Department of Electrical Engineering

CURRICULUM AND SYLLABUS

(2022-2026)

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 (2022-2026)

SEMESTER I

S. 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

S. 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

S. No.	Course Code	Courses	L	T	P	Credit
1	EE3BS01	Engineering Mathematics -III	3	0	0	3
2	EE3ES03	Data Structures through C	3	0	2	4
3	EE3CO49	Electrical Circuit Analysis	3	0	2	4
4	EE3CO50	Analog & Digital Electronics	3	0	2	4
5	EE3CO36	Electrical Machines -I	3	0	0	3
6	EE3CO22	Electrical Workshop	0	0	2	1
7	EE3CO43	Programming for Electrical Engineers	0	0	2	1
8	EN3HS04	Fundamentals of Management, Economics and Accountancy	3	0	0	3
9	EN3NG103	Soft Skills-I	2	0	0	2
		Total	**20**	**0**	**10**	**25**
		Total Contact Hours	**30**			

SEMESTER IV

S. No.	Course Code	Courses	L	T	P	Credit
1	EE3CO53	Microprocessors & Microcontrollers	3	0	2	4
2	EE3CO27	Signals & Systems	3	0	0	3
3	EE3CO54	Measurements & Instrumentation	3	1	0	4
4	EE3CO37	Electrical Machines -II	3	0	0	3
5	EE3CO55	Power Electronics	3	0	2	4
6	EN3NG10	Soft Skills -II	2	0	0	2
7	EE3CO56	Power System -I	3	0	0	3
8	EE3ES01	Python Programming	0	0	2	1
9	EE3CO29	Electromagnetic Theory	3	0	0	3
		Total	**23**	**1**	**6**	**27**
		Total Contact Hours	**30**			

SEMESTER V

S. No.	Course Code	Courses	L	T	P	Credit
1	EE3CO41	PLC & Applications Lab	0	0	2	1
2	EE3CO40	Power System -II	3	0	2	4
3	EE3ES04	Data Analysis with Python	2	0	2	3
4	EE3CO48	IOT Applications in Electrical Engineering Lab	0	0	2	1
5	EE3CO38	Electrical Machines Lab	0	0	2	1
6	EE3CO34	Control Systems	3	0	0	3
7	EE3EI01	Program Elective -I (PLC & Applications)	3	0	0	3
8	EE3EI03	Program Elective -II (IoT Applications in Electrical Engineering)	3	0	0	3
9	EN3NG009	Soft Skills -III	2	0	0	2
10	OE00093	Open Elective -I (Hybrid Electric Vehicles)	3	0	0	3
		Total	**19**	**0**	**10**	**24**
		Total Contact Hours	**29**			

SEMESTER VI

S. No.	Course Code	Courses	L	T	P	Credit
1	EE3PC08	Mini Project	0	0	4	2
2	EN3NG08	Soft Skills -IV	2	0	0	2
3	EE3CO46	Power System Protection	3	0	0	3
4	EE3CO51	Embedded Systems	3	0	0	3
5	EE3EL18	Program Elective -III (Electric Drives)	3	0	0	3
6	EE3CO45	Electrical Simulation Lab	0	0	2	1
7	EE3EL16	Program Elective -IV (Digital Signal Processing)	3	0	0	3
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
10	EE3CO35	Electrical Measurement & Control Lab	0	0	2	1
		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
7	EN3NG02	Universal Human Values & Professional Ethics	2	0	0	2
		Total	**12**	**2**	**8**	**18**
		Total Contact Hours	**22**			

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		173	
Summary of Credits			
S. No.	**Course Work**	**Total Credits (CS)**	**Credits as per Model scheme**
1	Basic Sciences (BS)	16	10-15% (16-24)
2	Engineering Sciences (ES)	32	15-20% (24-32)
3	Humanities and Social Sciences (HS)	8	5-10% (8-16)
4	Core (CO)	59	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	18	10-15%(16-24)
8	Non-Grading	13	
173			

Choice Based Credit System Scheme- B. Tech EE

Batch 2022-2026

Medi-Caps University Indore (M.P.)

B.Tech. (I year)

Scheme (2022-26 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-gradial 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:

CO_{01} To illustrate the tools of matrices in solving the system of simultaneous equations,

CO_{02} To investigate the tools of differential calculus to relevant fields of engineering and can implement the concept of several variables.

CO_{03} 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.

CO_{04} To solve Ordinary Differential Equations using different methods.

CO_{05} To relate the knowledge of complex number and categorize it in solving functions of several complex numbers.

Course Code	Course Name	Hours per Week			
		L	T	P	Credits
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 (Tc), 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:

CO_{01}	Understand and analyse the different types of lasers and optical fibres, operation, and its characteristics.
CO_{02}	Understand and apply various phenomenon of Interference, diffraction and polarization and their applications.
CO_{03}	Understand and apply the concept of Quantum Mechanics.
CO_{04}	Understand and examine the crystal structures and acquire the basic knowledge of various semiconductor devices.
CO_{05}	Evaluate and apply the applications of superconductivity in technology and real world.
CO_{06}	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 an 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):

CLO_{01} To introduce fundamental concepts and analysis techniques in electrical engineering to students across all disciplines.

CLO_{02} 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.

CLO_{03} 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.

CLO_{04} To provide knowledge about the basic DC and AC electric circuits and magnetic circuits.

CLO_{05} 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:

CO_{01}	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.
CO_{02}	Demonstrate an understanding of basic concepts of analysis of simple DC and AC circuits used in electrical engineering.
CO_{03}	Demonstrate an understanding of power supply, UPS, type of motors and their applications.
CO_{04}	Demonstrate an understanding of basic concepts of transformers, power system components and their application in transmission and distribution of electric power system.
CO_{05}	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			
		L	T	P	Credits
EN3NG01	Environmental Science	2	0	0	2

Course Learning Objectives (CLOs):

CLO_{01}	To impart knowledge of Environment and its basic components.
CLO_{02}	To build basic understanding of various effects of human activities to the environment.
CLO_{03}	To understand concepts of water pollution
CLO_{04}	To understand function of solid waste management
CLO_{05}	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:

CO_{01}	Gain knowledge of Ecosystem & Biodiversity.
CO_{02}	Develop basic understanding of air pollution and its control method
CO_{03}	Develop basic understanding of water pollution and its control method
CO_{04}	Gain knowledge of Solid waste management and its importance.
CO_{05}	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):

CLO_{01} To familiarize with the construction of geometrical figures.
CLO_{02} To familiarize with the projection of 1D, 2D and 3D elements
CLO_{03} To familiarize with the projection and sectioning of solids.
CLO_{04} To familiarize with the Preparation and interpretation of building drawing.
CLO_{05} 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 andSons.
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:

CO_{01}	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
CO_{02}	Understand the projection of points, straight lines and have the ability to convert the practical problems in to projections
CO_{03}	To understand and apply concepts of the projection of simple planes & solids.
CO_{04}	Understand and apply the concepts of Projection & Sections of solids & development of surfaces
CO_{05}	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):

CLO_{01} Analyse Basics of Computers, programming environment and about different types of Programming languages.

