements, voltage & current sources, controlled & uncontrolled sources, review of mesh and nodal analysis, analysis of magnetically coupled circuits, dot convention, coupling co- efficient, network topology, concept of network graph, tree, tree branch & link, incidence matrix, cut set and tie set matrices, dual networks.

Unit- II Network theorems for ac & dc circuits

Thevenin's & Norton's theorem, Superpositions theorem, Reciprocity theorem, Compensation theorem, Substitution theorem, Maximum power transfer, and Millman's theorem, Tellegen's theorem, problems with dependent & independent sources.

Unit- III Transient analysis

Transients in RL, RC & RLC Circuits, initial conditions, time constants. **Steady state analysis-** Concept of phasor & vector, impedance & admittance.

Unit- IV Frequency domain analysis

Laplace transform solution of integro-differential equations, transform of waveform synthesized with step ramp, gate and sinusoidal functions, initial & final value theorem, network theorems in transformed domain.

Unit- V Network function & two port networks

Two port parameters – Z, Y, ABCD, hybrid parameters, their inverse & image parameters, relationship between parameters, interconnection of two ports networks. Condition of reciprocity and symmetry in two port parameter presentation,

Text-Books:

1. Mittal GK; Network Analysis; Khanna Publisher
2. Mesereau and Jackson; Circuit Analysis- A system Approach; Pearson.
3. William D Stanley: Network Analysis with Applications, Pearson Education

Reference Books: -

1. M.E. Van Valkenburg, Network Analysis, (PHI)
2. Sudhakar & Pillai; Circuit & Networks- Analysis and Synthesis; TMH
3. Hayt W.H. & J.E. Kemmerly; Engineering Circuit Analysis; TMH

Course Outcomes (COs):

After completion of this course the students shall be able to:

- CO₀₁** Able to know the basic working of various circuit elements and their combination.
- CO₀₂** Apply theorems for solutions of electrical networks.
- CO₀₃** Analyse the transient and steady state condition of electrical networks and its effect.
- CO₀₄** Ability to measure the various parameters related to electrical networks.

List of Experiments

1. To measure and calculate currents and voltages for a given resistive circuit and verify KCL and KVL.
2. To verify Thevenin's theorem.
3. To verify Norton's theorem.
4. To verify Superposition theorem.
5. To verify Reciprocity theorem.
6. To verify Maximum Power Transfer theorem.
7. To verify Millman's theorem.
8. To verify Tellegen's theorem.
9. To determine open circuit & short circuit parameters of a two-port network.
10. To determine the ABCD parameters of two port network.
11. To determine the h parameters of two port network.
12. To determine the time constant of RC circuit.
13. To determine the time constant of RL circuit.



Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
EE3CO30	Analog Electronics	3	0	0	3

Course Learning Objectives (CLOs):

- CLO₀₁** Impart a basic knowledge of transistor such as BJT, JFET, MOSFET to understand the impact of technology in a global and social context.
- CLO₀₂** To empower students the design and working of BJT/FET amplifier and oscillators.
- CLO₀₃** To learn about fundamentals of operational amplifier.
- CLO₀₄** To study the application of operational amplifier, filters and oscillators.
- CLO₀₅** To learn the IC -555 and its operations.

Unit-I

BJT and FET- Construction, basic operation, CB, CE and CC- configuration, input and output characteristics, active, cut-off and saturation region. BJT as an amplifier. Transistor biasing fixed bias, self-bias, voltage divider bias, collector to base bias, load-line analysis, h-parameter model of BJT, hybrid π model of BJT.

FET: Construction, n-channel and p-channel, enhancement and depletion type MOSFET, drain and transfer Characteristics.

Unit-II

Amplifier and Oscillators- Introduction, voltage amplifier, current amplifier, trans-conductance amplifier and trans-resistance amplifier. BJT Amplifier, CE, CB, CC amplifiers, analysis using h-parameter model. Multistage amplifier, direct and RC coupled amplifier, Feedback amplifiers: effect of negative feedback, various feedback topologies. power amplifiers: class A, class B, class AB, class C, class D, transformer coupled and push-pull amplifier.

Oscillators: criterion for oscillation, types of oscillators: Hartley oscillator, Colpitt oscillator, phase-shift oscillators, Wein bridge oscillator, voltage-controlled oscillator.

Unit-III

Operational Amplifier- Differential amplifier: types and applications. block diagram of op-amp, ideal op-amp characteristics, equivalent circuit. characteristics of OP-AMP, ideal and practical, like input offset voltage, offset current, input bias current, output offset voltage, common mode rejection ratio, slew rate power supply rejection ratio (PSRR). Inverting, non-inverting and differential configurations in open loop and closed loop.

Unit-IV

Op-Amp Applications- Adder, subtractor, integrators and differentiators, instrumentation amplifier, log/ antilog amplifier, sample and hold circuit, voltage-to-current converter, current-to-voltage converter. triangular/rectangular wave generator, comparator, zero crossing detector, Schmitt trigger. Filters: 1st and 2nd order low pass, high pass, band pass filters and band reject filter.

Unit-V

Timer and Regulators- IC-555 Timer concept, block pin configuration of timer. Mono-stable, Bi-stable and A-stable multi-vibrator using timer 555-IC.

Voltage Regulator using OP-AMP, fixed and adjustable voltage regulators. characteristics of standard regulator ICs (LM317, LM78XX and LM79XX). Regulated and unregulated power supply, switch mode power supply (SMPS).

Text Books:

1. Millman and Halkias: Integrated electronics, TMH.
2. Boylestad and Nashelsky: Electronic Devices and Circuit Theory, Pearson Education.
3. Ramakant A. Gaikwad, OP- Amp and linear Integrated circuits, Pearson.

References:

1. Sedra and Smith: Microelectronics, Oxford Press.
2. D. Roy Choudhury, Linear Integrated Circuits, New Age Publication.
3. Salivahanan: Electronic Circuits Analysis and Design, TMH

Course Outcomes (COs):

After completion of this course the students shall be able to:

- CO01 To state and define amplifier and OP-amp circuit.
- CO02 To classify amplifier, oscillators and OP-amp circuit. To explain different amplifier configuration, adder, subtractor, integrator, Hartley and Colpitt oscillator.
- CO03 To demonstrate op-amps fundamentals in project design, evaluation and analysis.
- CO04 To analyse adder, subtracter, integrators and differentiators, filters, oscillators.
- CO05 To analyse the function of regulators and timers.



Course Code	Course Name	Hours per week			Total Credits
		L	T	P	
EE3CO36	Electrical Machines-I	3	1	0	4

Course Learning Objectives (CLOs):

- CLO₀₁ To learn how to solve magnetic circuit and learn about various terms related to magnetic circuits.
- CLO₀₂ To learn the constructional features of transformers.
- CLO₀₃ To learn about the voltage regulation, efficiency and various tests on three phase and single phase transformers
- CLO₀₄ To Learn the working, constructional features, speed control, phasor diagram and regulation of three-phase Induction Motors.
- CLO₀₅ To Learn the working, constructional features, starting methods, phasor diagram and regulation of single-phase Induction Motors.

Unit I Introduction:

Magnetic circuits, comparison with electric circuit, Concepts of MMF, flux, flux density, reluctance, permeability and field strength, their relationship and numerical, simple series and parallel magnetic circuits calculations.

Energy in magnetic systems, Energy and co-energy, singly excited systems; mechanical force, Mechanical energy, Torque equation, doubly excited Systems; Energy stored in magnetic field, Generated EMF equation.

Unit-II Transformers-I:

Working principle, construction of single-phase transformer, EMF equation, Phasor diagrams on no-load and on loaded conditions, open circuit and short circuit tests, equivalent circuit parameters estimation, voltage regulation and efficiency, back-to-back test. Effect of saturation on exciting current and in-rush current phenomenon. Parallel operation of single-phase transformers.

Unit III Transformer-II:

Three phase transformer construction, groups and connections, their working and applications, Scott connection, parallel operation of three phase transformers, application, advantages, requirement and load sharing, cooling, conservator and breather. Tap changing transformers, auto-transformer.

Unit-IV Induction Motor-I:

Three Phase IM: Working principle, construction, types and comparison, starting of IM, phasor diagram, equivalent circuit, power flow diagram, torque-speed characteristic, Losses and efficiency, No load and block rotor test, PF control.



Unit V Induction Motor-II:

Three Phase IM: Speed control, cogging & crawling, NEMA classification of induction motor, induction generator and its applications.

Single Phase Motors: single phase induction motor; double revolving field theory, working principle, starting methods and types of single-phase induction motors.

Text-Books

1. Nagrath I.J. and Kothari D.P., “Electrical Machines”, Tata McGraw Hill
2. Vincent Del Toro, “Electric Machines and Power Systems”, Prentice Hall; Facsimile edition.
3. P. S. Bimbhra, “Electrical Machinery”, Khanna Publication.

Reference Book:

1. Stephen J Chapman, “Electric Machinery Fundamentals”, McGraw-Hill.
2. Gerling Dieter, “Electrical Machines”, Springer.
3. M. G. Say, “The Performance and Design of AC machines”, Pit man & Sons.

Course Outcomes (COs):

After completion of this course the students shall be able to:

- CO₀₁** **Understand** magnetic circuits, concepts of mmf, flux, reluctance etc. and solve magnetic circuits using energy and co-energy concepts.
- CO₀₂** **Understand** the constructional features of Single-phase transformer, three-phase transformer; their voltage regulation and application.
- CO₀₃** **Understand** constructional features, speed control, phasor diagram of three phase induction machines; working ,starting methods and types of single-phase induction motor.
- CO₀₄** **Apply** the knowledge of transformer to perform various test like open circuit, short circuit and back to back test and operate transformers in parallel.
- CO₀₅** **Apply** the knowledge of three-phase induction motor to perform no load and blocked rotor test and determine efficiency.
- CO₀₆** **Analyze** performance and characteristics of three-phase induction motor by determining its equivalent circuit, power flow diagram and speed-torque characteristics.



Course Code	Course Name	Hours per week			Total Credits
		L	T	P	
EE3CO43	Programming for Electrical Engineering	0	0	2	1

Unit-I Introduction to a high level numerically oriented programming language like MATLAB, SCILAB, SageMath, Octave, Mathematica etc.

Environment, variables, operators, expressions, input and output. vectors, arrays, matrices.

Unit-II Programming

Input, output, plotting, formatting a plot, multiple plots, additional 2-D plot, three dimensions plot, relation and logical operators, conditional statements, programming and debugging.

Unit-III Loops

For – Loops, While – Loops, break statement.

Unit-IV Mathematical Computing

Algebraic equations, basic symbolic calculus and differential equations, numerical techniques and transforms

Unit-V Applications

Electrical (Mesh and Node method, Thevenin's and Norton's theorem), electronics, control system (root locus, Bode and Nyquist plot).

Text Books:

1. Averill Law, Simulation Modeling and Analysis, McGraw Hill Education
2. Tejas B. Sheth, Scilab: A Practical Introduction to Programming and Problem Solving, Create Space Independent Publishing Platform.
3. S. Jain, "Modelling and Simulation Using Matlab-Simulink", Willey India

Reference Books

1. David McMahon, MATLAB Demystified, McGraw-Hill Pub.
2. Raj Kumar Bansal, Ashok Kumar Goel, Manoj Sharma, "MATLAB and its Applications in Engineering", Pearson Education.
3. Titus A. Beu, Introduction to Numerical Programming: A Practical Guide for Scientists and Engineers, CRC Press



List of experiments based on numerical computing environment

1. To create one dimensional array (row/column vector)
2. To create two-dimensional array (matrix of given Size)
3. To perform arithmetic operations addition, subtraction, multiplication, and exponentiation
4. To obtain modified matrix inverse, transpose, appended and deleted elements.
5. To find roots of the polynomial $S^4+3S^3+15S^2+2S+9=0$
6. Generation and plotting of trigonometric functions- $\sin(\omega t)$, $\cos(\omega t)$, $\tan(\omega t)$ and $\sec(\omega t)$, $\operatorname{cosec}(\omega t)$ and $\cot(\omega t)$ for given duration of t.
7. To plot function $f(x) = \sin(1/x)$ and $g(x) = (\sin(x))/x$ for given range of $0.01 < x < 0.1$
8. To plot the function, x , x^3 , e^x and e^{x^2} in the range $0 < x < 4$
9. To obtain node voltage, and branch current, in a given resistive network.
10. Write a programme to find out voltage and current through Thevenin's equivalent circuit.
11. Write a programme to find out voltage and current through Norton's equivalent circuit.
12. Write a programme to find out time response of first order system.
13. To determine stability criteria using Root locus.
14. Write a programme to find out convert temperature from *Fahrenheit to Celsius* and vice versa.
15. Write a programme to plot step response of series RL circuit.
16. Write a programme to find out generate 3-phase line to neutral and line to line voltage.
17. Write a programme to validate the maximum power transfer theorem.
18. Write a programme to find out branch current through superposition theorem.
19. Write a programme to find out transient response in RC circuit.
20. Write a programme to plot voltage and current in single phase AC inductive, and resistive circuit.



Course Code	Course Name	Hours per Week			Total	Total
		L	T	P	Hrs.	Credits
EN3NG02	Universal Human Values and Professional Ethics	2	0	0	2	2

Course Learning Objectives (CLOs):

- CLO₀₁** To help students distinguish between values and skills, and understand the need, basic guidelines, content and process of value education.
- CLO₀₂** To help students initiate a process of dialog within themselves to know what they ‘really want to be’ in their life and profession.
- CLO₀₃** To help students understand the meaning of happiness and prosperity for a human being.
- CLO₀₄** To facilitate the students to understand harmony at all the levels of human living, and live accordingly.
- CLO₀₅** To facilitate the students in applying the understanding of harmony in existence in their profession and lead an ethical life.

UNIT-I

Introduction-Need, Basic Guidelines, Content and Process for Value Education
Understanding the need, basic guidelines, content and process for Value Education, Self-Exploration – what is it ?-its content and process; ‘Natural Acceptance’ and Experiential Validation as the mechanism for self - exploration, Continuous Happiness and Prosperity-A look at basic Human Aspirations, Right understanding, Relationship and Physical Facilities-the basic requirements for fulfilment of aspirations of every human being with their correct priority, Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario, Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

UNIT-II

Understanding Harmony in the Human Being-Harmony in Myself Understanding human being as a co-existence of the sentient ‘I’ and the material ‘Body’, Understanding the needs of Self (‘I’) and ‘Body’- Sukhand Suvridha, Understanding the Body as an instrument of ‘I’(I being the doer, seer and enjoyer), Understanding the characteristics and activities of ‘I’ and harmony in ‘I’, Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail, Programs to ensure Sanyam and Swasthya.