CLO_{02} Application of various basic concepts required to create programs, use good problem solving approach.

CLO_{03} Use different control structures for conditional programming.

CLO_{04} Use of Arrays and string in different problems and also to apply different operations on arrays and strings

CLO_{05} 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. Balguruswamy, 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:

- **CO_{01}** Understand Basics of Computers and Programming languages.
- **CO_{02}** Understand basic concepts of C programming language required to create programs.
- **CO_{03}** Apply different types of control structures in problem solving.
- **CO_{04}** Use of Arrays and string in different problems and also to apply different operations on arrays and strings.
- **CO_{05}** 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			
		L	T	P	Credits
EN3ES01	Basic Civil Engineering	3	0	2	4

Course Learning Objectives (CLOs):

CLO_{01} To give the knowledge of various building and general construction materials such as bricks, stones, timber, cement, steel and concrete & their properties and application.

CLO_{02} To provide basic understanding of the forces and its components, stresses, strains and the modulus of elasticity of the different construction materials.

CLO_{03} To understand the components of the building such as beams, columns, foundations, slabs and different types of soils and their bearing capacities.

CLO_{04} 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.

CLO_{05} 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, poisons 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:

CO_{01}	Students will be able to recognize the civil engineering works and conversant about different construction materials and their uses.
CO_{02}	Student will be able to differentiate force, pressure and stresses.
CO_{03}	Students will be able to know the different building component and its importance.
CO_{04}	Students will be conversant about vertical and horizontal variation of different terrains.
CO_{05}	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'srule.
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 sin 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	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**			

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):

CLO_{01} To illustrate knowledge of Laplace Transform and investigate its application.

CLO_{02} To explain the concept of Fourier Series and Fourier Transform.

CLO_{03} To illustrate the concept of Partial Differential Equations.

CLO_{04} To impart the knowledge of Vector Calculus.

CLO_{05} 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 Evenand 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 Methodand Lagrange's Method), Non-Linear Partial Differential Equations of First order {Standard formI, 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 CompanyLtd., 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			
		L	T	P	Credits
EN3BS14	Engineering Chemistry	2	0	2	3

Course Learning Objectives (CLOs):

CLO_{01} To gain fundamental knowledge of the principles related to, so as to meet the challenging requirements of students in chemistry studies.

CLO_{02} To attain awareness in students about current & new issues in the fields of chemistry.

CLO_{03} 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.

CLO_{04} 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 Bhawsar, A text book of Engineering Chemistry, 1st edition, Manthan Publication, 2016.
2. Preeti Jain, S L Garg, Engineering Chemisty, 4th edition, Variety Publication.
3. Shashi Chawla, Engineering Chemistry, 11th edition, Dhanpat RaiPublications.

References:

1. P C Jain, Monika Jain, Engineering Chemistry, Dhanpat RaiPublications.
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 Practicals:

Volumetric Analysis:

1.To determine Hardness of given water sample by Complex ometrictitration.
2.To determine total and mixed Alkalinity of given water sample using phenolphthalein and methyl orange asindicator.
3.To determine strength of unknown FAS solution by Redox titration using N-Phenyl anthranilic acid as internalindicator.
4.To determine strength of unknown $CuSO_4$ solution by Iodometric titration using Starch as internalindicator.
5.To determine Chloride content of water sample by Mohr's method (Argentometrictitration).

Fuel Testing:

1.Todeterminemoisturecontentingivensampleofcoalbyproximateanalysis.
2.Todeterminevolatilecontentingivensampleofcoalbyproximateanalysis.
3.Todetermineashcontentingivensampleofcoalbyproximateanalysis.
4.To determine percentage carbon content of coal by proximate analysis.

Lubricant Testing:

1. To determine penetration number of grease by Cone Penetrometerapparatus.
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 Closecup apparatus.
5. To determine Steam emulsification number of givenlubricant.
6. To determine Aniline point of given oilsample.
7. To determine Cloud and Pour point of given lubricatingsample.
8. To study rate of change of viscosity with temperature of the given lubricating oil by meansof Redwood Viscometerno.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:

CO_{01}	Students will be able to understand the engineering materials, their properties, Iron-Carbon Diagram and Stress-Strain Curve, Measuring Equipment's and Testing Machines.
CO_{02}	Student will be thorough with the basic laws of thermodynamics and their applications in engineering also know about Refrigeration cycles and properties of refrigerants.
CO_{03}	Students will be able to understand the construction and working of I.C. Engines .
CO_{04}	Students will be able to understand the construction and working of Steam Generators
CO_{05}	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, pieslice, 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:

CO_{01}	Apply Pointers, Pointer Arithmetic and Accessing arrays, strings through pointers.
CO_{02}	Use different user defined data types like structures, union and enum.
CO_{03}	Understand and Use of dynamic memory allocation and preprocessor directives.
CO_{04}	Use the concepts of file handing.
CO_{05}	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 annimations.
41. Write a program to implement traffic signal.
42. Write a pogram to simulate a moving car. Draw car using simple shapes like line, circle and polygon.

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

Course Learning Objectives (CLOs):

CLO_{01} To develop, enhance and demonstrate LSRW Skills.

CLO_{02} To enable students to acquire oral presentation skills.

CLO_{03} To prepare students to become more confident and active participants in all aspects of their undergraduate programs

CLO_{04} To enable students with good vocabulary, grammar and writing skills.