UNIT-III

Understanding Harmony in the Family and Society-Harmony in Human-

Human Relationship Understanding harmony in the Family- the basic unit of human interaction, Understanding values in human -human relationship ;meaning of Nyayaand

program for its fulfilment to ensure Ubhayatripti; Trust (Vishwas) and Respect (Samman) as the foundational values of relationship, Understanding them meaning of Vishwas; Difference between intention and competence, Understanding the meaning of Samman ,Difference between respect and differentiation ;the other salient value in relationship, Understanding the harmony in the society(society being an extension of family):Samadhan, Samridhi, Abhay, Sah-astitvaas comprehensive Human Goals, Visualizing a universal harmonious order in society-Undivided Society (AkhandSamaj), Universal Order (SarvabhaumVyavastha)-from family to world family!.

UNIT- IV

Understanding Harmony in the Nature and Existence-Whole existence as Co-existence Understanding the harmony in the Nature, Inter connectedness and mutual fulfilment among the four orders of nature –recyclability and self-regulation in nature, Understanding Existence as Coexistence (Sah-astitva) of mutually interacting units in all-pervasive space, Holistic perception of harmony at all levels of existence.

UNIT-V

Implications of the above Holistic Understanding of Harmony on Professional Ethics

Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in Professional Ethics: a) Ability to utilize the professional competence for augmenting universal human order, b) Ability to identify the scope and characteristics of people- friendly and eco-friendly production systems, technologies and management models, Case studies of typical

Holistic technologies, management model sand production systems, Strategy for transition from the present state to Universal Human Order:

- a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers,
- b) At the level of society :as mutually enriching institutions and organizations.

Text Books:

1. R R Gaur, R Sangal, G P Bagaria, 2009, A Foundation Course in Human Values and Professional Ethics.

References:

1. IvanIllich,1974, Energy & Equity, The Trinity Press, Worcester, and Harper Collins, USA
2. E.F. Schumacher,1973, Smallis Beautiful: a sudy of economics as if people mattered, Blond & Briggs, Britain.
3. SussanGeorge, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991
4. Donella H . Meadows, DennisL. Meadows,JorgenRanders, WilliamW. BehrensIII, 1972, Limits to Growth–Club of Rome’s report, UniverseBooks.

5. ANagraj, 1998, Jeevan Vidya Ek Parichay, Divya Path Sansthan, Amarkantak.
6. PLDhar, RRGaur, 1990, Science and Humanism, Commonwealth Publishers.
7. A NTripathy, 2003, Human Values, New Age International Publishers. SubhasPalekar, 2000, How to practice Natural Farming, Pracheen(Vaidik) Krishi Tantra Shodh, Amravati.
8. EGSeebauer&RobertL.Berry, 2000, Fundamentals of Ethics for Scientists & Engineers , Oxford University Press
9. M Govindrajan, SNatrajan & V.S.Senthil Kumar ,Engineering Ethics (including Hu Man Values), Eastern Economy Edition, Prentice Hall of India Ltd.
10. BP Banerjee, 2005, Foundations of Ethics and Management, Excel Books.
11. BLBajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.

Course Outcomes (COs):

After completion of this course the students shall be able to:

- CO01** Understand the significance of value inputs in a classroom, distinguish between values and skills, understand the need, basic guidelines, content and process of value education, explore the meaning of happiness and prosperity and do a correct appraisal of the current scenario in the society
- CO02** Distinguish between the Self and the Body, understand the meaning of Harmony in the Self the Co-existence of Self and Body.
- CO03** Understand the value of harmonious relationship based on trust, respect and other naturally acceptable feelings in human-human relationships and explore their role in ensuring a harmonious society.
- CO04** Understand the harmony in nature and existence, and work out their mutually fulfilling participation in the nature.
- CO05** Distinguish between ethical and unethical practices, and start working out the strategy to actualize a harmonious environment wherever they work.



Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
EN3HS04	Fundamentals of Management, Economics and Accountancy	3	0	0	3

Course Learning Objectives (CLOs):

- CLO01** To inculcate management skills and concepts to the students. Understanding management and administration decision making under risk certainty, uncertainty and risk. Acquiring the skills and techniques required to implement energy management.
- CLO02** To inculcate the spirit and perspective of Fundamental of marketing and Introduction in changing era of role of HR in india ,at global level and its impact on human resource.
- CLO03** To Learn fundamentals of economic at micro and macro level. Price elasticity of demand in flasher a market struggle an phases of business cycle.
- CLO04** To basic accounting principles. Meaning types of cost. Trading ,profit and loss account, cost sheet reparation technique break even analysis.Energy Auditors.
- CLO05** To Learn about the concept of financial management. Profit maximization and wealth maximization . Investment decision , Financial decision and dividend policy decisions.

Unit I: Concepts of Management

Definition, characteristics and importance of management; Management: Science or Art, Difference between Management and Administration, Levels of management, Functions of Management, Managerial Roles, Managerial skills and competencies; Decision Making: Definition, process and types; Decision making under certainty, uncertainty and risk; Cross cultural issues in management and challenges.

Unit II: Fundamentals of Marketing and Human Resource Management

Introduction to Marketing: Definition, importance, function and scope of marketing, Core concepts of marketing, Marketing concepts and orientations, Marketing environment, Marketing-mix, Holistic marketing concept, Customer Relationship Management (CRM).

Introduction to Human Resource Management (HRM): Nature, Scope, Objectives and Functions; Role of HR manager, Process and need for Human Resource Planning, Human resource policies, Changing role of Human Resource in India, Globalization and its impact on Human Resource.

Unit III: Fundamentals of Economics

Introduction to Economics: Definition, nature, scope and significance; Difference between micro and macro economics; Time value of money, Law of diminishing marginal utility; Theory of Demand and Supply, Price elasticity of demand; Meaning and types of costs, Law of variable proportions; Types of market structure; National income and related aggregates; Meaning and types of Inflation; Meaning and phases of business cycle.

Unit IV: Basic Accounting Principles

Accounting Principles and Procedure, Double entry system, Journal, Ledger, Trail Balance, Cash Book; Preparation of Trading, Profit and Loss Account; Balance sheet; Cost Accounting:

Introduction, Classification of costs, Methods and Techniques of costing, Cost sheet and preparation of cost sheet; Breakeven Analysis: Meaning and its application.

Unit V: Fundamentals of Financial Management

Introduction of Business Finance: Meaning, Definition of Financial Management, Goals of Financial Management (Profit Maximization and Wealth Maximization), Modern approaches to Financial Management – (Investment Decision, Financing Decision and Dividend Policy Decisions).

Text Books

1. R. D. Agarwal, “Organization and Management”, McGraw Hill Education.
2. P. C. Tripathy and P. N. Reddy, “Fundamentals of Management, Economics and Accountancy”, Tata McGraw Hill
3. Kotler Philip and Keller Kevin Lane, “Marketing Management”, Pearson

Reference Books

1. Peter F Drucker, “The Practice of Management”, McGraw Hill
2. Harold Koontz, “Essentials for Management”, Tata McGraw Hill
3. M Y Khan and P K Jain, “Management Accounting”, Tata McGraw Hill

Course Outcomes (COs):

After completion of this course the students shall be able to:

- CO₀₁** The student will be able to understand concept of administration and management. Managerial role cross cultural issues and conflict resolution
- CO₀₂** Student will be able to understand concept and fundamentals of marketing and human resource management and customer relationship management.
- CO₀₃** Students will be familiarized with fundamentals of economic, Demand and supply meaning and phases of business cycle.
- CO₀₄** Students will understand accounting and financial principle and their application in business.
- CO₀₅** Students will understand time value of money price elasticity of demand types of inflation.



SEMESTER IV

Sr. No.	Course Code	Courses	L	T	P	Credit
1	EE3CO29	Electromagnetic Theory	3	0	0	3
2	EE3CO31	Digital Electronics	3	0	0	3
3	EE3CO32	Analog and Digital Electronics Lab	0	0	2	1
4	EE3CO33	Electrical Measurement and Instrumentation	3	0	0	3
5	EE3CO37	Electrical Machines II	3	0	0	3
6	EE3CO38	Electrical Machines Lab	0	0	2	1
7	EE3CO39	Power System I	3	0	0	3
8	EE3CO42	Power Electronics	3	0	2	4
9	EE3ES01	Python Programming	0	0	2	1
10	EE3PC04	Mini Project I	0	0	4	2
		Total	18	0	12	24
		Total Contact Hours	30			



Course Code	Course Name	Hours Per Week			
		L	T	P	Credits
EE3CO29	Electromagnetic Theory	3	0	0	3

Course Learning Objectives (CLOs):

- CLO₀₁** Impart a basic knowledge of Co-ordinate systems in scalar and vectors form.
- CLO₀₂** Provide working knowledge for the analysis of different charge distributions, electric flux density and its applications in electrostatic field.
- CLO₀₃** Develop skill to understand magnetostatics field and its applications. Understanding self-inductance and mutual inductance.
- CLO₀₄** Relate the working of electrostatic and magnetostatics field. Understanding how to solve wave equation for time varying fields.
- CLO₀₅** Emphasize the effects of polarization, reflection of uniform plane waves, standing wave ratio, Brewster angle, total internal reflection, transmission line analogy.

Unit-I

Co-ordinate Geometry and Vector Calculus-Co-ordinate systems and co-ordinate geometry, line, surface and volume integrals, curl, divergence and gradient, divergence theorem and stokes' theorem, Laplacian for scalar and vectors, vector identities.

Unit-II

Electrostatics- Coulomb's law, field due to different charge distributions, electric flux density, dielectric constant, gauss's law and its applications, potential difference, potential field of a point charge and different charge distributions, potential gradient, dipole, capacitance between two isolated conductors, boundary conditions between two media, energy density in electrostatic field, Poisson's and Laplace equation, solution of Laplace equation, ohm's law and continuity of current.

Unit-III

Magnetostatics- Biot-savart's law, magnetic field intensity, magnetic flux density, permeability, ampere's circuital law, applications of ampere's law, solenoid and toroid, point form of ampere's circuital law, vector magnetic potential, magnetization, magnetic boundary conditions, magnetic circuit, self-inductance and mutual inductance.

Unit-IV

Time varying fields and Maxwell's equations- Lorentz force equation, force on a moving charge, faraday's law, displacement current, modified ampere's law, Maxwell's equations in point and integral forms for time varying fields, Maxwell's equation for time harmonic field, wave equations in source free region, solution to wave equation, intrinsic impedance, poynting theorem, complex poynting vector. plane waves in lossy medium, low loss dielectric, good conducting and ionized media, complex permittivity, skin depth.



Unit-V

Polarization and uniform plane waves- Linear, circular and elliptic polarization, reflection of uniform plane waves, plane waves at normal and oblique incidence, standing wave ratio, Brewster angle, total internal reflection, transmission line analogy.

Text Books:

1. Matthew Sadiku, Elements of Electromagnetics, Oxford University Press.
2. E.C. Jordan & K.G. Balmain: Electromagnetic wave and Radiating System, PHI.
3. S.P. Seth, Elements of Electromagnetic Fields, Dhanpat Rai Publication

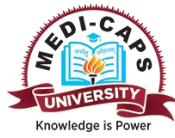
Reference Books:

1. William H. Hayt, Engineering Electromagnetic, TMH
2. John D. Kraus, Electromagnetics, Mc. Graw Hill.
3. Joseph Edminister, Electromagnetics -Schaum's Outline Series, TMH

Course Outcomes (COs):

After completion of this course the students shall be able to:

- CO₀₁** To Understand Basic terms and parameters of Co-ordinate systems in scalar and vectors form and how to use them in different fields of Electrical Engineering.
- CO₀₂** To predict the behaviour of any electrical field effects and its application.
- CO₀₃** Have knowledge of magnetic field and its applications in electrical field. Able to understand basics concepts of self-inductance and mutual inductance.
- CO₀₄** To understand behaviour of any electrical and magnetic field effects in a combined form and able to solve wave equation for time varying fields.
- CO₀₅** To be able to analyze polarization reflection and transmission line analogy.



Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
EE3CO31	Digital Electronics	3	0	0	3

Course Learning Objectives (CLOs):

- CLO₀₁** The objective of this course is to provide the fundamental concepts associated with the digital logic and circuit design.
- CLO₀₂** To introduce the basic concepts and laws involved in the Boolean algebra and logic families and digital circuits.
- CLO₀₃** To familiarize with the different number systems, logic gates, and combinational and sequential circuits utilized in the different digital circuits and systems.
- CLO₀₄** The course will help in design and analysis of the digital circuit and system.
- CLO₀₅** To understand concept of Programmable Devices, PLA, PAL, logic families.

Unit- I

Number system- Introduction to binary numbers, data representation, binary, octal, hexadecimal number system and their conversion, various coding schemes such as BCD codes, excess-3 code, gray code, hamming code, weighted, non-weighted code, error detection and correction, ASIIC codes Boolean algebra, basic theorems and properties of boolean algebra, Boolean functions, canonical and standard forms, minimization techniques, sum of products and product of sums simplification, Karnaugh's map method.

Unit-II

Logic gates and combinational logic- Digital logic gates such as AND, OR, NAND, NOR, EX OR, EX-NOR. Realization of boolean functions using logic gates. Adders, subtractors, BCD adder, magnitude comparator, decoders and encoders, multiplexers and demultiplexers, code converters. Analysis and design of combinational circuits.

Unit-III

Sequential circuits- Introduction, comparison of sequential and combinational circuits. various types of flip-flops and their conversions, triggering of flip flops, timing issues, setup and hold times, registers, counters, ring, Johnson, asynchronous and synchronous, finite state machines, Moore and mealy.

Unit-IV

Memories- Memories and its classifications, ROM, PLA and PAL. Memories: organisation and construction of RAM, SRAM, DRAM, ROM, PROM, EPROM, EEPROM.

Unit-V

Logic families- Introduction to different logic families and their characteristics, DTL, RTL, TTL, IIL, PMOS, NMOS and CMOS logic families, interfacing between TTL and MOS vice-versa.

Text Book:

1. D Roy Chudhury, Digital Electronics, Vol-I & II, TMH Publication.
2. M. Mano, Digital and Computer Design, Pearson Education.
3. A. Anand Kumar: Digital Circuits, PHI.

Reference Books :

1. Leach and Malvino, Digital Principles and Applications, TMH.
2. Millman and Taub, Pulse, Digital and Switching Waveforms, MGM.
3. Salivahanam and Ari Vahagan: Digital Circuits and Design, Vikas Publishing House.

Course Outcomes (COs):

After completion of this course the students shall be able to:

- CO₀₁** Became familiar with the digital signal, positive and negative logic, Boolean algebra, logic gates, logical variables, the truth table, number systems, codes, and their conversion from to others.
- CO₀₂** Learn the minimization techniques to simply the hardware requirements of digital circuits, implement it, design and apply for real time digital systems.
- CO₀₃** Understand the working mechanism and design guidelines of different combinational, sequential circuits and their role in the digital system design.
- CO₀₄** Became able to know various types of components-ADC and DAC, memory elements and the timing circuits to generate different waveforms, and also the different logic families involved in the digital system.
- CO₀₅** The ability to identify and prevent various hazards and timing problems in a digital design and develop skill to build, and troubleshoot digital circuits.



Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
EE3CO32	Analog & Digital Electronics Lab	0	0	2	1

1. To determine input and output characteristics of BJT in CE, CB & CC configurations.
2. To realize a single stage BJT amplifier in CE configuration.
3. To realize inverting and noninverting amplifier using Op-Amp.
4. To realize adder, subtracter, integrator and differentiator circuits using Op-Amp.
5. To realize multiplier and divider circuits using Op-Amp.
6. To design first and second order low pass filter with a given cut off frequency using Op-Amp.
7. Implementation of AND, OR, NOT, XOR and XNOR gates using universal gates.
8. To verify Binary addition by half adder and full adder.
9. To verify Binary subtraction by half subtractor and full subtractor circuit.
10. To design of BCD to excess-3 code converter.
11. Verification of Demorgans' theorem.
12. To Study RS, JK, T and D flip flops.
13. Realization of 4 bit binary counter.
14. Realization of 4-bit shift register.
15. Analog to digital and digital to analog signal conversion.

Text Book:

1. D Roy Chudhury, Digital Electronics, Vol-I & II, TMH Publication.
2. M. Mano, Digital and Computer Design, Pearson Education.
3. A. Anand Kumar: Digital Circuits, PHI.

Reference Books :

1. Leach and Malvino, Digital Principles and Applications, TMH.
2. Millman and Taub, Pulse, Digital and Switching Waveforms, MGM.
3. Salivahanam and Ari Vahagan: Digital Circuits and Design, Vikas Publishing House.



Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
EE3CO33	Electrical Measurement and Instrumentation	3	0	0	3

Course Learning Objectives (CLOs):

- CLO₀₁** Objective is to give knowledge of different types of errors, measuring instruments and application of measurement.
- CLO₀₂** Objective is to understand working fundamental of all electrical and electronics measuring instruments.
- CLO₀₃** Objective behind this course is to build ability of applying concept of measurement in calibration and error calculation followed by solving mathematical equation behind measurement concept.
- CLO₀₄** Objective is to analyse output obtained from measuring instrument and modelled according to desired output for minimizing the errors.
- CLO₀₅** Objective is to evaluate mathematical modelling behind the measuring instrument and also able to review concept for measurement after proper justification of data.

Unit-I

Fundamentals of measurement system: static and dynamic characteristics of measurement systems: measurement error, loading effects due to shunt connected and series connected instruments, testing & calibration of instruments. theory, principle of operation and construction of galvanometer, classification of analog instruments, their operating principle, operating force, damping, controlling. PMMC, MI, induction type, expression for control & deflection torque, extension of range of instruments using shunt & multiplier.

Unit-II

Power measurement: Power in single phase and three phase ac circuit, electro-dynamometer type of wattmeter: low power factor & UPF wattmeter, measurement of power in three phase circuit by one, two & three wattmeter methods, measurement of reactive power by single wattmeter, single phase and three phase energy meter, ampere hour meter & power factor meter- single phase & three phase, frequency meter.

Unit-III

Instrument transformers: Potential and current transformers, ratio and phase angle errors, measurement of power using CTs & PTs.

Resistance Measurement – Classification of low, medium & high resistance, ohmmeter – series & shunt type, megger & ratio meter. Wheatstone bridge, kelvin's double bridge & loss of charge methods for resistance measurement, earth resistance measurement.

UNIT-IV

AC Bridges: Measurement of inductance, capacitance & Q factor, sources and detectors maxwell's bridge, maxwell's inductance capacitance bridge, hays bridge, Anderson's bridge,

Owen's bridge, de-sauté's bridge, Schering bridge, high voltage Schering bridge, wine's bridge, universal bridge, sources of errors in bridge circuit, Q meter and its applications and measurement methods.

UNIT-V

Oscilloscopes: Components and working of modern oscilloscopes.

Transducers:

Transducers definition and classification, mechanical devices as primary detectors, characteristic & choice of transducers, resistive, inductive and capacitive transducers, strain gauge and gauge factor, thermistor, thermo-couples, LVDT, RVDT, synchro's, piezo - electric transducers, magnet elastic and magneto strictive hall effect transducers, opto-electronic transducers such as photo voltaic, photo conductive, photo diode and photo conductive cells, photo transistors, photo optic transducers.

Text Book:-

1. A.K. Sawhney; 'A course in Electrical & Electronic Measurements & Instrumentation'; Dhanpat Rai & co(p) Ltd .
2. E.W. Golding, 'Electrical Measurements and Measuring Instruments' Sir Isaac Pitman & Sons Ltd.
3. Helfrick & Cooper , "Modern Electronic Instrumentation and Measurement Techniques", PHI Learning Pvt. Ltd.

Reference Books:-

1. G. K. Banerjee, 'Electrical and Electronic Measurements'. PHI Learning Pvt. Ltd.
2. R. B. Northrop, 'Introduction to Instrumentation and Measurement'; CRC Press Taylor & Francis.
3. Vijay Singh, 'Fundamentals of Electrical & Electronic Measurements', New Age International Publishers.

Course Outcomes (COs):

After completion of this course the students shall be able to:

- CO₀₁** To identify *and* define different errors in measurement and measuring instruments.
- CO₀₂** To explain working fundamental of measuring instruments *and* classify the measuring instruments according to construction and application.
- CO₀₃** To calculate errors, calibrate the instruments and able to solve mathematical equation behind measurement concept *and* interpret the *experimental* data.
- CO₀₄** To compare and analyse output obtained from measuring instrument also able to modify the model according to desired output for minimizing the errors.
- CO₀₅** To determine mathematical modelling behind the measuring concept and also able to recommend new concept for measurement after proper justification of data.



Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
EE3CO37	Electrical Machines II	3	0	0	3

Course Learning Objectives (CLOs):

- CLO₀₁ To learn the constructional features of DC machine and methods of excitation of DC generators.
- CLO₀₂ To learn about the working, starting methods, losses and efficiency of DC motor.
- CLO₀₃ To Learn the working, constructional features, excitation, phasor diagram and regulation of synchronous generator.
- CLO₀₄ To Learn the working and constructional features of salient pole machine & to know about the parallel operation of synchronous generators.
- CLO₀₅ To learn about the working, starting methods, losses and efficiency of synchronous motor.

Unit-I

D.C. generator, working principle, construction of DC Machines, armature windings, single- & double-layer winding diagrams, E.M.F. equation, regulation, armature reaction, effect of brush shift, compensating winding, commutation, methods of improving commutation, methods of excitation of DC generators and their characteristics.

Unit-II

D.C. Motor, working principle, characteristics, torque equation, starting of shunt and series motor, starters, speed control methods: field and armature control. Braking: plugging, dynamic and regenerative braking, Testing: Swinburn's test, Hopkinson test, Field test. Estimation of losses and efficiency.

Unit-III

Synchronous generators- constructional features, types of prime movers, excitation system and brushless excitation, poly phase distributive winding, integral slot & fractional slot winding, emf equation, generation of harmonics and their elimination. armature reaction, leakage reactance, synchronous reactance, equivalent circuit of alternator, determination of equivalent circuit parameters, short circuit ratio and its effect on performance, phasor diagrams, synchronous generator under load, effect of excitation variation, regulation curve, regulation by synchronous impedance method, mmf method, Zpf method.

Unit-IV

Salient pole machine, two reaction theory equivalent circuit model and phasor diagram, determination of X_d and X_q by slip test, regulation of salient pole alternator, power angle equation and characteristic. synchronizing alternator with bus-bar, synchronizing power, parallel operation and load sharing operation on infinite bus bar, effect of varying excitation and mechanical torque, effect of synchronizing current, hunting & damper winding, synchroscopes and phase sequence indicator.

Unit-V

Synchronous motor, construction, starting methods of synchronous motor, pull in torque, motor under load power and torque, reluctance torque, effect of excitation effect of armature reaction, power factor adjustment v curves, inverted v curves, synchronous motors as power factor correcting device, synchronous motors as frequency changer, super synchronous motors, efficiency, and losses, single phase synchronous motors, hysteresis motor, stepper motor, BLDC motor.

Text-Books:

1. Vincent Del Toro, "Basic electrical machines", Prentice Hall; Facsimile edition.
2. P S Bhimbra., "Electrical Machines", Khanna Pub.
3. I J Nagrath & D P Kothari, "Electric Machines", Tata McGraw Hill.

Reference Books:

1. A.E. Clayton & N.N. Nancock, "The Performance & design of DC machines", CBS publications & distributors.
2. E. Fitzeral C. Kingsley & S.D. Umans, "Electric Machinery", Tata McGraw Hill.
3. P.S. Bhimbra, "Generalized theory of Electrical Machines", Khanna publishers.

Course Outcomes (COs):

After completion of this course the students shall be able to:

- CO₀₁** Understand the constructional features of DC machine, methods of excitation of DC generators and working, starting and efficiency of DC Motor.
- CO₀₂** Understand constructional features, excitation, phasor diagram of synchronous machine and parallel operation of synchronous generators, working of hysteresis motor, stepper motor and BLDC motor.
- CO₀₃** Apply the knowledge of DC machines to solve complex problems related to DC generator and motor.
- CO₀₄** Apply the knowledge of synchronous machine to solve complex problems related to synchronous generator and motor.
- CO₀₅** Analyze different speed control mechanisms of dc motors, process of synchronization of alternator with grid.



Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
EE3CO38	Electrical Machine Lab	0	0	2	1

List of Experiments

1. To perform OC and SC tests on a 1-phase transformer and determine its equivalent circuit.
2. To perform No-load and block rotor test on a 3-phase IM and determine its equivalent circuit.
3. To perform load test on a 3-phase IM and plot its performance characteristics.
To perform back-to-back (Sumpner's) test on transformer.
4. To perform speed control of three phase induction motor.
5. To plot magnetisation characteristic of a separately excited DC generator
6. To perform load test on DC series and shunt motor
7. To perform Swinburn's test on a DC machine and find out its efficiency under full load condition.
8. To perform OCC and SCC test on an alternator and determine its regulation.
9. To determine regulation of alternator using mmf and zpf methods.
10. To plot V and inverted V curves for a synchronous motor
11. To find X_d and X_q of salient pole synchronous machine by slip test.

Text-Books:

1. M.G. Say, "Performance & design of AC machines", CBS publishers & distributors.
2. P S Bhimbra, "Electrical Machines", Khanna Pub.
3. I J Nagrath & D P Kothari, "Electric Machines", Tata McGraw Hill.

Reference Books:

1. A.E. Clayton & N.N. Nancock, "The Performance & design of DC machines", CBS publications & distributors.
2. E. Fitzeral C. Kingsley & S.D. Umans, "Electric Machinery", Tata McGraw Hill.
3. P.S. Bhimbra, "Generalized theory of Electrical Machines", Khanna publishers.



Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
EE3CO39	Power System-I	3	0	0	3

Course Learning Objectives (CLOs):

- CLO₀₁** To define the various terms related to components of power system, overhead transmission system, insulators and cables.
- CLO₀₂** To classify loads, parameters of transmission system, transmission system, power plants, insulators and cables
- CLO₀₃** To describe about the loads, parameters of transmission system, various transmission system, power plants, insulators and cables
- CLO₀₄** To apply formulae to solve mathematical problems on tariff, energy generated, transmission line and sag, Cables
- CLO₀₅** To compare various conductor configuration, conductor materials, conventional energy sources, cables lines and overhead transmission lines

Unit-I

Economics of Generation: General background, structure and components of power system, load curves, demand factor, diversity factor, coincidence factor, utilization factor, connected load, maximum demand, load factor etc., load duration curve, types of loads, load forecasting, selection of generating unit, interconnection of generating stations, economics of power generation, depreciation, tariff, power factor improvement.

Unit-II

Conventional Energy Sources: comparison, generation of electrical energy, selection of sight, hydroelectric, thermal and nuclear power plants, detailed layout, explanation and comparison of hydroelectric, thermal and nuclear power plants, calculation of total electrical energy generated in hydroelectric and thermal power stations, problems.

Unit-III

Overhead Transmission Lines: Resistance, Inductance and capacitance of transmission line, calculation of inductance and capacitance for 1- ϕ and 3- ϕ , single and double circuit line, concept of GMR and GMD, symmetrical & asymmetrical conductor configuration, effect of ground on capacitance, charging current, transposition of line, composite conductor, bundle conductors.

Unit-IV

Design of Transmission Line: Transmission systems & performance of transmission line, various systems of transmission, effect of system voltage, comparison of conductor materials required for various overhead systems. Short, medium & long transmission line and their representation, nominal T, nominal π , equivalent T and equivalent π network models, ABCD constants for symmetrical & asymmetrical network, mathematical solution to estimate regulation & efficiency of all types of lines. Surge impedance, loading, tuned power lines, power flow through transmission line, circle diagram, method of voltage control.

Unit-V

Insulators and Cables: Insulators, types of insulators, string efficiency, methods of improving string efficiency. Corona effect, mechanical design, length of span and sag- tension calculation for transmission line, wind & ice loading, support of line at two different levels, string chart, sag template, vibration and vibration dampers. Underground cable, comparison of cables and overhead transmission lines, classification of cables, capacitance of single and multi-core cable, heating of cables, thermal resistance of cables.

Text-Books

1. B. R. Gupta, Generation of Electrical Energy, S. Chand Publication.
2. C.L. Wadhwa, Electrical Power System Analysis, New Age International Publishing Co. Ltd.
3. I. J. Nagrath and D. P. Kothari, "Modern Power System Analysis", Tata McGraw Hill

Reference Books:

1. C. A. Gross, Power System analysis, John Wiley.
2. W.D. Stevenson and John J Grainger, Elements of Power System Analysis, McGraw Hill International.
3. Hadi Saadat, "Power System Analysis", TMH Edition.

Course Outcomes (COs):

After completion of this course the students shall be able to:

- CO₀₁** Define terms like load curves, demand factors, GMD, GMR, Surge impedance loading etc.
- CO₀₂** Classify loads, parameters of transmission system, transmission system, power plants, insulators and cables
- CO₀₃** Explain about loads, parameters of transmission system, short, medium & long transmission line, power plants, insulators and cables
- CO₀₄** Apply formulae to solve mathematical problems on tariff, energy generated, transmission line parameters, SIL and sag, string efficiency, single core and multi-core cables etc.
- CO₀₅** Compare symmetrical & asymmetrical conductor configuration, Aluminium & copper conductor materials, conventional energy sources, Overhead transmission system & underground cable system etc.



Subject Code	Subject Name	Hours per Week			Total
		L	T	P	Credits
EE3CO42	Power Electronics	3	0	2	4

Course Learning Objectives (CLOs):

- CLO₀₁** Understand the structure of power electronic devices such as SCR, IGBT, MOSFET and GTO.
- CLO₀₂** Understand, analyze and explain the operation of AC-DC converters for different load conditions.
- CLO₀₃** Specify the performance parameters of various types of inverters, analyze and compare different PWM techniques for their control.
- CLO₀₄** To understand various control strategies in chopper and its configurations.
- CLO₀₅** To understand various AC voltage controller and cycloconverters.

Unit-I

Thyristors and their characteristics: Introduction to Thyristor family, V-I characteristics of silicon- controlled rectifier (SCR), gate turn-off thyristor (GTO), bidirectional diode for alternating current (DIAC) and triode for alternating current (TRIAC). Two transistor analogy. Turn on methods of a thyristor. Thyristor specifications; such as latching current and holding current, critical rate of rise of off-state voltage (dv/dt) and critical rate of rise of on-state current (di/dt) etc. R, RC & UJT triggering circuit for SCR.

Unit-II

Phase controlled rectifier: Principle of phase control, operation and analysis of single phase (Half wave & Full Wave) and multiphase (Three Phase) controlled rectifier circuit with resistive, resistive & inductive load (continuous & non continuous conduction) and RLE loads. Estimation of average load voltage and load current for above rectifier circuits active and reactive power input. Effect of freewheeling diode.

Unit-III

Inverters: Single phase voltage source inverter, forced-commutated thyristor inverter, Three phase bridge inverter – 180° and 120° conduction mode, PWM inverter, CSI, series and parallel inverter.

Unit-IV

Chopper Circuit: Principle of chopper operation, various control strategies in chopper, chopper configuration (Type A, B, C, D, & E), steady state analysis of chopper circuits, current & voltage commutation of chopper circuits. Buck, boost and buck-boost topology.

Unit-V

AC controller and Cycloconverter: Principle of on-off and phase controls of single-phase ac voltage controller with resistive and inductive loads. Three phase ac voltage controllers. Basic principle of operation of cyclo-converter, single phase to single phase cyclo-converter, three phase to single phase and three phase to three phase cyclo-converters, output voltage equation and their applications.



Text-Books:

1. M.H. Rashid, Power Electronics Circuits, Devices and Applications, Pearson Education.
2. P.S. Bhimbhra, Power Electronics, Khanna Pub.
3. Vedam Subramanyam, Power Electronics, New Age International.

Reference Books:-

1. V.R. Moorthy, Power Electronics: Devices, Circuits and Industrial Applications” Oxford University Press.
2. Ned Mohan, T.M.Undeland and W.P.Robbins, “Power Electronics: Converters, Applications and Design”, Wiley India Ltd.
3. M.D. Singh, K.B. Khanchandani, Power Electronics, TMH, Delhi.

List of Open-Source Software/learning website:

1. ocw.mit.edu/courses/electrical.../6-334-power-electronics-spring-2007
2. Courses available through NPTEL - website: <https://nptel.ac.in>

Course Outcomes (COs):

After completion of this course the students shall be able to:

- CO01** Describe the structure, working and protection techniques of power devices.
- CO02** To classify and explain single phase and three phase converters, chopper, inverters and cycloconverters.
- CO03** Demonstrate and solve the problem related to single phase and three phase converters, chopper, inverters and cycloconverters.
- CO04** To examine and design appropriate control techniques and controller for various converters.
- CO05** Analyses, model and simulate various converters such as AC-DC converters, single phase and three phase inverters, multi-level inverters, choppers cycloconverter.

Experiments List-

1. To Plot input /output characteristics of SCR.
2. To Plot V-I characteristics of IGBT & MOSFET.
3. To construct the R, RC &UJT triggering circuit for SCR and plot its output waveforms.
4. To draw wave shape of the electrical signal at input and output points of the half wave, full wave and bridge rectifiers.



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5. Single phase half-controlled converter using R and RL load using MATLAB/Simulink tool.
6. To study the operations and the performance of the three phase fully controlled converter with resistive and inductive load.
7. To study single-phase full-bridge inverter connected to R load using MATLAB/Simulink.
8. To study three-phase full-bridge inverter (180°) connected to R load using MATLAB/Simulink.
9. To construct step up choppers and to draw its output response.
10. To construct step down choppers and to draw its output response.
11. To construct single-phase ac voltage controller with resistive and inductive loads.
12. To study the operation of single phase cycloconverter using MATLAB/Simulink tool.



Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
EE3ES01	Python Programming	0	0	2	1

Unit-I

Introduction to Python: Importance of Python, installing and working with python in windows, the concept of data types - variables, arithmetic operators and expressions, strings: creating and storing strings, basic string operations, accessing characters in string by index number, string slicing and joining, string methods, formatting strings,

Unit-II

Control flow: if statements, for and while loops, nested loops, range function, break and continue statements, pass statements.

Unit-III

Lists: Creating lists, basic list operations, indexing and slicing in lists, built-in functions used on lists, list methods, the del statement.

Unit-IV

Dictionaries: Creating dictionary, accessing, and modifying key, value pairs in dictionaries, built-in functions used on dictionaries, dictionary methods, the del statement.

Tuples and sets: creating tuples, basic tuple operations, indexing and slicing in tuples, built-in functions used on tuples, relation between tuples and lists, relation between tuples and dictionaries

Unit-V

Files: Types of files, creating and reading text data, file methods to read and write data, reading and writing binary files, the pickle module, reading and writing CSV files.

Text-Books

1. Kenneth A. Lambert, The Fundamentals of Python: First Programs, Cengage Learning., 2011.
2. Reema Thareja , Python programming using problem solving approach, Oxford university press.
3. Vamsi Kurama, Python Programming: A Modern Approach, Pearson.

Reference Books:

1. Gowrishankar. S. and Veena A, Introduction to Python Programming, CRC Press.
2. Y. Daniel Liang Introduction to Programming Using Python, Pearson.
3. W. Mark J Guzdial, Introduction to Computing and programming in Python, Pearson India



Practical List

1. Write a program to demonstrate different number data types in python.
2. Write a program to perform different arithmetic operations on numbers in python.
3. Write a program to create, concatenate and print a string and accessing substring from a given string.
4. Write a python script to print the current date in following format “Sunday Dec 30 02:26:23 IST 2022.”
5. Write a python program to create and append lists in python.
6. Write a python program to remove lists in python.
7. Write a program to demonstrate working with tuples in python.
8. Write a program to demonstrate working with dictionaries in python.
9. Write a python program to find largest of three numbers.
10. Write a python program to convert temperature to and from Celsius to Fahrenheit.
11. Write a python program to construct the triangular star pattern using nested for loop.
12. Write a python program to print prim numbers less than 20.
13. Write a python program to find factorial of a number using recursion.
14. Write a python program to that accepts length of three sides of a triangle as inputs. The program should indicate whether or not the triangle is a right-angled triangle (use Pythagoras theorem).
15. Write a python program to define a module to find Fibonacci Numbers and import the module to another program.
16. Write a python program to define a module and import a specific function in that module to another program.
17. Write a script named copyfile.py. This script should prompt the user for the names of two text files. The contents of the first the second file.
18. Write a program that inputs a text file. The program should print all of the unique words in the file in alphabetical order.
19. Write a Python class to convert an integer to a roman numeral.
20. Write a Program to find factorial of the entered number.



Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
EE3PC04	Mini Project I	0	0	4	2

Type of course: Undergraduate

Prerequisite: Basic Knowledge of Electrical & Electronics Engineering.

Rationale: This is a laboratory-oriented course which will provide a platform to students to enhance their practical knowledge and skills by development of small scale electrical or electronics circuits/systems.

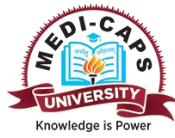
Objectives:

- To develop their own innovative prototype of ideas.
- To train the students in preparing mini project, reports and examination.

The students in a group of maximum 3 works on a topic approved by the head of the department and prepare a comprehensive mini project report after completing the work to the satisfaction. The progress of the project is evaluated based on a minimum of two reviews. The review committee may be constituted by the Head of the Department. A mini project along with report is required at the end of the semester. The mini project work is evaluated based on oral presentation and the mini project report jointly by external and internal examiners constituted by the Head of the Department.

Guidelines:

1. Students should select a problem which addresses some basic home, office or other real life applications.
2. The electrical or electronic circuit for the selected problem should have at least 20 to 25 components.
3. Students should understand testing of various components.
4. Soldering of components should be carried out by students.
5. Students should develop a necessary PCB for the circuit.
6. Students should see that final circuit submitted by them is in working condition.
7. 5-10 pages report to be submitted by students.
8. Group of maximum three students can be permitted to work on a single mini project.
9. The mini project must have hardware part. The software part is optional.
10. Department may arrange demonstration with poster presentation of all mini projects developed by the students at the end of semester.



SEMESTER V

Sr. No.	Course Code	Courses	L	T	P	Credit
1	EE3CO34	Control Systems	3	0	0	3
2	EE3CO35	Electrical Measurement & Control Lab	0	0	2	1
3	EE3CO40	Power System -II	3	0	2	4
4	EE3ES02	Data Analysis using Python	0	0	2	1
5	EE3CO44	Electric Drives	3	0	0	3
6	EE3CO45	Electrical Simulation Lab	0	0	2	1
7	EE3CO41	PLC & Applications Lab	0	0	2	1
8	EE3EL16	Program Elective -I (Digital Signal Processing)	3	0	0	3
9	EE3EI01	Program Elective -II (PLC & Applications)	3	0	0	3
10	EN3NG04	Soft Skills -II	2	0	0	2
11	OE00093	Open Elective -I (Hybrid Electric Vehicles)	3	0	0	3
		Total	20	0	10	25
		Total Contact Hours	30			

Program Elective

EE3EL16 Digital Signal Processing

EE3EI01 PLC & Applications

Open Elective -I

OE00093 Hybrid Electric Vehicles



Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
EE3CO34	Control Systems	3	0	0	3

Course Learning Objectives (CLOs):

CLO 1 To learn the mathematical modeling of physical systems and to use block diagram algebra and signal flow graph to determine overall transfer function

CLO 2 To analyze the time response of first and second order systems and improvement of performance using PI, PD, PID controllers. To investigate the stability of closed loop systems using Routh's stability criterion and root locus method.

CLO 3 To understand basic aspects of design and compensation of LTI systems using Bode diagrams.

CLO 4 To learn Frequency Response approaches for the analysis of LTI systems using Bode plots, polar plots and Nyquist stability criterion.

CLO 5 To learn state space approach for analysis of LTI systems and understand the concepts of controllability and observability.

UNIT - I

Mathematical Modeling of Control Systems

Classification of control systems - open loop and closed loop control systems and their differences - Feedback characteristics - transfer function of linear system, differential equations of electrical networks- translational and rotational mechanical systems - transfer function of Armature voltage controlled DC servo motor - block diagram algebra - signal flow graph – reduction using Mason's gain formula.

UNIT - II

Time Response Analysis and Controllers

Standard test signals – time response of first and second order systems – time domain specifications - steady state errors and error constants - effects of proportional (P) - proportional integral (PI) - proportional derivative (PD) - proportional integral derivative (PID) systems.

Stability Assessment Techniques

The concept of stability – Routh’s stability criterion – limitations of Routh’s stability, root locus concept – construction of root loci (simple problems) - Effect of addition of Poles and Zeros to the transfer function.

UNIT - III

Frequency Response Analysis

Introduction to frequency domain specifications – Bode diagrams – transfer function from the Bode diagram –Polar plots, Nyquist stability criterion- stability analysis using Bode plots (phase margin and gain margin).

UNIT - IV

Classical Control Design Techniques

Lag, lead, lag-lead compensators - physical realisation - design of compensators using Bode plots.

UNIT - V

State Space Analysis of Linear Time Invariant (LTI) Systems

Concepts of state - state variables and state model - state space representation of transfer function - diagonalization using linear transformation - solving the time invariant state equations - State Transition Matrix and its properties- concepts of controllability and observability.

Text Books:

1. Kotsuhiko Ogata, “Modern Control Engineering”, Prentice Hall of India
2. Benjamin C.Kuo, “Automatic control systems”, Prentice Hall of India, 2nd Edition.

Reference Books:

1. M.Gopal, “Control Systems principles and design”, Tata Mc Graw Hill Education Pvt Ltd., 4th Edition.
2. Norman S. Nise, “Control Systems Engineering”, Wiley Publications, 7th edition
3. Manik Dhanesh N, “Control Systems” Cengage publications.
4. I.J.Nagarath and M.Gopal, “Control Systems Engineering” Newage International Publications, 5th Edition.

Course Outcomes (COs):

After the completion of the course the student should be able to:

CO₁ Derive the transfer function of physical systems and determination of overall transfer function using block diagram algebra and signal flow graphs.



CO₂ Determine time response specifications of second order systems and absolute and relative stability of LTI systems using Routh's stability criterion and root locus method.

CO₃ Analyze the stability of LTI systems using frequency response methods.

CO₄ Design Lag, Lead, Lag-Lead compensators to improve system performance using Bode diagrams.

CO₅ Represent physical systems as state models and determine the response. Understand the concepts of controllability and observability.



Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
EE3CO35	Electrical Measurement and Control Lab	0	0	2	1

List of Experiments:

a) Electrical Measurements Experiments:

1. Measurement of medium resistance using Wheatstone's bridge
2. Measurement of high resistance by loss of charge method
3. Measurement of Insulation resistance using Megger
4. Measurement of power in a single-phase ac circuit by 3 voltmeter/ 3 Ammeter method
5. Calibration of a dynamometer type of wattmeter with respect to a standard/Sub Standard wattmeter
6. Calibration of single phase digital/Electronic type energy meter.
7. Calibration of a dynamometer type of wattmeter by Phantom Loading method.
8. Measurement of power of three phase load by using two wattmeter method.
9. Calibration of dynamometer type power factor meter.

b) Control Systems Experiments:

10. To study shaft angle measurement using synchro.
11. To Study operation of DC Servo motor.
12. To study speed & torque measurement of AC servo motor.
13. Steady state error constant for type-0, type-1 & type-2 systems
14. To study working of Magnetic Amplifier.
15. Simulation of transfer function using OPAMP.

Text Books:

1. A.K. Sawhney, "A course in Electrical & Electronic Measurements & Instrumentation", Dhanpat Rai & co (p) Ltd ,New Delhi
2. Rajput R.K., "Electrical Measurements and Measuring Instruments", S. Chand. Publications.
3. Bell David A., "Electronics Instrumentation and Measurements", PHI Learning Pvt. Ltd.
4. M. Gopal, "Control system engineering", McGraw Hill.
5. B.S.Manke, "Control system Engineering", Khanna Publishers.

Reference Books:

1. G. K. Banerjee, "Electrical and Electronic Measurements", PHI Learning Pvt. Ltd.



2. R. B. Northrop, "Introduction to Instrumentation and Measurement", CRC press Taylor & Francis
3. Vijay Singh, "Fundamentals of Electrical & Electronic Measurements", New Age International Publishers.
4. Buckingham & Price, "Electrical Measurements" PHI Learning Pvt. Ltd.
5. B.C. Kuo and FaridGolnaraghi, "Automatic Control Systems", Wiley India.
6. K. Ogata, "Modern Control Engineering", Pearson Education
7. D. Roy, Chaudhary, "Modern Control Systems", PHI Learning Pvt. Ltd.



Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
EE3CO40	Power Systems – II	3	0	2	4

Course Learning Objectives (CLOs):

CLO 1 To form Ybus matrix and to learn the different load flow methods.