CLO5 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:

CO_{01}	The students will be able to enhance confidence in their ability to read, comprehend, organize, and retain written and oral information.
CO_{02}	The students will be able to distinguish between general and technical communication and understand its importance
CO_{03}	The students will be able to improve upon their language skills, communication skills, group discussion, and personality development and confidence level.
CO_{04}	The students will be able to bridge the language gap which is vital to their success
CO_{05}	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			
		L	T	P	Credits
EN3ES16	Basic Electronics Engineering	3	0	2	4

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 andswitch, 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:

CO_{01}	Should have the knowledge of basic semiconductor materials and their usage in variety of PN junction diodes and applications of diodes
CO_{02}	Should be able to understand the concept operation of transistors and its configuration.
CO_{03}	Understand and identify the fundamental concepts and various components of analog communication systems
CO_{04}	Should have the knowledge of number systems and Boolean Algebra, minimization, Logic gates and other Combinational circuits and their designing.
CO_{05}	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, planning, 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. Raghuwanshi, 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:

CO_{01} Understand the engineering materials, their properties, and their utilization in manufacturing tool and other equipment's.

CO_{02} Understand the primary manufacturing process.

CO_{03} Understand the basic operation involve in casting.

CO_{04} Understand the basic process of forging.

CO_{05} Basic knowledge of simple cutting, holding. Marking and striking tool.

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

Course Learning Objectives (CLOs):

CLO_{01} To know the historical perspective of science and technology in India, its roots and its role.

CLO_{02} To know how research and development field is progressing in India.

CLO_{03} To know what were the policies and plans are proposed after independence to be technologically sound.

CLO_{04} To Know what were the developments done in major areas of science & technology.

CLO_{05} 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 Scienceand 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 thenew era, science and technology developments during the Five-Year Plan Periods and scienceand 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 developmentin 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 ofIndia, 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, SterlingPublications (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:

CO_{01}	Student will be aware about the ancient India & the existence of science & technology in that era & how it is reciprocated.
CO_{02}	Student will be aware about the upliftment done in the field of R & D after independence.
CO_{03}	Student will come to know about the plans and policies that brought about radical changes for the growth of science in India.
CO_{04}	Student will come to know about the major areas of the applied science and their existence. And can set the relationship between the technologies.
CO_{05}	Students will understand the need of technology transfer, its types and processes.

SEMESTER III

S. No.	Course Code	Courses	L	T	P	Credit
1	EE3BS01	Engineering Mathematics -III	3	0	0	3
2	EE3ES03	Data Structures through C	3	0	2	4
3	EE3CO49	Electrical Circuit Analysis	3	0	2	4
4	EE3CO50	Analog & Digital Electronics	3	0	2	4
5	EE3CO52	Electrical Machines -I	3	0	0	3
6	EE3CO22	Electrical Workshop	0	0	2	1
7	EE3CO43	Programming for Electrical Engineers	0	0	2	1
8	EN3HS04	Fundamentals of Management, Economics and Accountancy	3	0	0	3
9	EN3NG03	Soft Skills -I	2	0	0	2
		Total	**20**	**0**	**10**	**25**
		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	Hours per Week			Total
		L	T	P	Credits
EE3ES03	Data Structures Through C	3	0	2	4

Course Learning Objectives (CLOs):

CLO 1 Operations on linear data structures and their applications.

CLO 2 The various operations on linked lists.

CLO 3 The basic concepts of Trees, Traversal methods and operations.

CLO 4 Concepts of implementing graphs and its relevant algorithms.

CLO 5 Sorting and searching algorithms.

Unit-I: Linear Data Structures: Arrays, Stacks and Queues

Data Structures -Operations-Abstract Data Types-Complexity of Algorithms-Time and Space-Arrays-Representation of Arrays-Linear Arrays-Insertion–Deletion and Traversal of a Linear Array-Array as an Abstract Data Type-Multi-Dimensional Arrays-Strings-String Operations-Storing Strings-String as an Abstract Data Type.

Stack -Array Representation of Stack-Stack Abstract Data Type-Applications of Stacks: Prefix- Infix and Postfix Arithmetic Expressions-Conversion-Evaluation of Postfix Expressions- Recursion-Towers of Hanoi-Queues-Definition-Array Representation of Queue-The Queue Abstract Data Type-Circular Queues-Dequeues-Priority Queues.

Unit-II: Linked Lists

Pointers-Pointer Arrays-Linked Lists-Node Representation-Single Linked List-Traversing and Searching a Single Linked List-Insertion into and Deletion from a Single Linked List-Header Linked Lists-Circularly Linked Lists-Doubly Linked Lists-Linked Stacks and Queues-Polynomials-Polynomial Representation-Sparse Matrices.

Unit-III: Trees

Terminology-Representation of Trees-Binary Trees-Properties of Binary Trees-Binary Tree Representations-Binary Tree Traversal-Preorder-In-order and Post-order Traversal-Threads-Thread Binary Trees-Balanced Binary Trees-Heaps-Max Heap-Insertion into and Deletion

from a Max Heap-Binary Search Trees-Searching-Insertion and Deletion from a Binary Search Tree- Height of Binary Search Tree, m-way Search Trees, B-Trees.

Unit-IV: Graphs

Graph Theory Terminology-Graph Representation-Graph Operations-Depth First Search-Breadth First Search-Connected Components-Spanning Trees-Biconnected Components-Minimum Cost Spanning Trees-Kruskal's Algorithm-Prism's Algorithm-Shortest Paths-Transitive Closure-All- Pairs Shortest Path-Warshall's Algorithm.

Unit-V: Searching and Sorting

Searching -Linear Search-Binary Search-Fibonacci Search-Hashing-Sorting-Definition-Bubble Sort-Insertion sort-Selection Sort-Quick Sort-Merging-Merge Sort-Iterative and Recursive Merge Sort-Shell Sort-Radix Sort-Heap Sort.

Text Books:

1. Fundamentals of Data Structures in C, 2nd Edition, E.Horowitz, S.Sahni and Susan Anderson Freed, Universities Press Pvt. Ltd.
2. Data Structures with C, Seymour Lipschutz, Schaum's Outlines, Tata McGraw Hill

Reference Books:

1. Data structures: A Pseudo code Approach with C, 2nd edition, R.F.Gilberg & B.A.Forouzan, Cengage Learning.
2. Data structures and Algorithm Analysis in C, 2nd edition, M.A.Weiss, Pearson.
3. Data Structures using C, A.M.Tanenbaum,Y. Langsam, M.J.Augenstein, Pearson.
4. Data structures and Program Design in C, 2nd edition, R.Kruse, C.L.Tondo and B.Leung, Pearson.