CLO 2 To understand optimal dispatch of generation with and without losses.

CLO 3 To learn the Zbus building algorithm and to understand the load frequency control for single area system.

CLO 4 To understand the load frequency control for two area system.

CLO 5 To learn the stability of power systems and methods to improve stability.

UNIT - I

Y bus formation & Per Unit Representation

Formation of Ybus matrix - Per Unit Quantities–Single line diagram – Impedance diagram of a power system – Numerical Problems.

Power Flow Studies

Necessity of power flow studies – Derivation of static power flow equations – Power flow solution using Gauss-Seidel Method – Newton Raphson Method (Rectangular and polar coordinates form) – Decoupled and Fast Decoupled methods – Algorithmic approach – Numerical Problems on 3–bus system only.

UNIT - II

Economic Operation of Power Systems

Optimal operation of Generators in Thermal power stations - – Heat rate curve – Cost Curve – Incremental fuel and Production costs – Input–output characteristics – Optimum generation allocation with line losses neglected – Optimum generation allocation including the effect of transmission line losses – Loss Coefficients – General transmission line loss formula.

UNIT - III

Z bus algorithm

Formation of Zbus: Algorithm for the Modification of Zbus Matrix (without mutual impedance) – Numerical Problems.

Load Frequency Control - I

Modelling of steam turbine – Generator – Mathematical modelling of speed governing system – Transfer function – Necessity of keeping frequency constant. Definitions of Control area – Single area control system – Block diagram representation of an isolated power system – Steady state analysis – Dynamic response – Uncontrolled case.

UNIT - IV

Load Frequency Control-II

Block diagram development of Load Frequency Control of two area system uncontrolled case and controlled case – Tie-line bias control – Load Frequency Control and Economic dispatch control.

UNIT - V

Power System Stability –Steady-state, dynamic and transient stability, swing equation of a synchronous machine connected to an infinite bus, power angle curve, description of the phenomena of loss of synchronism in a single-machine infinite bus system following a disturbance like a three-phase fault, solution of swing equations using step by step methods, equal area criterion, methods of improving stability.

Text Books:

1. A. R. Bergen and V. Vittal, “Power System Analysis”, Pearson Education Inc.
2. C. L. Wadhwa, Electrical Power systems, New age International.
3. D. P. Kothari and I. J. Nagrath, Modern Power System Analysis, McGraw Hill Education

References Books:

1. O. I. Elgerd, “Electric Energy Systems Theory”, McGraw Hill Education.
2. P. Kundur, Power system stability and control, McGraw Hill Inc.
3. J. Grainger and W. D. Stevenson, “Power System Analysis”, McGraw Hill Education.
4. Allen J Wood, Bruce F Wollen Berg, “Power Generation - Operation and Control”, 3rd Edition - Wiley Publication 2014.
5. Power System Analysis and Stability by S.S.Vadhera - Khanna Publications - 4th edition - 2005.
6. Power System Analysis by Hadi Saadat – – Tata McGraw–Hill 3rd edition - 2010.

Course Outcomes (COs):

After the completion of the course the student should be able to:

- CO₁** Apply the load flow solution to a power system using different methods.
CO₂ Compute optimal load scheduling of Generators.

CO₃ Form Zbus for a power system networks and analyze effect of Load Frequency Control for single area system.

CO₄ Analyze effect of Load Frequency Control for two area system.

CO₅ Analyze the stability concepts of a power system.

List of Experiments:

a) Experiments using Power World Simulator:

1. Formation of Y-bus matrix for a 3 bus system.
2. Load flow solution for 3-bus system using Gauss-Seidel load flow method.
3. Load flow solution for 3-bus system using Newton Raphson load flow method
4. Load flow solution for 3-bus system using Fast Decoupled load flow method.
5. Load flow solution for 3-bus system using DC load flow method.
6. Solution of Economic Dispatch problem without and with losses.
7. Contingency analysis of a power system.

b) Experiments using MATLAB / Simulink:

8. Formation for symmetric π configuration for Verification of $AD-BC=1$, Determination of Efficiency and regulation.
9. Formation for symmetric T configuration for Verification of $AD-BC=1$, Determination of Efficiency and regulation.
10. Assessment of transient stability of a single machine system.
11. Design of Single Area Load Frequency Controller using MATLAB/SIMULINK
12. Design of Two Area Load Frequency Control using MATLAB/SIMULINK
13. Simulation of Ferranti effect by MATLAB/SIMULINK



Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
EE3ES02	Data Analysis Using Python	0	0	2	1

Unit - I

Python Fundamentals for Data Analysis: Python data structures, Control statements, Functions, Exception handling, Implementation of user-defined Modules and Package. File handling in python.

Unit - II

Introduction to Data Understanding and Preprocessing: Knowledge domains of Data Analysis, understanding structured and unstructured data, Data Analysis process, Dataset generation, Importing Dataset: Importing and Exporting Data, Basic Insights from Datasets, Cleaning and Preparing the Data: Identify and Handle Missing Values.

Unit - III

Data Analysis using NumPy: Array Creation, Printing Arrays, Basic Operation - Indexing, Slicing, and Iterating, Shape Manipulation - Changing shape, stacking, and splitting of array. Vector stacking, NumPy for Statistical Operation.

Unit - IV

Data Analysis using Pandas: Introduction to Pandas, Importing data into Python. Pandas Data Frames, Indexing Data Frames, Basic Operations with Data frame, Renaming Columns, Concatenation, Merge, Groupby, Handling missing values in Data frame.

Unit - V

Data Visualization using Seaborn and Matplotlib: Data Formatting, Exploratory Data Analysis. Bar-graph, pie-chart, scatter plot, box plot, swarm plot. Univariate, bivariate and covariate analysis in Seaborn and Matplotlib.

Text Books:

1. Kenneth A. Lambert, The Fundamentals of Python: First Programs, Cengage Learning., 2011.
2. Reema Thareja, Python programming using problem solving approach, Oxford university press.
3. Wes Mckinney, "Python for Data Analysis" First edition, Publisher O'Reilly Media.

Reference Books:

1. David Taieb, Data Analysis with Python: A Modern Approach.1st Edition, Packt Publishing.
2. Allen Downey, Jeffrey Elkner, Chris Meyers: Learning with Python, Dreamtech Press.
3. Mark J. Guzdial, Introduction to Computing and programming in Python, Pearson India.

List of Experiments:

1. Write a program for execution of break control statement in Python.
2. Write a program for execution of continue control statement in Python.
3. Write a program to demonstrate exceptional handling in Python.
4. Write a program to implement a function for addition subtraction and multiplication of numbers with and without return statement.
5. Write a program to demonstrate user defined module in Python.
6. Write a program to demonstrate read, write, and append mode for file handling in python.
7. Write a python program to create a NumPy array from list and tuples.
8. Write a python program to create a NumPy array by arrange and linspace function.
9. Write a program to perform basic arithmetic operation between two arrays.
10. Write a python program to demonstrate indexing and slicing function in n-dimensional array.
11. Write a python program to create a dataframe by list, dictionary, and tuples.
12. Write a python program to import dataset using csv, excel file.
13. Write a python program to demonstrate tail, head, describe and info functions for a dataframe.
14. Write a python program to demonstrate slicing and indexing using loc and iloc functions for a dataframe.
15. Write a python program to concatenate two dataframe row wise and column wise.
16. Write a python program to merge two dataframe by inner join, outer join, right join and left join.
17. Write a python program to demonstrate group-by and aggregate function for a dataframe.
18. Write a python program to demonstrate univariate analysis by Seaborn and Matplotlib plotting functions.
19. Write a python program to demonstrate bivariate analysis by Seaborn and Matplotlib plotting functions.
20. Write a program to visualize outliers by boxplot.



Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
EE3CO44	Electric Drives	3	0	0	3

Course Learning Objectives (CLOs):

CLO 1 To learn the fundamentals of electric drive and different electric braking methods.

CLO 2 To analyze the operation of three phase converter controlled dc motors and four quadrant operation of dc motors using dual converters.

CLO 3 To discuss the DC-DC converter control of dc motors.

CLO 4 To understand the concept of speed control of induction motor by using AC voltage controllers, voltage source inverters and slip power recovery scheme.

CLO 5 To learn the speed control mechanism of synchronous motors

UNIT - I

Fundamentals of Electric Drives

Electric drive and its components– Fundamental torque equation – Load torque components – Nature and classification of load torques – Steady state stability – Load equalization– Four quadrant operation of drive (hoist control) – Braking methods: Dynamic – Plugging – Regenerative methods.

UNIT - II

Controlled Converter Fed DC Motor Drives

3-phase half and fully-controlled converter fed separately and self-excited DC motor drive – Output voltage and current waveforms – Speed-torque expressions – Speed-torque characteristics – Dual converter fed DC motor drives -Numerical problems.

UNIT - III

DC–DC Converters Fed DC Motor Drives

Single quadrant, two quadrant and four quadrant DC-DC converter fed separately excited and self-excited DC motors – Continuous current mode of operation - Output voltage and current waveforms – Speed–torque expressions and characteristics – Closed loop operation (qualitative treatment only).

UNIT - IV

Stator and Rotor side control of 3-phase Induction motor Drive

Stator voltage control using 3-phase AC voltage regulators – Waveforms –Speed torque characteristics– Variable Voltage Variable Frequency control of induction motor by PWM voltage source inverter – Closed loop V/f control of induction motor drives (qualitative treatment only). Static rotor resistance control – Slip power recovery schemes – Static Scherbius drive – Static Kramer drive – Performance and speed torque characteristics.

UNIT - V

Control of Synchronous Motor Drives

Separate control of synchronous motor – self-control of synchronous motor employing load commutated thyristor inverter - closed loop control of synchronous motor drive (qualitative treatment only)– PMSM (Basic operation only).

Text Books:

1. Fundamentals of Electric Drives – by G K Dubey - Narosa Publications - 2nd edition – 2002.
2. Power Semiconductor Drives - by S.B.Dewan - G.R.Slemon - A.Straughen - Wiley India - 1984.

Reference Books:

1. Electric Motors and Drives Fundamentals - Types and Applications - by Austin Hughes and Bill Drury - Newnes.4th edition - 2013.
2. Thyristor Control of Electric drives – Vedam Subramanyam Tata McGraw Hill Publications - 1987.
3. Power Electronic Circuits - Devices and applications by M.H.Rashid - PHI - 3rd edition - 2009.

Course Outcomes (COs):

After the completion of the course the student should be able to:

CO₁ Explain the fundamentals of electric drive and different electric braking methods.

CO₂ Analyze the operation of three-phase converter fed dc motors and four quadrant operations of dc motors using dual converters.

CO₃ Describe the DC-DC converter fed control of dc motors in various quadrants of operation

CO₄ Know the concept of speed control of induction motor by using AC voltage controllers and voltage source inverters and differentiate the stator side control and rotor side control

CO₅ Learn the concepts of speed control of synchronous motor with different methods.



Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
EE3CO45	Electrical Simulation Lab	0	0	2	1

List of Experiments:

1. Verification of Milliman's theorem using MATLAB/ SIMULINK
2. Verification of Maximum Power Transfer theorem using MATLAB/ SIMULINK
3. Verification of series resonance using MATLAB/ SIMULINK
4. Verification of parallel resonance using MATLAB/ SIMULINK
5. To study the transient analysis of RLC, RL and RC circuits for sinusoidal and step inputs using MATLAB
6. To find the i) Time response for step input ii) Frequency response for sinusoidal input of a second order control system using MATLAB
7. To obtain the root locus of the system using MATLAB
8. To obtain the bode plot and to calculate the phase margin, gain margin, phase cross over and gain cross over frequency for the systems whose open loop transfer function is given using MATLAB
9. To obtain the Nyquist plot and to calculate the phase margin, gain margin, phase cross over and gain cross over frequency for the systems whose open loop transfer function is given using MATLAB
10. Simulation of single phase full control rectifier with R-L-E load using MATLAB/ SIMULINK
11. Simulation & analysis of three-phase semi-converter with R and R-L load using MATLAB/ SIMULINK
12. Generation of gate pulses of 3-phase inverter using sinusoidal PWM technique using MATLAB/ SIMULINK
13. Simulation of full wave power diode rectifier with L-C filters using MATLAB/ SIMULINK



14. Mathematical modeling of photovoltaic cell using MATLAB/ SIMULINK

15. Mathematical modeling of wind turbine using MATLAB/ SIMULINK

Text Books:

1. Rudra Pratap, Getting Started with MATLAB - A Quick introduction for Scientists & Engineers, Oxford Univ. Press

2. S. Jain, Modelling and Simulation Using Matlab-Simulink, Willey India

Reference Books:

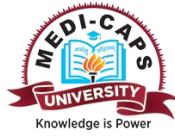
1. Averill Law, Simulation Modeling and Analysis, McGraw Hill Education



Course Code	Course Name	Hours per Week			Total Credits
		L	T	P	
EE3CO41	PLC & Applications Lab	0	0	2	1

List of Experiments:

1. Introduction to PLC hardware and software.
2. To Study various building blocks of PLC.
3. Creating and simulating simple ladder logic programs.
4. To study about the logic gates operations using delta PLC via ISPsoft Software.
5. To study about the Timer operation using delta PLC via ISPsoft Software.
6. To Implementation of On-Delay Timer using delta PLC via ISPsoft Software.
7. To Implementation of Off-Delay Timer using delta PLC via ISPsoft Software.
8. To study about the Counter operation using delta PLC via ISPsoft Software.
9. To Implementation of Up-Down Counter using delta PLC via ISPsoft Software.
10. Execute Ladder diagrams for Stair case lighting.
11. To Implementation of PLC Arithmetic Instructions.
12. To Implementation of PID Controller.
13. To study the simple Traffic Light system by using PLC.
14. To study the Water Level controller by using PLC.
15. To study the operation of PLC based direct on-line starter.
16. To study the operation of PLC based direct Star-Delta starter.
17. To Control the speed of the DC motor using PLC.
18. To study the Variable frequency drive based 3 ϕ induction motor operation by using Keypad.
19. To study the Variable frequency drive based 3 ϕ induction motor operation by using Jog mode.
20. To study the Variable frequency drive based 3 ϕ induction motor operation by using Pot meter (0-10) V.
21. To study the Variable frequency drive based 3 ϕ induction motor operation by using PLC.
22. To study the functions and control of Bottle filling system using PLC.



Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
EE3EL16	Digital Signal Processing	3	0	0	3

□

Course Learning Objectives (CLOs):

CLO 1 To explore the basic concepts of digital signal processing.

CLO 2 To connect the time domain signal to frequency domain signals using fourier transform.

CLO 3 To understand the basic structures of IRR systems.

CLO 4 To understand and design FIR Digital filters.

CLO 5 To explore the concepts of multiple sampling rates for DSP.

UNIT - I

Introduction

Introduction to Digital Signal Processing: Discrete time signals & sequences - Classification of Discrete time systems - stability of LTI systems - Invertability - Response of LTI systems to arbitrary inputs. Solution of Linear constant coefficient difference equations. Frequency domain representation of discrete time signals and systems. Review of Z-transforms - solution of difference equations using Z-transforms - System function.