Course Outcomes (COs):

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

CO_1 data structures concepts with arrays, stacks, queues.

CO_2 linked lists for stacks, queues and for other applications.

CO_3 traversal methods in the Trees.

CO_4 various algorithms available for the graphs.

CO_5 sorting and searching in the data ret retrieval applications.

List of Experiments:

1. Implement operations on Strings.

2. Implement basic operations on Stacks.

3. Implement basic operations on Queue.

4. Implement basic operations on Circular Queue.

5. Implement multi stack in a single array.

6. Implement List data structure using i) array ii) singly linked list.

7. Implement basic operations on doubly linked list.

8. Implement basic operations (insertion, deletion, search, find min and find max) on Binary Search trees.

9. Implementation of Heaps.

10. Implementation of Breadth First Search Techniques.

11. Implementation of Depth First Search Techniques.

12. Implementation of Prim's algorithm.

13. Implementation of Kruskal's Algorithm.

14. Implementation of Linear search.

15. Implementation of Fibanocci search.

16. Implementation of Merge sort.

17. Implementation of Quick sort.

Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
EE3CO49	Electrical Circuit Analysis	3	0	2	4

Course Learning Objectives (CLOs):

CLO 1 To gain knowledge of graph theory and coupled circuits.

CLO 2 Solving networks using different theorems.

CLO 3 To study Transients analysis of electrical circuits in time domain and to know about various passive filters.

CLO 4 To study different two port networks and different network functions.

CLO 5 To get idea of network synthesis.

Unit-I Graph Theory & Circuits

Network topology, concept of network graph, tree, tree branch & link, incidence matrix, cut set and tie set matrices, self and mutual inductance, analysis of magnetically coupled circuits, dot convention, co-efficient of coupling, Resonance: Band Width and Q-factor for parallel resonant circuits

Unit- II Network theorems for ac & dc circuits

Superpositions theorem, Reciprocity theorem, Compensation theorem, Maximum power transfer, and Millman's theorem, Tellegen"s theorem, problems with dependent & independent sources, Concept of duality and dual networks

Unit- III Transient analysis & Filters

Transient study in RL, RC & RLC networks by Laplace transform method with DC and AC excitation, Response to step, impulse and ramp inputs

Passive Filter: Brief idea about network filters (Low pass, High pass, Band pass and Band elimination) and their frequency response

Unit- IV Two port networks & network functions

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

Concept of complex frequency, driving point and transfer functions for two port network, poles and zeros of network functions, Time domain behavior from pole-zero plot.

Unit- V Network Synthesis

Realizability concept, Hurwitz property, positive realness, properties of positive real functions, Synthesis of R-L, R-C and L-C driving point functions, Foster and Cauer forms

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

4. Sukhija & Nagsarkar: Circuits & Networks: Analysis, Design and Synthesis, Oxford

5. Franklin Fa-Kun. Kuo: Network Analysis & Synthesis: John Wiley & Sons

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

CO_1 Analyse coupled circuits and various circuits using graph theory.

CO_2 Apply theorems for solutions of electrical networks.

CO_3 Analyse the transient condition of electrical networks and design the passive filters.

CO_4 Evaluate two-port network parameters and network functions.

CO_5 Synthesize one port network using Foster and Cauer forms.

List of Experiments

1. To verify Superposition theorem.
2. To verify Reciprocity theorem.
3. To verify Maximum Power Transfer theorem.
4. To verify Millmans theorem.
5. To verify Tellegens theorem.
6. To verify Compensation Theorem
7. To determine open circuit & short circuit parameters of a two-port network.
8. To determine the ABCD parameters of two port network.
9. To determine the h parameters of two port network.

10. Determination of self inductance, mutual inductance and coupling coefficient of a single phase two winding transformer representing a coupled circuit

11. Frequency response of Low pass and High Pass Filters.

12. Frequency response of Band pass and Band Elimination Filters

13. Study of resonance in R-L-C parallel circuit using oscilloscope

14. Study of DC and AC Transients for R-L, R-C & R-L-C circuits using storage oscilloscope.

Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
EE3CO50	Analog & Digital Electronics	3	0	2	4

Course Learning Objectives (CLOs):

CLO 1 Impart a basic knowledge of transistor such as BJT, FET, MOSFET to understand the impact of technology in a global and social context.

CLO 2 To empower students on the design and working of amplifier and oscillators.

CLO 3 To learn basic techniques for the design of digital circuits.

CLO 4 To understand the concepts of combinational logic circuits.

CLO 5 To understand the concepts of sequential circuits.

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, transfer and drain characteristics, equivalent model, CG, CS and CD configuration of FET. 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, boot-strapping technique, Darlington 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.

Unit-III

Digital Circuits: Digital (binary) operations of a system, OR gate, AND gate, NOT, EXCLUSIVE OR gate, De Morgan Laws, NAND and NOR DTL gates, modified DTL gates, HTL and TTL gates, output stages, RTL and DCTL, CMOS, Comparison of logic families.

UNIT - IV

Combinational Logic Circuits: Basic Theorems and Properties of Boolean Algebra, Canonical and Standard Forms, Digital Logic Gates, The Map Method, Product-of-Sums Simplification, Don't-Care Conditions, NAND and NOR Implementation, Exclusive-OR Function, Binary Adder-Subtractor, Decimal Adder, Binary Multiplier, Magnitude Comparator, Decoders, Encoders, Multiplexers.

UNIT – V

Sequential Logic Circuits: Sequential Circuits, Storage Elements: Latches and flip flops, Analysis of Clocked Sequential Circuits, State Reduction and Assignment, Shift Registers, Ripple Counters, Synchronous Counters, Random-Access Memory, Read-Only Memory.

TEXTBOOKS:

1. Integrated Electronics: Analog and Digital Circuits and Systems, 2/e, Jaccob Millman, Christos Halkias and Chethan D. Parikh, *Tata McGraw-Hill Education*, India, 2010.