UNIT - II

Discrete Fourier Transforms and FFT Algorithms

Discrete Fourier Series representation of periodic sequences -Properties of Discrete Fourier Series - Discrete Fourier transforms: Properties of DFT - linear filtering methods based on DFT - Fast Fourier transforms (FFT) - Radix-2 decimation in time and decimation in frequency FFT Algorithms - Inverse FFT.

UNIT - III

Design and Realizations of IIR Digital Filters

Analog filter approximations – Butter worth and Chebyshev - Design of IIR Digital filters from analog filters - Design Examples. Analog and Digital frequency transformations.

Basic structures of IIR systems – Direct-Form Structures - Transposed Structures - Cascade-Form Structures - Parallel-Form Structures Lattice and Lattice-Ladder Structures.

UNIT - IV

Design and Realizations of FIR Digital Filters

Characteristics of FIR Filters with Linear Phase - Frequency Response of Linear Phase FIR Filters - Design of FIR Digital Filters using Window Techniques and Frequency Sampling technique - Comparison of IIR & FIR filters.

Basic structures of FIR systems – Direct-Form Structure - Cascade-Form Structures Linear Phase Realizations - Lattice structures.

UNIT - V

Multirate Digital Signal Processing

Introduction-Decimation –Interpolation-Sampling Rate Conversion by a Rational Factor-Implementation of sampling rate converters-Applications of Multirate Signal Processing-Digital Filter Banks.

Text Books:

1. Digital Signal Processing - Principles - Algorithms - and Applications: John G. Proakis - Dimitris G.Manolakis - 4th Edition - Pearson Education / PHI - 2007.
2. Discrete Time Signal Processing – A.V.Oppenheim and R.W. Schaffer - PHI.
3. Digital Signal Processing: A Computer based approach. Sanjit K Mitra - 4th Edition - TMH - 2014.

Reference Books:

1. Digital Signal Processing: Andreas Antoniou - TATA McGraw Hill - 2006
2. Digital Signal Processing: MH Hayes - Schaum's Outlines - TATA Mc-Graw Hill - 2007.
3. DSP Primer - C. Britton Rorabaugh - Tata McGraw Hill - 2005.
4. Fundamentals of Digital Signal Processing using Matlab – Robert J. Schilling - Sandra L.Harris - Thomson - 2007.
5. Digital Signal Processing – Alan V. Oppenheim - Ronald W. Schafer - PHI Ed. - 2006.
6. Digital Signal Processing – K Raja Rajeswari - 1st edition - I.K. International Publishing - House - 2014.

Course Outcomes (COs):

After the completion of the course the student should be able to:



CO₁ Know the concepts of Digital signal processing - frequency domain representation & z-transform.

CO₂ Compute discrete Fourier transform and fast fourier transforms for different sequences.

CO₃ Design IIR filters through analog filter approximation and basic structure of IIR filters.

CO₄ Design FIR filters with window techniques and basic structure of FIR filters.

CO₅ Learn the concepts of Multirate Signal Processing. .



Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
EE3EI01	PLC & Applications	3	0	0	3

Course Learning Objectives:

CLO 1 To understand the various components of PLC systems and ladder diagrams.

CLO 2 To know the programming instructions and registers in the PLC.

CLO 3 To understand the use and applications of timer and counter functions.

CLO 4 To familiar the data handling function and this application.

CLO 5 To understand and implementation of analog operations and PID modules.

UNIT – I

Introduction to PLC systems

I/O modules and interfacing - CPU processor - programming Equipment - programming formats - construction of PLC ladder diagrams - Devices connected to I/O Modules. Digital logic gates - programming in the Boolean algebra system - conversion examples Ladder Diagrams for process control: Ladder diagrams & sequence listings - ladder diagram construction and flowchart for spray process system.

UNIT – II

PLC Programming: Input instructions - outputs - operational procedures - programming examples using contacts and coils. Drill press operation.

PLC Registers: Characteristics of Registers - module addressing - holding registers - Input Registers - Output Registers.

UNIT – III

PLC Functions: Timer functions & Industrial applications - counters - counter function industrial applications - Arithmetic functions - Number comparison functions - number conversion functions.

UNIT – IV

Data Handling functions: SKIP - Master control Relay - Jump - Move - FIFO - FAL - ONS - CLR & Sweep functions and their applications. Bit Pattern and changing a bit shift register - sequence functions and applications - controlling of two-axis & three axis Robots with PLC - Matrix functions.

UNIT – V

Analog PLC operation: Analog modules & systems - Analog signal processing - Multi bit Data Processing - Analog output Application Examples - PID principles - position indicator with PID control - PID Modules - PID tuning - PID functions.

Text Books:

1. “Programmable Logic Controllers- Principles and Applications” by John W. Webb & Ronald A. Reiss - Fifth Edition - PHI
2. “Programmable Logic Controllers- Programming Method and Applications” by JR.Hackworth & F.D Hackworth Jr. –Pearson - 2004

Reference Books:

1. “Introduction to Programmable Logic Controllers” by Gary A. Dunning - 3rd edition - Cengage Learning - 2005.
2. “Programmable Logic Controllers” by W.Bolton - 5th Edition - Elsevier publisher - 2009.
3. “Advanced Industrial Automation (PLC programming in simplest way with 110 solved examples)” by Himanshu Kumar, 1st Edition, Notion Press.
4. “PLCs & SCADA - Theory and Practice” by Rajesh Mehra, Vikrant Vij, 1st Edition, Laxmi Publications Pvt Ltd

Course Outcomes (Cos):

After the completion of the course the student should be able to:

CO₁ Illustrate I/O modules of PLC systems and ladder diagrams

CO₂ Demonstrate various types of registers and programming instructions.

CO₃ Examine various types of PLC functions and its applications.

CO₄ Assess different data handling functions and its applications.

CO₅ Describe the analog operations and PID modules.



Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
OE00093	Hybrid Electric Vehicles	3	0	0	3

Course Learning Objectives (CLOs):

CLO 1 To familiarize the students with the need and advantages of electric and hybrid electric vehicles.

CLO 2 To know various architectures of hybrid electric vehicles.

CLO 3 To understand the power management of plug in electric vehicles.

CLO 4 To study and understand different power converters used in electrical vehicles.

CLO 5 To familiarize with different batteries and other storage systems.

UNIT - I

Introduction

Fundamentals of vehicle - components of conventional vehicle and propulsion load; Drive cycles and drive terrain; Concept of electric vehicle and hybrid electric vehicle; History of hybrid vehicles - advantages and applications of Electric and Hybrid Electric Vehicles.

UNIT - II

Hybridization of Automobile

Architectures of HEVs - series and parallel HEVs - complex HEVs. Plug-in hybrid vehicle(PHEV) - constituents of PHEV - comparison of HEV and PHEV; Extended range hybrid electric vehicles(EREVs) - blended PHEVs - Fuel Cell vehicles and its constituents.

UNIT - III

Special Machines for EV and HEVs

Characteristics of traction drive - requirement of electric motors for EV/HEVs. Induction Motor drives - their control and applications in EV/HEVs. Permanent magnet Synchronous motor: configuration - control and applications in EV/HEVs. Brushless DC Motors: Advantages - control of application in EV/HEVs. Switch reluctance motors: Merits limitations - converter configuration - control of SRM for EV/HEVs.

UNIT - IV

Power Electronics in HEVs

Boost and Buck-Boost converters - Multi Quadrant DC-DC converters - DC-AC Inverter for EV and HEV applications - Three Phase DC-AC inverters - Voltage control of DC-AC inverters using PWM - EV and PHEV battery chargers.

UNIT - V

Energy Sources for HEVs

Energy Storage - Battery based energy storage and simplified models of battery - fuel cells - their characteristics and simplified models - super capacitor based energy storage - its analysis and simplified models - flywheels and their modeling for energy storage in EV/HEV - Hybridization of various energy storage devices.

Course Outcomes (COs):

After the completion of the course the student should be able to:

CO₁ Know the concept of electric vehicles and hybrid electric vehicles.

CO₂ Familiar with different configuration of hybrid electric vehicles.

CO₃ Choose an effective motor for EV and HEV application

CO₄ Understand the power converters used in hybrid electric vehicles

CO₅ Know different batteries and other energy storage systems.

Text Books:

1. Ali Emadi - Advanced Electric Drive Vehicles - CRC Press - 2014.
2. Iqbal Hussein - Electric and Hybrid Vehicles: Design Fundamentals - CRC Press - 2003.

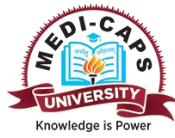
Reference Books:

1. Mehrdad Ehsani - YimiGao - Sebastian E. Gay - Ali Emadi - Modern Electric - Hybrid Electric and Fuel Cell Vehicles: Fundamentals - Theory and Design - CRC Press - 2004.
2. James Larminie - John Lowry - Electric Vehicle Technology Explained - Wiley - 2003.
3. H. Partab: Modern Electric Traction - DhanpatRai& Co - 2007.



SEMESTER VI

S. No.	Course Code	Courses	L	T	P	Credit
1	EE3CO53	Microprocessors & Microcontrollers	3	0	2	4
2	EE3CO46	Power System Protection	3	0	0	3
3	EE3CO48	IOT Applications in Electrical Engineering Lab	0	0	2	1
4	EE3EI03	Program Elective -III (IOT Applications in Electrical Engineering)	3	0	0	3
5	EE3EI02	Program Elective-IV (Embedded Systems)	3	0	0	3
6	EE3PC05	Mini Project -II	0	0	4	2
7	EN3NG05	Soft Skills -III	2	0	0	2
8	EE3CO47	Machine Learning for Electrical Engineering	3	0	2	4
9	OE00094	Open Elective -II (Battery Management Systems & Charging Stations)	3	0	0	3
		Total	20	0	10	25
		Total Contact Hours	30			



Course Code	Course Name	Hours per Week			Total Credits
		L	T	P	
EE3CO53	Microprocessors & Microcontrollers	3	0	2	4

Course Learning Objectives (CLOs):

CLO 1 To understand the organization and architecture of Microprocessor

CLO 2 To understand addressing modes to access memory

CLO 3 To understand 8051 micro controller architecture

CLO 4 To understand the programming principles for 8086 and 8051

CLO 5 To understand the interfacing of Microprocessor with I/O as well as other devices

CLO 6 To understand how to develop cyber physical systems

UNIT - I

Introduction to Microprocessor Architecture

Introduction and evolution of Microprocessors – Architecture of 8086 – Memory Organization of 8086 – Register Organization of 8086– Introduction to 80286 - 80386 – 80486, Pentium series (brief description about architectural advancements only).

UNIT - II

Minimum and Maximum Mode Operations

Instruction sets of 8086 - Addressing modes – Assembler directives - General bus operation of 8086 – Minimum and Maximum mode operations of 8086 – 8086 Control signal interfacing – Read and write cycle timing diagrams.

UNIT - III

Microprocessors I/O interfacing

8255 PPI– Architecture of 8255–Modes of operation– Interfacing I/O devices to 8086 using 8255–Interfacing A to D converters– Interfacing D to A converters– Stepper motor interfacing– Static memory interfacing with 8086.

Architecture and interfacing of 8251 USART – Architecture and interfacing of DMA controller (8257).

UNIT - IV

8051 Microcontroller

Overview of 8051 Microcontroller – Architecture– Memory Organization – Register set – I/O ports and Interrupts – Timers and Counters – Serial Communication – Interfacing of peripherals- Instruction set.

UNIT - V

PIC Architecture

Block diagram of basic PIC 18 micro controller – registers I/O ports – Programming in C for PIC: Data types - I/O programming - logical operations - data conversion.

Text Books:

1. Ray and Burchandi - “Advanced Microprocessors and Interfacing” - Tata McGraw–Hill - 3rd edition - 2006.
2. Kenneth J Ayala - “The 8051 Microcontroller Architecture - Programming and Applications” - Thomson Publishers - 2nd Edition.
3. PIC Microcontroller and Embedded Systems using Assembly and C for PIC 18 - - Muhammad Ali Mazidi - RolindD.Mckinay - Danny causey -Pearson Publisher 21st Impression.

Reference Books:

1. Microprocessors and Interfacing - Douglas V Hall - Mc–Graw Hill - 2nd Edition.
2. R.S. Kaler - “A Text book of Microprocessors and Micro Controllers” - I.K. International Publishing House Pvt. Ltd.
3. Ajay V. Deshmukh - “Microcontrollers – Theory and Applications” - Tata McGraw–Hill Companies –2005.
4. Ajit Pal - “Microcontrollers – Principles and Applications” - PHI Learning Pvt Ltd - 2011.
5. <https://archive.nptel.ac.in/courses/108/105/108105102/>

Course Outcomes (COs):

After the completion of the course the student should be able to:

CO₁ Know the concepts of the Microprocessor capability in general and explore the evaluation of microprocessors.

CO₂ Analyse the instruction sets - addressing modes - minimum and maximum modes operations of 8086 Microprocessors.

CO₃ Analyse the Microcontroller and interfacing capability.

CO₄ Describe the architecture and interfacing of 8051 controller.

CO₅ Know the concepts of PIC micro controller and its programming.



List of Experiments:

8086 Microprocessor Programs:

1. Arithmetic operations – Two 16-bit numbers and multibyte addition - subtraction - multiplication and division – Signed and unsigned arithmetic operations - ASCII – Arithmetic operations.
2. Logic operations – Shift and rotate – Converting packed BCD to unpacked BCD - BCD to ASCII conversion.
3. Arrange the given array in ascending and descending order
4. Determine the factorial of a given number
5. By using string operation and Instruction prefix: Move block - Reverse string Sorting - Inserting - Deleting - Length of the string - String comparison.
6. Find the first and nth number of 'n' natural numbers of a Fibonacci series.
7. Find the number and sum of even and odd numbers of a given array
8. Find the sum of 'n' natural numbers and squares of 'n' natural numbers
9. Arithmetic operations on 8051
10. Conversion of decimal number to hexa equivalent and hexa equivalent to decimal number
11. Find the Sum of elements in an array and also identify the largest & smallest number of a given array using 8051.

Programs on Interfacing:

12. Interfacing 8255–PPI with 8086.
13. Stepper motor control using 8253/8255.
14. Reading and Writing on a parallel port using 8051
15. Timer in different modes using 8051
16. Serial communication implementation using 8051
17. Understanding three memory areas of 00 – FF Using 8051 external interrupts.
18. Traffic Light Controller using 8051.



Course Code	Course Name	Hours per Week			Total Credits
		L	T	P	
EE3CO46	Power System Protection	3	0	0	3

Course Learning Objectives (CLOs):

CLO 1 To learn short circuit calculation for symmetrical faults and to learn the effect of unsymmetrical faults and their effects.

CLO 2 To provide the basic principles and operation of various types of circuit breakers.

CLO 3 To know the classification, operation and application of different types of electromagnetic protective relays.

CLO 4 To explain protective schemes for generator and transformers.