2. Digital Design, 5/e, Morris Mano and Michael D. Cilette, *Pearson*, 2011.

Reference books:

1. Electronic Devices and Circuits, Jimmy J Cathey, *Schaum's outline series*, 1988.

2. Digital Principles, 3/e, Roger L. Tokheim, *Schaum's outline series*, 1994.

3. Salivahanan: Electronic Circuits Analysis and Design, TMH

Course Outcomes (COs):

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

CO_1 Know the characteristics of various components.
CO_2 Design and analyze amplifier circuits and oscillator circuits.
CO_3 Know about the logic families and realization of logic gates.
CO_4 Design and analyze combinational logic circuits.
CO_5 Design and analyze sequential logic circuits.

List of Experiments:

1. To determine Drain and Transfer Characteristics of JFET.
2. Full Wave Rectifier with & without filters
3. Common Emitter Amplifier Characteristics
4. Common Base Amplifier Characteristics
5. Common Source amplifier Characteristics
6. Measurement of h-parameters of transistor in CB, CE, CC configurations
7. Input and Output characteristics of FET in CS configuration

8. Realization of Boolean Expressions using Gates

9. Design and realization logic gates using universal gates

10. Generation of clock using NAND / NOR gates

11. Design a 4 – bit Adder / Subtractor

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-phse 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 Credits
		L	T	P	
EE3CO52	Electrical Machines-I	3	1	0	4

Course Learning Objectives (CLOs):

CLO_{01} To learn how to solve magnetic circuit and learn about various terms related to magnetic circuits.

CLO_{02} To learn the constructional features of transformers.

CLO_{03} To learn about the voltage regulation, efficiency and various tests on three phase and single phase transformers

CLO_{04} To Learn the working, constructional features, speed control, phasor diagram and regulation of three-phase Induction Motors.

CLO_{05} 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:

CO_{01}	**Understand** magnetic circuits, concepts of mmf, flux, reluctance etc. and solve magnetic circuits using energy and co-energy concepts.
CO_{02}	**Understand** the constructional features of Single-phase transformer, three-phase transformer; their voltage regulation and application.
CO_{03}	**Understand** constructional features, speed control, phasor diagram of three phase induction machines; working ,starting methods and types of single-phase induction motor.
CO_{04}	**Apply** the knowledge of transformer to perform various test like open circuit, short circuit and back to back test and operate transformers in parallel.
CO_{05}	**Apply** the knowledge of three-phase induction motor to perform no load and blocked rotor test and determine efficiency.
CO_{06}	**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(ωt), cos(ωt), tan(ωt) and sec(ωt), cosec(ωt) and cot(ωt) 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
		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 repreparation 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:

CO_{01}	The student will be able to understand concept of administration and management. Managerial role cross cultural issues and conflict resolution
CO_{02}	Student will be able to understand concept and fundamentals of marketing and human resource management and customer relationship management.
CO_{03}	Students will be familiarized with fundamentals of economic, Demand and supply meaning and phases of business cycle.
CO_{04}	Students will understand accounting and financial principle and their application in business.
CO_{05}	Students will understand time value of money price elasticity of demand types of inflation.

SEMESTER IV

S. No.	Course Code	Courses	L	T	P	Credit
1	EE3CO53	Microprocessors & Microcontrollers	3	0	2	4
2	EE3CO27	Signals & Systems	3	0	0	3
3	EE3CO54	Measurements & Instrumentation	3	1	0	4
4	EE3CO37	Electrical Machines -II	3	0	0	3
5	EE3CO55	Power Electronics	3	0	2	4
6	EN3NG10	Soft Skills -II	2	0	0	2
7	EE3CO56	Power System -I	3	0	0	3
8	EE3ES01	Python Programming	0	0	2	1
9	EE3CO29	Electromagnetic Theory	3	0	0	3
		Total	**23**	**1**	**6**	**27**
		Total Contact Hours	**30**			

Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
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:

CO_1 Know the concepts of the Microprocessor capability in general and explore the evaluation of microprocessors.

CO_2 Analyse the instruction sets - addressing modes - minimum and maximum modes operations of 8086 Microprocessors.

CO_3 Analyse the Microcontroller and interfacing capability.

CO_4 Describe the architecture and interfacing of 8051 controller.

CO_5 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
		L	T	P	Credits
EE3CO27	Signals and Systems	3	0	0	3

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. Wilsky and Nawab, Signal & system, Pearson Education.
2. Simon Haykin and Bary 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 Hill, Indian Reprint.
2. Michel J. Robert, "Fundamentals of Signals and Systems" MGH International Edition.
3. Anand Kumar, "Signal & System", PHI Learning.

Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
EE3CO54	Measurements & Instrumentation	3	1	0	4

Course Learning Objectives (CLOs):

CLO 1 To introduce the basic principles of all measuring instruments

CLO 2 To deal with the measurement of voltage, current, Power factor, power, energy and magnetic measurements

CLO 3 To understand the basic concepts of smart and digital metering

UNIT - I

Introduction to Measuring Instruments

Classification – deflecting, control and damping torques – Ammeters and Voltmeters – PMMC, moving iron type instruments – expression for the deflecting torque and control torque – Errors and compensations, extension of range using shunts and series resistance. Electrostatic Voltmeters – electrometer type and attracted disc type – extension of range of E.S. Voltmeters.

UNIT - II

Potentiometers & Instrument Transformers

Principle and operation of D.C. Crompton's potentiometer – standardization – Measurement of unknown resistance, current, voltage. A.C. Potentiometers: polar and coordinate type's standardization – applications. CT and PT – Ratio and phase angle errors

UNIT - III

Measurement of Power & Energy

Single phase dynamometer wattmeter, LPF and UPF, Double element and three element dynamometer wattmeter, expression for deflecting and control torques – Extension of range of wattmeter using instrument transformers – Measurement of active and reactive powers in balanced and unbalanced systems. Single phase induction type energy meter – driving and braking torques – errors and compensations – testing by phantom loading using R.S.S. meter. Three phase energy meter – tri-vector meter, maximum demand meters.

UNIT - IV

DC & AC Bridges

Method of measuring low, medium and high resistance – sensitivity of Wheat-stone's bridge – Carey

Foster's bridge, Kelvin's double bridge for measuring low resistance, measurement of high resistance

– loss of charge method.

Measurement of inductance- Maxwell's bridge, Hay's bridge, Anderson's bridge - Owen's bridge.

Measurement of capacitance and loss angle –Desaunty's Bridge - Wien's bridge – Schering Bridge.