CLO 5 To gain the knowledge of various protective schemes used for feeders, bus bars and to understand protection against over voltages.

UNIT - I

Symmetrical Fault Analysis:

Reactance's of Synchronous Machine – Three Phase Short Circuit Currents - Short circuit MVA calculations for Power Systems – Numerical Problems.

Symmetrical Components

Definition of symmetrical components – symmetrical components of unbalanced three phase systems – Power in symmetrical components – Sequence impedances and Sequence networks: Synchronous generator – Transmission line and transformers – Numerical Problems.

Unsymmetrical Fault analysis

Various types of faults: LG– LL– LLG and LLL on unloaded alternator-Numerical problems.

UNIT - II

Circuit Breakers

Application oriented evolution of Switchgear - Miniature Circuit Breaker(MCB)– Elementary principles of arc interruption– Restriking Voltage and Recovery voltages– Restriking phenomenon - RRRV– Average and Max. RRRV– Current chopping and Resistance switching– Concept of oil circuit breakers– Description and operation of Air Blast– Vacuum and SF6 circuit breakers– Circuit Breaker ratings and specifications– Concept of Auto reclosing.

UNIT - III

Electromagnetic Protection

Relay connection – Balanced beam type attracted armature relay - induction disc and induction cup relays–Torque equation - Relays classification–Instantaneous– DMT and IDMT types– Applications of relays: Over current and under voltage relays– Directional relays– Differential relays and percentage differential relays– Universal torque equation– Distance relays: Impedance– Reactance– Mho and offset mho relays– Characteristics of distance relays and comparison, relay coordination.

UNIT - IV

Generator Protection

Protection of generators against stator faults– Rotor faults and abnormal conditions– restricted earth fault and inter turn fault protection– Numerical examples.

Transformer Protection

Percentage differential protection– Design of CT's ratio– Buchholz relay protection– Numerical examples.

UNIT - V

Feeder and Bus bar Protection:

Over current Protection schemes – PSM - TMS – Numerical examples – Carrier current and three zone distance relay using impedance relays. Protection of bus bars by using Differential protection.

Protection against over voltage:

Generation of over voltages in power systems– Protection against lightning over voltages– Valve type and zinc oxide lightning arresters.

Text Books:

1. Badri Ram and D.N Viswakarma, Power System Protection and Switchgear, Tata McGraw Hill Publications - 2nd edition - 2011.
2. I.J.Nagrath & D .P.Kothari, Modern Power system Analysis, Tata McGraw–Hill Publishing Company - 3rd edition - 2007.

Reference Books:

1. B.R.Gupta, Power System Analysis, A H Wheeler Publishing Company Limited - 1998.
2. Sunil S. Rao, Switchgear & protection, Khanna Publication.
3. Ravindra P. Singh, Switchgear & Power System Protection, PHI Learning.

Course Outcomes (COs):

After the completion of the course the student should be able to:

CO₁ Analyze the effect of symmetrical faults and unsymmetrical faults.

CO₂ Illustrate the principles of arc interruption for application to high voltage circuit breakers of air - oil - vacuum - SF₆ gas type.

CO₃ Analyse the working principle and operation of different types of electromagnetic protective relays.

CO₄ Acquire knowledge of protective schemes for generator and transformers for different fault conditions.

CO₅ Classify various types of protective schemes used for feeders and bus bar protection and also analyze the operation of different types of over voltages protective schemes.



Course Code	Course Name	Hours per Week			Total Credits
		L	T	P	
EE3CO48	IOT Applications in Electrical Engineering Lab	0	0	2	1

List of Experiments:

1. Familiarization with Arduino/Raspberry Pi and perform necessary software installation.
2. To interface LED/Buzzer with Arduino/Raspberry Pi and write a program to turn ON LED for 1 sec after every 2 seconds.
3. To interface Push button/Digital sensor (IR/LDR) with Arduino/Raspberry Pi and write a program to turn ON LED when push button is pressed or at sensor detection.
4. To interface temperature sensor with Arduino/Raspberry Pi and write a program to print temperature and humidity readings.
5. To interface Organic Light Emitting Diode (OLED) with Arduino/Raspberry Pi
6. To interface Bluetooth with Arduino/Raspberry Pi and write a program to send sensor data to smartphone using Bluetooth.
7. To interface Bluetooth with Arduino/Raspberry Pi and write a program to turn LED ON/OFF when '1'/'0' is received from smartphone using Bluetooth.
8. Write a program on Arduino/Raspberry Pi to upload and retrieve temperature and humidity data to thingspeak cloud.
9. 7 Segment Display
10. Analog Input & Digital Output
11. Night Light Controlled & Monitoring System
12. Fire Alarm Using Arduino
13. IR Remote Control for Home Appliances
14. A Heart Rate Monitoring System



Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
EE3EI03	IOT Applications in Electrical Engineering	3	0	0	3

Course Learning Objectives (CLOs):

The objectives of this course is to acquire knowledge on

CLO 1 architecture and various technologies of Internet of Things.

CLO 2 communication technologies used in the Internet of Things.

CLO 3 connectivity of devices using web and internet in the IoT environment.

CLO 4 various data acquisition methods and data handling using cloud for IoT applications.

CLO 5 IoT implementation for Smart Home, Smart city, etc.

UNIT - I

The Internet of Things: An Overview of Internet of Things (IoT) – IoT framework – Architecture – Technology behind IoT – Sources of the IoT – M2M Communication – Examples of IoT.

UNIT – II

Design Principles for Connected Devices: Introduction –IoT/M2M systems, Layers and Designs Standardization – Communication Technologies – Data Enrichment, Consolidation and Device Management at Gateway – Ease of designing and affordability.

UNIT – III

Design Principles for the Web Connectivity: Introduction – Web Communication protocols for Connected Devices - Message Communication protocols for Connected Devices – Web Connectivity for connected devices network.

Introduction to Internet Connectivity Principles, Internet connectivity, Internet based communication – IP addressing in the IoT – Application Layer Protocols: HTTP, HTTPS, FTP, Telnet, WAP (Wireless Application Protocol).

UNIT-IV

Data Acquiring, Organizing, Processing and Analytics: Introduction – Data Acquiring and Storage – Organizing the Data – Analytics.

Data Collection, Storage and Computing Using a Cloud Platform: Introduction – Cloud computing paradigm for data collection, storage and computing – IoTas a service and Cloud

Service Models – IoT cloud based services using the Xively (Pachube/COSM), Nimbits and other platforms.

UNIT– V

Sensor technology: Actuator, Sensor data communication protocols, Radio Frequency Identification technology, Wireless Sensor Network Technology.

IoT application case studies: Smart Home, Smart Cities, Environment monitoring and Agriculture practices.

Text Books:

1. Internet of Things: Architecture, Design Principles, Raj Kamal, McGraw Hill Education (India) Pvt. Limited, 2017.
2. IOT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things, David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, Pearson India Pvt. Ltd.

Reference Books:

1. Designing the Internet of Things, Adrian McEwen and Hakim Cassimally, Wiley, First edition, 2013.
2. Getting Started with the Internet of Things, Cuno Pfister, O'reilly, 2011.
3. Internet of Things: A Hands-on Approach, Arshdeep Bahga, and Vijay Madisetti, 2014.

Course Outcomes (COs):

After the completion of the course the student should be able to:

CO₁ know the various fundamentals, architectures and technologies of Internet of Things.

CO₂ discuss about various communication technologies used in the Internet of Things.

CO₃ acquire knowledge on the various device connectivity methods using web and internet in the IoT environment.

CO₄ explore various data acquisition methods, data handling using cloud for IoT applications.

CO₅ apply IoT to design Smart Home, Smart city, agriculture practices etc.



Course Code	Course Name	Hours per Week			Total Credits
		L	T	P	
EE3EI02	Embedded Systems	3	0	0	3

Course Learning Objectives (CLOs):

CLO 1 To provide an overview of Design Principles of Embedded System.

CLO 2 To provide clear understanding about the role of firmware.

CLO 3 To understand the necessity of operating systems in correlation with hardware systems.

CLO 4 To learn the methods of interfacing and synchronization for tasking.

UNIT - I

Introduction to Embedded Systems: Definition of Embedded System, Embedded Systems Vs General Computing Systems, History of Embedded Systems, Classification, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems.

UNIT – II

Typical Embedded System: Core of the Embedded System: General Purpose and Domain Specific Processors, ASICs, PLDs, Commercial Off-The-Shelf Components (COTS), Memory: ROM, RAM, Memory according to the type of Interface, Memory Shadowing, Memory selection for Embedded Systems, Sensors and Actuators, Communication Interface: Onboard and External Communication Interfaces.

UNIT – III

Embedded Firmware: Reset Circuit, Brown-out Protection Circuit, Oscillator Unit, Real Time Clock, Watchdog Timer, Embedded Firmware Design Approaches and Development Languages.

UNIT–IV

RTOS Based Embedded System Design: Operating System Basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling.

UNIT– V

Task Communication: Shared Memory, Message Passing, Remote Procedure Call and Sockets,

Task Synchronization: Task Communication/Synchronization Issues, Task Synchronization Techniques, Device Drivers, Methods to Choose an RTOS.

Text Books:

1. Introduction to Embedded Systems - Shibu K.V, Mc Graw Hill.
2. Embedded System design: Steve Heath, Elsevier.

Reference Books:

1. Embedded Systems - Raj Kamal, TMH.
2. Embedded System Design - Frank Vahid, Tony Givargis, John Wiley.
3. Embedded Systems – Lyla B. Das, Pearson, 2013
4. An Embedded Software Primer - David E. Simon, Pearson Education.

Course Outcomes (COs):

After the completion of the course the student should be able to:

CO₁ Demonstrate the history, purpose and application areas of embedded systems.

CO₂ Understand the selection procedure of Processors in the embedded domain.

CO₃ Design Procedure for Embedded Firmware.

CO₄ Visualize the role of Real time Operating Systems in Embedded Systems.

CO₅ Evaluate the Correlation between task synchronization and latency issues.



Course Code	Course Name	Hours per Week			Total Credits
		L	T	P	
EE3CO47	Machine Learning for Electrical Engineering	3	0	2	4

Course Learning Objectives (CLOs):

CLO 1 patterns and concepts from data without being explicitly programmed in various IOT nodes.

CLO 2 to design and analyze various machine learning algorithms and techniques with a modern outlook focusing on recent advances.

CLO 3 to explore supervised and unsupervised learning paradigms of machine learning, Deep learning technique and various feature extraction strategies.

UNIT - I

Introduction to Machine Learning with Python

Introduction to Machine Learning, basic terminology, Types of Machine Learning and Applications, Using Python for Machine Learning: Installing Python and packages from the Python Package Index, Introduction to NumPy, SciPy, matplotlib and scikitlearn, Tiny application of Machine Learning.

UNIT – II

Supervised Learning

Types of Supervised Learning, Supervised Machine Learning Algorithms: k-Nearest Neighbors, Linear Models, Naive Bayes Classifiers, Decision Trees, Ensembles of Decision Trees, Kernelized Support Vector Machines, Uncertainty Estimates from Classifiers.

UNIT – III

Unsupervised Learning

Types of Unsupervised Learning, challenges, Preprocessing and scaling, Dimensionality Reduction, Feature Extraction, Manifold Learning, Clustering: K-Means Clustering, Agglomerative Clustering, DBSCAN, Comparing and Evaluating Clustering Algorithms.

UNIT-IV

Representing Data and Engineering Features

Categorical Variables, Binning, Discretization, Linear Models, Trees, Interactions and Polynomials, Univariate Nonlinear Transformations, Automatic Feature Selection. Parameter Selection with Preprocessing, Building Pipelines, The General Pipeline Interface.

UNIT– V

Working with Text Data (Data Visualization)

Types of Data Represented as Strings, Example Application: Sentiment Analysis of Movie Reviews, Representing Text Data as a Bag of Words, Stop Words, Rescaling the Data with tf-idf, Investigating Model Coefficients, Approaching a Machine Learning Problem, Testing Production Systems, Ranking, Recommender Systems and Other kinds of Learning.

Text Books:

1. Introduction to Machine Learning with Python: A Guide for Data Scientists, Andreas C. Muller & Sarah Guido, Orielly Publications, 2019.
2. Python Machine Learning, Sebastian Raschka & Vahid Mirjalili, 3rd Edition, 2019.
3. Building Machine Learning Systems with Python, Luis Pedro Coelho, Willi Richert, 2nd Edition, 2015.

Reference Books:

1. Machine Learning, Tom M. Mitchell, Mc Graw-Hill Publication, 2017
2. Machine Learning, S Sridhar, M Vijayalakshmi, Oxford University Press.
3. An Introduction to Machine Learning, Miroslav Kubat, Springer.

Course Outcomes (COs):

After the completion of the course the student should be able to:

CO₁ Illustrate and comprehend the basics of Machine Learning with Python

CO₂ Demonstrate the algorithms of Supervised Learning and be able to differentiate linear and logistic regressions

CO₃ Demonstrate the algorithms of Unsupervised Learning and be able to understand the clustering algorithms

CO₄ Evaluate the concepts of binning, pipeline Interfaces with examples

CO₅ Apply the sentiment analysis for various case studies

List of Experiments:

Requirements: Develop the following program using Anaconda/ Jupiter/ Spider and evaluate ML models.

Experiment-1: Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file.



Experiment-2: For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.

Experiment-3: Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.

Experiment-4: Exercises to solve the real-world problems using the following machine learning methods: a) Linear Regression b) Logistic Regression c) Binary Classifier

Experiment-5: Develop a program for Bias, Variance, Remove duplicates, Cross Validation.

Experiment-6: Write a program to implement Categorical Encoding, One-hot Encoding

Experiment-7: Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.

Experiment-8: Write a program to implement k-Nearest Neighbor algorithm to classify the iris data set. Print both correct and wrong predictions.

Experiment-9: Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.

Experiment-10: Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.

Experiment-11: Apply EM algorithm to cluster a Heart Disease Data Set. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.

Experiment-12: Exploratory Data Analysis for Classification using Pandas or Matplotlib.

Experiment-13: Write a Python program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set

Experiment-14: Write a program to Implement Support Vector Machines and Principle Component Analysis

Experiment-15: Write a program to Implement Principle Component Analysis.



Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
OE00094	Battery Management Systems & Charging Stations	3	0	0	3

Course Learning Objectives (CLOs):

CLO 1 Able to understand the working of different batteries for EV applications

CLO 2 Able to know the fundamentals of battery charging methods and their advantages

CLO 3 Able to know the different kinds of equipment in charging station

CLO 4 Able to know the requirements of battery management.

CLO 5 Able to know method of modelling batteries and their simulation studies.

UNIT – I: EV Batteries

Cells & Batteries, Nominal voltage and capacity, C rate, Energy and power, Cells connected in series, Cells connected in parallel. **Lead Acid Batteries:** Lead acid battery basics, special characteristics of lead acid batteries, battery life and maintenance, Li-ion batteries. **Nickel-based Batteries:** Nickel cadmium, Nickel metal hydride batteries. **Sodium-Based Batteries:** Introduction, sodium sulphur batteries, sodium metal chloride (Zebra) batteries. **Lithium Batteries:** Introduction, the lithium polymer battery, lithium ion battery.