UNIT - V

Transducers

Definition of transducers, Classification of transducers, Advantages of Electrical transducers, Characteristics and choice of transducers; Principle operation of LVDT and capacitor transducers; LVDT Applications, Strain gauge and its principle of operation, gauge factor, Thermistors, Thermocouples, Piezo electric transducers, photovoltaic, photo conductive cells, and photo diodes.

Text Books:

1. G. K. Banerjee, "Electrical and Electronic Measurements", PHI Learning Pvt. Ltd., 2nd Edition, 2016

2. S. C. Bhargava, "Electrical Measuring Instruments and Measurements", BS Publications, 2012.

3. J.B.Gupta, "Electrical Measurements and Measuring Instruments", S K Kataria and Sons, 2012 edition.

4. J. Amarnath S. Kamakshaiah, Pannala Krishna Murthy, "Electrical Measurements and Measuring Instruments", Dreamtech Press, 2019 edition.

Reference Books:

1. A. K. Sawhney, "Electrical & Electronic Measurement & Instruments", Dhanpat Rai & Co. Publications, 2005.

2. R. K. Rajput, "Electrical & Electronic Measurement & Instrumentation", S. Chand and Company Ltd., 2007.

3. Buckingham and Price, "Electrical Measurements", Prentice – Hall, 1988.

4. Reissland, M. U, "Electrical Measurements: Fundamentals, Concepts, Applications", New Age International (P) Limited Publishers, 1st Edition 2010.

5. E.W. Golding and F. C. Widdis, "Electrical Measurements and measuring Instruments", Fifth Edition, Wheeler Publishing, 2011.

Course Outcomes (COs):

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

CO_1 Understand different types of measuring instruments, their construction, operation and characteristics

CO_2 Measure the voltage and current through potentiometers and instrument transformers

CO_3 **C**hoose the suitable method for measurement of active, reactive powers and energy

CO_4 Apply the suitable method for measurement of resistance, inductance and capacitance

CO_5 Know the operational concepts of various transducers

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

Course Learning Objectives (CLOs):

- **CLO_{01}** To learn the constructional features of DC machine and methods of excitation of DC generators.
- **CLO_{02}** To learn about the working, starting methods, losses and efficiency of DC motor.
- **CLO_{03}** To Learn the working, constructional features, excitation, phasor diagram and regulation of synchronous generator.
- **CLO_{04}** To Learn the working and constructional features of salient pole machine & to know about the parallel operation of synchronous generators.
- **CLO_{05}** 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 Xd and Xq 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, Electrical Machines and power Systems, Prentice Hall.
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:

- **CO_{01}** Understand the constructional features of DC machine, methods of excitation of DC generators and working, starting and efficiency of DC Motor.
- **CO_{02}** Understand constructional features, excitation, phasor diagram of synchronous machine and parallel operation of synchronous generators, working of hysteresis motor, stepper motor and BLDC motor.
- **CO_{03}** Apply the knowledge of DC machines to solve complex problems related to DC generator and motor.
- **CO_{04}** Apply the knowledge of synchronous machine to solve complex problems related to synchronous generator and motor.
- **CO_{05}** 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
EE3CO55	Power Electronics	3	0	2	4

Course Learning Objectives (CLOs):

CLO 1 To know the characteristics of various power semiconductor devices.

CLO 2 To learn the operation of single phase full–wave converters and perform harmonic analysis of input current.

CLO 3 To learn the operation of three phase full–wave converters and AC/AC converters.

CLO 4 To learn the operation of different types of DC-DC converters.

CLO 5 To learn the operation of PWM inverters for voltage control and harmonic mitigation.

UNIT – I

Power Semi-Conductor Devices

Silicon controlled rectifier (SCR) – Two transistor analogy - Static and Dynamic characteristics – Turn on and Turn off Methods - Triggering Methods (R, RC and UJT) – Snubber circuit design.

Static and Dynamic Characteristics of Power MOSFET and Power IGBT– Gate Driver Circuits for Power MOSFET and IGBT - Numerical problems.

UNIT – II

Single-phase AC-DC Converters

Single-phase half-wave controlled rectifiers - R and RL loads with and without freewheeling diode - Single-phase fully controlled mid-point and bridge converter with R load, RL load and RLE load - Continuous and Discontinuous conduction - Effect of source inductance in Single-phase fully controlled bridge rectifier – Expression for output voltages – Single-phase Semi-Converter with R load-RL load and RLE load – Continuous and Discontinuous conduction - Harmonic Analysis – Dual converter and its mode of operation - Numerical Problems.

UNIT – III

Three-phase AC-DC Converters & AC – AC Converters

Three-phase half-wave Rectifier with R and RL load - Three-phase fully controlled rectifier with R and RL load - Three-phase semi converter with R and RL load - Expression for Output Voltage - Harmonic Analysis - Three-phase Dual Converters - Numerical Problems.

Single-phase AC-AC power control by phase control with R and RL loads - Expression for rms output voltage – Single-phase step down and step up Cycloconverter - Numerical Problems.

UNIT – IV

DC–DC Converters

Operation of Basic Chopper – Analysis of Buck, Boost and Buck-Boost converters in Continuous Conduction Mode (CCM) and Discontinuous Conduction Modes (DCM) - Output voltage equations using volt-sec balance in CCM & DCM – Expressions for output voltage ripple and inductor current ripple – control techniques – Introduction to PWM control - Numerical Problems.

UNIT – V

DC–AC Converters

Introduction - Single-phase half-bridge and full-bridge inverters with R and RL loads – Phase Displacement Control – PWM with bipolar voltage switching, PWM with unipolar voltage switching - Three-phase square wave inverters - 1200 conduction and 1800 conduction modes of operation - Sinusoidal Pulse Width Modulation - Current Source Inverter (CSI) - Numerical Problems.

Text-Books:

1. Power Electronics: Converters, Applications and Design by Ned Mohan, Tore M Undeland, William P Robbins, John Wiley & Sons.

2. Power Electronics: Circuits, Devices and Applications – by M. H. Rashid, Prentice Hall of India, 2nd edition, 1998

3. Power Electronics: Essentials & Applications by L.Umanand, Wiley, Pvt. Limited, India, 2009.

Reference Books:

1. Elements of Power Electronics–Philip T.Krein. Oxford University Press; Second edition

2. Power Electronics – by P.S.Bhimbra, Khanna Publishers.

3. Thyristorised Power Controllers – by G. K. Dubey, S. R. Doradla, A. Joshi and R. M. K.Sinha, New Age International (P) Limited Publishers, 1996.

4. Power Electronics: by Daniel W.Hart, Mc Graw Hill.

Course Outcomes (COs):

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

CO_1 Illustrate the static and dynamic characteristics of SCR, Power-MOSFET and Power-IGBT.

CO_2 Analyse the operation of phase-controlled rectifiers.

CO_3 Analyse the operation of three-phase full–wave converters, AC Voltage Controllers and Cycloconverters.

CO_4 Examine the operation and design of different types of DC-DC converters.

CO_5 Analyse the operation of PWM inverters for voltage control and harmonic mitigation.

List of Experiments

1. Study of Characteristics of SCR, MOSFET & IGBT.
2. R, RC & UJT firing circuits for SCR.
3. SCR Commutation circuits.
4. Single phase half wave rectifier with R, RL, RLE load and freewheeling diode.
5. Single -Phase semi converter with R, RL & RLE loads and freewheeling diode.
6. Single -Phase fully controlled converter with R, RL & RLE loads and freewheeling diode.
7. Single-phase dual converter in circulating current & non circulating current mode of operation.
8. Three -Phase semi converter with R, RL & RLE loads and freewheeling diode.
9. Three -Phase fully controlled converter with R, RL & RLE loads and freewheeling diode.
10. Single -Phase AC Voltage Controller with R & RL loads.
11. Three -Phase AC Voltage Controller with R & RL loads.
12. Single -Phase step-down Cycloconverter with R & RL loads.
13. Single -Phase step-up Cycloconverter with R & RL loads.
14. Boost converter in Continuous Conduction Mode operation.
15. Buck converter in Continuous Conduction Mode operation
16. Buck-Boost converter in Continuous Conduction Mode operation
17. Single -Phase square wave bridge inverter with R & RL Loads.
18. Single - Phase PWM inverter.
19. Three-phase bridge inverter with 120^0 and 180^0 conduction mode.
20. BLDC motor speed control
21. Multilevel inverter (3 level)

Course Code	Course Name	Hours per week			Total
		L	T	P	Credits
EE3CO56	Power System-I	3	0	0	3

Course Learning Objectives (CLOs):

CLO 1 To understand the concepts of GMR, GMD and to determine the inductance and capacitance of composite and bundled conductors for various conductor configurations.

CLO 2 To classify the overhead transmission lines and to evaluate the performance of lines using various network models.

CLO 3 To classify the overhead line insulators, underground cables and to derive the voltage expression for insulator string, capacitance expression for single and multi-core cables.

CLO 4 To understand the mechanical design concept of overhead transmission lines by the help of sag calculation at various levels of support, sag template and string chart and to understand the concept of corona.

CLO 5 To compare various power plants and to understand the use of various terms related to economics of generation.

Unit-I

Transmission Line Parameters: 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-II

Performance of overhead Transmission Lines: 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, power flow through transmission line

Unit-III

Insulators and Cables: Insulators, types of insulators, voltage distribution over insulator string, string efficiency, methods of improving string efficiency. 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

Unit-IV

Mechanical design of overhead transmission lines: Line supports, Types of steel towers, cross arms, length of span, sag & tension calculation of transmission lines for supports at same level, effect of wind & ice loading, Factors affecting sag, support of line at two different levels, string chart, sag template, vibration and vibration dampers, Corona effect

Unit-V

Conventional energy sources and economics of Generation: Comparison of hydroelectric, thermal and nuclear power plants**,** 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, selection of generating unit, economics of power generation, depreciation, tariff, power factor improvement.

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:

CO_1 Define GMR, GMD and can derive expressions of inductance and capacitance for composite and bundled conductors using symmetrical and asymmetrical configurations.

CO_2 Analyze various transmission lines and can calculate constants of transmission lines for T and π network models.

CO_3 Differentiate various overhead line insulators and underground cables, explain the methods of improving string efficiency and can compare the capacitance of single core cable with multi-core cables.

CO_4 Explain about sag, sag template, string chart and corona effect and can enumerate the factors affecting sag.

CO_5 Compare various conventional power plants and can define terms related to economics of generation like demand factor, diversity factor, coincidence factor, utilization factor, connected load, maximum demand, load factor etc.

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
4.

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			
		L	T	P	Credits
EE3CO29	Electro-Magnetic Theory	3	0	0	**3**

Course Learning Objectives (CLOs):

CLO_{01} Impart a basic knowledge of Co-ordinate systems in scalar and vectors form.

CLO_{02} Provide working knowledge for the analysis of different charge distributions, electric flux density and its applications in electrostatic field.

CLO_{03} Develop skill to understand magnetostatics field and its applications. Understanding self-inductance and mutual inductance.

CLO_{04} Relate the working of electrostatic and magnetostatics field. Understanding how to solve wave equation for time varying fields.

CLO_{05} 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. Balmian: 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:

CO_{01}	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.
CO_{02}	To predict the behaviour of any electrical field effects and its application.
CO_{03}	Have knowledge of magnetic field and its applications in electrical field. Able to understand basics concepts of self-inductance and mutual inductance.
CO_{04}	To understand behaviour of any electrical and magnetic field effects in a combined form and able to solve wave equation for time varying fields.
CO_{05}	To be able to analyze polarization reflection and transmission line analogy.

SEMESTER V

S. No.	Course Code	Courses	L	T	P	Credit
1	EE3CO41	PLC & Applications Lab	0	0	2	1
2	EE3CO40	Power System -II	3	0	2	4
3	EE3ES04	Data Analysis with Python	2	0	2	3
4	EE3CO48	IOT Applications in Electrical Engineering Lab	0	0	2	1
5	EE3CO38	Electrical Machines Lab	0	0	2	1
6	EE3CO34	Control Systems	3	0	0	3
7	EE3EI01	Program Elective -I (PLC & Applications)	3	0	0	3
8	EE3EI03	Program Elective -II (IoT Applications in Electrical Engineering)	3	0	0	3
9	EN3NG009	Soft Skills -III	2	0	0	2
10	OE00093	Open Elective -I (Hybrid Electric Vehicles)	3	0	0	3
		Total	**19**	**0**	**10**	**24**
		Total Contact Hours	**29**			

Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
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 3ϕ induction motor operation by using Keypad.
19. To study the Variable frequency drive based 3ϕ induction motor operation by using Jog mode.
20. To study the Variable frequency drive based 3ϕ induction motor operation by using Pot meter (0-10) V.
21. To study the Variable frequency drive based 3ϕ 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
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:

CO_1 Apply the load flow solution to a power system using different methods.