UNIT – II: Battery charging strategies

Charging algorithms for a single battery: Basic terms for charging performance evaluation and characterization, CC charging for NiCd/NiMH batteries, CV charging for lead acid batteries, CC/CV charging for lead acid and Li-ion batteries, MSCC charging for lead acid, NiMH and Li-ion batteries, TSCC/CV charging for Li-ion batteries, CVCC/CV charging for Li-ion batteries, Pulse charging for lead acid, NiCd/NiMH and Li-ion batteries, Charging termination techniques, Comparisons of charging algorithms and new development; Balancing methods for battery pack charging: Battery sorting Overcharge for balancing, Passive balancing, Active balancing.

UNIT – III: Charging Infrastructure

Domestic Charging Infrastructure, Public charging Infrastructure, Normal Charging Station, Occasional Charging Station, Fast Charging Station, Battery Swapping Station, Move-and-charge zone.

UNIT–IV :Battery-Management-System Requirements

Battery-pack topology, BMS design requirements, Voltage sense, Temperature sense, Current sense, Contactor control, Isolation sense, Thermal control, Protection, Charger control, Communication via CAN bus, Log book, SOC estimation, Energy estimation, Power estimation, Diagnostics .

UNIT– V: Battery Modelling

General approach to modelling batteries, simulation model of rechargeable Li-ion battery, simulation model of a rechargeable NiCd battery, Parameterization of NiCd battery model, Simulation examples.

Text Books:

1. Electric Vehicles Technology Explained by James Larminie Oxford Brookes University, Oxford, UK John Lowry Acenti Designs Ltd., Uk. (Unit-1)
2. Energy Systems for Electric and Hybrid Vehicles by K.T. Chau, IET Publications, First edition, 2016. (Unit-2)

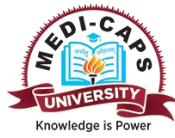
Reference Books:

1. Modern Electric Vehicles Technology by C. C. Chan, K.T Chau, Oxford University Press Inc., New york , 2001. (Unit-3)
2. Battery Management Systems Vol. – II Equivalent Circuits and Methods, by Gregory L.Plett, Artech House publisher, First edition 2016. (Unit-4)
3. Battery Management Systems: design by Modelling by Henk Jan Bergveld, Wanda S. Kruijt, Springer Science & Business Media, 2002. (Unit-5)

Course Outcomes (COs):

After the completion of the course the student should be able to:

- CO₁** Describe the construction and operation of different batteries for EV applications
- CO₂** Describe charging algorithms of different batteries and balancing methods of battery packs
- CO₃** Describe the different kinds of infrastructure needed in the charging stations
- CO₄** Describe the requirements of battery management and their maintenance
- CO₅** Obtain the modelling of batteries and develop their simulation models.



SEMESTER VII

S. No.	Course Code	Courses	L	T	P	Credit
1	EE3EI04	Program Elective-V (AI Applications in Electrical Engineering)	3	0	0	3
2	EE3EL17	Program Elective-VI (Electric Power Distribution)	3	0	0	3
3	OE00095	Open Elective-III (Renewable & Distributed Energy Technologies)	3	0	0	3
4	EE3PC03	Industrial Training	0	2	0	2
5	EE3PC06	Project-I	0	0	8	4
6	EN3NG06	Open Learning Course	1	0	0	1
		Total	10	2	8	16
		Total Contact Hours	20			



Course Code	Course Name	Hours per Week			Total Credits
		L	T	P	
EE3EI04	AI Applications to Electrical Engineering	3	0	0	3

Course Learning Objectives (CLOs):

- CLO₀₁** To observe the concepts of feed forward neural networks and about feedback neural networks.
- CLO₀₂** To learn various learning algorithms of neural network
- CLO₀₃** To practice the concept of fuzziness involved in various systems and comprehensive knowledge of fuzzy logic control and to design the fuzzy control.
- CLO₀₄** To analyze genetic algorithm, genetic operations and genetic mutations.
- CLO₀₅** To Apply artificial intelligence techniques to electrical engineering problems

UNIT - I

Artificial Neural Networks: Introduction, Models of Neuron Network-Architectures – Knowledge representation, Artificial Intelligence and Neural networks–Learning process - Error correction learning, Hebbian learning –Competitive learning-Boltzman learning, supervised learning-Unsupervised learning–Reinforcement learning-Learning tasks.

UNIT - II

ANN Paradigms: Multi-layer perceptron using Back propagation Algorithm (BPA), Self – Organizing Map (SOM), Radial Basis Function Network-Functional Link Network (FLN), Hopfield Network.

UNIT - III

Fuzzy Logic: Introduction –Fuzzy versus crisp, Fuzzy sets-Membership function –Basic Fuzzy set operations, Properties of Fuzzy sets –Fuzzy Cartesian Product, Operations on Fuzzy relations –Fuzzy logic–Fuzzy Quantifiers, Fuzzy Inference-Fuzzy Rule based system, Defuzzification methods.

UNIT - IV

Genetic Algorithms: Introduction-Encoding –Fitness Function-Reproduction operators, Genetic Modeling –Genetic operators-Cross over-Single site cross over, Two point cross over –Multi point cross over Uniform cross over, Matrix cross over-Cross over Rate-Inversion &

Deletion, Mutation operator –Mutation –Mutation Rate-Bit-wise operators, Generational cycle-convergence of Genetic Algorithm.

UNIT - V

Applications of AI Techniques: Load forecasting, Load flow studies, Economic load dispatch, Loadfrequency control, Single area system and two area system, Reactive power control, Speed control of DC and AC Motors.

Text Books:

1. S. Rajasekaran and G.A.V. Pai Neural Networks, Fuzzy Logic & Genetic Algorithms, PHI, New Delhi, 2003.
2. Rober J. Schalkoff, Artificial Neural Networks, Tata McGraw Hill Edition, 2011.

Reference Books:

1. P.D. Wasserman; Neural Computing Theory & Practice, Van Nostrand Reinhold, New York, 1989.
2. Bart Kosko; Neural Network & Fuzzy System, Prentice Hall, 1992.
3. D.E. Goldberg, Genetic Algorithms, Addison-Wesley 1999.

Course Outcomes (COs):

After the completion of the course the student should be able to:

- CO01** Understand feed forward neural networks and feedback neural networks.
- CO02** Understand various learning methods of neural network
- CO03** Analyze and appreciate the concepts of fuzzy set over classical set theory.
- CO04** Examine the concept of genetic algorithm.
- CO05** Apply ANN, fuzzy logic control and GA to electrical engineering problems



Course Code	Course Name	Hours per Week			Total Credits
		L	T	P	
EE3EL17	Electric Power Distribution	3	0	0	3

Course Learning Objectives (CLOs):

CLO 1 To study about different factors of Distribution system.

CLO 2 To know about designing the substations and distribution systems.

CLO 3 To study about the concepts of voltage drop and power loss in a distribution system.

CLO 4 To know about the distribution system protection and its coordination.

CLO 5 To study about the effect of compensation for power factor improvement and effect of voltage control on distribution system.

UNIT - I

General Concepts: Introduction to distribution systems, Load modeling and characteristics – Coincidence factor – Contribution factor-loss factor – Relationship between the load factor and loss factor – Classification of loads (Residential, commercial, Agricultural and Industrial) and their characteristics.

UNIT - II

Substations & Distribution Feeders: Location of substations: Rating of distribution substation – Service area with ‘n’ primary feeders – Benefits and methods of optimal location of substations. Design Considerations of distribution feeders: Radial and loop types of primary feeders – Voltage levels – Feeder loading – Basic Design practice of the secondary distribution system.

UNIT - III

System Analysis: Voltage drop and power-loss calculations: Derivation for voltage drop and power loss in lines – Uniformly distributed loads and non-uniformly distributed loads – Numerical problems - Three phase balanced primary lines.

UNIT - IV

Protective devices and Coordination: Objectives of distribution system protection – Types of common faults and procedure for fault calculations for distribution system – Protective devices: Principle of operation of fuses – Circuit reclosures – Line sectionalizers and circuit breakers, Co ordination of protective devices, General coordination procedures - Various types of coordinated operation of protective devices - Residual Current Circuit Breaker.

UNIT - V

Compensation for Power Factor Improvement and Voltage Control: Capacitive compensation for power factor control – Different types of power capacitors – shunt and series capacitors – Effect of shunt capacitors (Fixed and switched) – Power factor correction – Capacitor allocation – Economic justification – Procedure to determine the best capacitor location. Equipment for voltage control – Effect of series capacitors – Effect of AVB/AVR – Line drop compensation – Numerical problems.

Text Books:

1. “Electric Power Distribution System Engineering” – by Turan Gonen, 3rd Edition, CRC Press, Taylor & Francis.

Reference Books:

1. Electrical Distribution Systems by Dale R.Patrick and Stephen W.Fardo, CRC press.
2. Electric Power Distribution – by A.S. Pabla, Tata McGraw–hill Publishing company, 4th edition, 1997.
3. Electrical Power Distribution Systems by V.Kamaraju, Right Publishers.

Course Outcomes (COs):

After the completion of the course the student should be able to:

CO₁ discuss about various factors of distribution system.

CO₂ design the substation and feeders.

CO₃ determine the voltage drop and power loss

CO₄ apply the protection and coordination of distribution system.

CO₅ apply compensation techniques for power factor improvement in a distribution system.



Course Code	Course Name	Hours per Week			Total Credits
		L	T	P	
OE00095	Renewable & Distributed Energy Technologies	3	0	0	3

Course Learning Objectives (CLOs):

CLO 1 To study the solar radiation data, extraterrestrial radiation, radiation on earth's surface.

CLO 2 To study solar photo voltaic systems and maximum power point techniques in solar pv and wind energy.

CLO 3 To study wind energy conversion systems, Betz coefficient, tip speed ratio.

CLO 4 To study basic principle and working of hydro and other sources.

CLO 5 To understand the use of various renewable sources as distributed generators.

UNIT - I

Fundamentals of Energy Systems and Solar energy

Energy conservation principle – Energy scenario (world and India) – various forms of renewable energy - Solar radiation: Outside earth's atmosphere – Earth surface – Analysis of solar radiation data – Geometry – Radiation on tilted surfaces – Numerical problems.

UNIT - II

Solar Photovoltaic Systems

Solar photovoltaic cell, module, array – construction – Efficiency of solar cells – Developing technologies – Cell I-V characteristics – Equivalent circuit of solar cell – Series resistance – Shunt resistance – Applications and systems – Balance of system components - System design: storage sizing – PV system sizing – Maximum power point techniques: Perturb and observe (P&O) technique – Hill climbing technique.

UNIT - III

Wind Energy

Sources of wind energy - Wind patterns – Types of turbines –Horizontal axis and vertical axis machines - Kinetic energy of wind – Betz coefficient – Tip-speed ratio – Efficiency – Power output of wind turbine – Selection of generator(synchronous, induction) – Maximum power point tracking – wind farms – Power generation for utility grids.

UNIT - IV

Hydro and other sources

Basic working principle – Classification of hydro systems: Large, small, micro – measurement of head and flow – Energy equation – Types of turbines – Numerical problems - plant layouts. Brief idea of other sources viz. - tidal - geothermal - biomass - fuel cell – gas based etc.

UNIT – V

Distributed Energy Technologies

Requirements of hybrid/combined use of different renewable and distributed sources - Need of energy storage; Control of frequency and voltage of distributed generation in Stand-alone and Grid-connected mode - use of energy storage and power electronics interfaces for the connection to grid and loads - Design and optimization of size of renewable sources and storages.

Text Books:

1. Renewable Energy Resources, John Twidell and Tony Weir, Taylor and Francis -second edition, 2013.
2. Non Conventional sources of Energy by G.D.Rai, Kanna Publications.
3. Math J. Bollen - Fainan Hassan ‘Integration of Distributed Generation in the Power System’ - IEEE Press - 2011.

Reference Books:

1. Energy Science: Principles, Technologies and Impacts, John Andrews and Nick Jelly, Oxford University Press.
2. Solar Energy: Principles of Thermal Collection and Storage, S. P. Sukhatme and J. K. Nayak, TMH, New Delhi, 3rd Edition.
3. Renewable Energy- Edited by Godfrey Boyle-oxford university press, 3rd edition, 2013.
4. Handbook of renewable technology Ahmed and Zobaa, Ramesh C Bansal, World scientific, Singapore.
5. Renewable Energy Technologies /Ramesh & Kumar /Narosa.
6. Renewable energy technologies – A practical guide for beginners – Chetong Singh Solanki, PHI.
7. Non conventional energy source –B.H.khan- TMH-2nd edition.

Course Outcomes (COs):

After the completion of the course the student should be able to:

CO₁ analyze solar radiation data, extraterrestrial radiation, and radiation on earth’s surface.

CO₂ design solar photo voltaic systems and develop maximum power point techniques.

CO₃ explain wind energy conversion systems, wind generators.

CO₄ Illustrate the concept of Energy Production from Hydro and other sources.

CO₅ Distinguish between standalone and grid connected DG systems and design hybrid renewable energy systems,



SEMESTER VIII

S. No.	Course Code	Courses	L	T	P	Credit
1	EE3PC07	Project-II	0	0	20	10
		Total	0	0	20	10
		Total Contact Hours	20			



Course Code	Course Name	Hours per Week			Credits
		L	T	P	
EE3PC07	Project -II	0	0	20	10

Project Implementation Plan

Finalizing the Choice for New Project/ Continuation of Old Project	<ul style="list-style-type: none"> Finalize Title Finalize supervisor Presentation I 	1st week
Implementation	<ul style="list-style-type: none"> Interfaces Databases Full Implementation Presentation II 	6th week
Testing and Deployment	<ul style="list-style-type: none"> Test Cases Test Reporting Presentation III 	10th week
Report in Format (Spiral Binding)	<ul style="list-style-type: none"> Evaluation by supervisor and 2 additional teachers 	
Final Presentation	<ul style="list-style-type: none"> Presentation IV Assessment by Departmental Project Evaluation Committee 	14th week At least one paper must be presented in an International Conference or Publication in referred Journal.
Final Report Binding	<ul style="list-style-type: none"> Assessment by Departmental Project Evaluation Committee with one external member. At least three members including External Member will make the Quorum. Viva – Voce 	End semester Examination

1. For external projects there will be an external guide in addition to the allotted guide from the department.
2. The schedule of meeting with the supervisor shall be depending on the nature of project execution.



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3. Interdisciplinary projects will have guided from concerned departments duly approved by the Dean (Engineering).
4. The project conducted in the location of the industries with more than 10 crores Turn Over will be accepted for valuation of project. Professor in charge Training / HoDs must verify the company details from www.mca.gov.in before accepting the report for valuation. It is not mandatory have publications for these students for the evaluation of project.
5. For Project– I Total marks is 200 (80+ 120).
Project-II Total marks 500 (200+300).