CO_2 Compute optimal load scheduling of Generators.

CO_3 Form Zbus for a power system networks and analyze effect of Load Frequency Control for single area system.

CO_4 Analyze effect of Load Frequency Control for two area system.

CO_5 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
EE3ES04	Data Analysis Using Python	2	0	2	3

Course Learning Objectives (CLOs):

CLO 1 To develop a strong understanding of Python data structures like lists, tuples, dictionaries, and sets, and their applications in data analysis.

CLO 2 To learn the fundamental steps of the data analysis process, from dataset generation to insights extraction.

CLO 3 To explore advanced functionalities like vector stacking and statistical operations offered by NumPy for comprehensive data analysis.

CLO 4 To Practice handling missing values effectively within Pandas data frames to ensure accurate analysis results.

CLO 5 To develop skills in formatting and preparing data for effective visualization.

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.

Course Outcomes (COs):
After the completion of the course the student should be able to:

CO1 Exhibit a solid understanding of Python data structures, control statements, functions, and exception handling mechanisms essential for data analysis tasks.

CO2 Effective data cleaning and preprocessing techniques to identify and handle missing values, ensuring the quality and reliability of data for analysis.

CO3 Proficient in utilizing NumPy for array creation, manipulation, and statistical operations.

CO4 Demonstrate competence in data manipulation and analysis using Pandas, including importing, indexing, renaming columns, concatenating, merging, grouping, and handling missing values in data frames.

CO5 Acquire skills in formatting and preparing data for visualization and gain proficiency in exploratory data analysis techniques.

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 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 things peak 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 Credits
		L	T	P	
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 magnetization 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
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:

CO_1 Derive the transfer function of physical systems and determination of overall transfer function using block diagram algebra and signal flow graphs.

CO_2 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.

CO_3 Analyze the stability of LTI systems using frequency response methods.

CO_4 Design Lag, Lead, Lag-Lead compensators to improve system performance using Bode diagrams.

CO_5 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
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:

CO_1 Illustrate I/O modules of PLC systems and ladder diagrams

CO_2 Demonstrate various types of registers and programming instructions.

CO_3 Examine various types of PLC functions and its applications.

CO_4 Assess different data handling functions and its applications.

CO_5 Describe the analog operations and PID modules.

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, GonzaloSalgueiro, 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, CunoPfister, 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:

CO_1 know the various fundamentals, architectures and technologies of Internet of Things.

CO_2 discuss about various communication technologies used in the Internet of Things.

CO_3 acquire knowledge on the various device connectivity methods using web and internet in the IoT environment.

CO_4 explore various data acquisition methods, data handling using cloud for IoT applications.

CO_5 apply IoT to design Smart Home, Smart city, agriculture practices etc.

Course Code	Course Name	Hours Per Week			
		L	T	P	Credits
EN3NG09	Soft Skills-III	2	0	0	2

Unit-I

Curriculum Vitae: - Importance of Building a Curriculum Vitae: Why a CV is a crucial professional document. - Elements of Curriculum Vitae: Key components to include in a CV. - Model Curriculum Vitae: Analysing exemplary CVs. - Common Errors: Identifying and avoiding frequent mistakes. - Designing a Personalized Curriculum Vitae: Tailoring a CV to individual strengths and experiences.

Unit-II

Communication Skills: - Elements of Effective Communication. - Verbal and Non-verbal Communication. - Barriers to Effective Communication. - Presentation Skills. - Overcoming the Fear of Presentation. - Conversation Etiquette. - Art of Small Talk. **Building Communication Skills: -** Oral Communication. - Active Listening. - Engaging Speaking Skills. - Barriers to Communication. - Non-verbal Communication.

Unit-III

Group Discussion: - Need for and Importance of Group Discussion. - Skills Required for Effective GDs. - Do's and Don'ts ofGDs.-TypesofGDsTopics:-DomainSpecific.-Abstract.-Current Affairs. - Social Issues. - Techniques to Generate Points in a Group Discussion: Strategies to contribute effectively. - Roles in Group Discussion.

Unit-IV

Attitude Building: - Understanding the core concept of attitude.-DifferencebetweenAttitude and Behaviour. -Importance of Attitude in an Interview. -Personality Traits an Engineer Should Have. - Matching Profession to Your Personality: **Personal and Social Branding: -** Introduction to Self-branding. - Resume Building.-Video CV and Profiles. - Creating an Impressive Elevator Pitch. - Platforms for Branding. - Using Social Media Platforms Constructively.

Unit-V

Interview Techniques and Mock Interviews: - Common Interview Questions. - STAR Technique.-MockInterviews:Simulatedinterviewstopracticeandreceivefeedback.-Follow-up Etiquette: Sending thank you notes and inquiries post-interview.

Networking and Mentorship: - Importance of Networking: Building professional relationships forgrowth.- NetworkingPlatformsandEvents:Findingopportunitiestoconnectwithprofessionals.- SeekingMentorship:Identifyingpotentialmentorsandbuildingamentor-mentee relationship. - Giving Back: Becoming a mentor to others and sharing knowledge.

Textbooks:

1. Dr. Kalyana Chakravarthi and Elango K., Soft Skills for Managers, Wiley India.

Reference Books:

1. Gopalaswamy Ramesh And Mahadevan Ramesh,The Ace of Soft Skills: Attitude, Communication and Etiquette For Success, Pearson

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.

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.

Research Books:

1. Pistooa G. - "Power Sources - Models - Sustanability - Infrstructure and the market" - Elsevier 2008
2. Mi Chris - Masrur A. - and Gao D.W. - "Hybrid Electric Vehicle: Principles and Applications with Practical Perspectives" 1995.

Course Outcomes (COs):

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

CO_1 Know the concept of electric vehicles and hybrid electric vehicles.

CO_2 Familiar with different configuration of hybrid electric vehicles.

CO_3 Choose an effective motor for EV and HEV application

CO_4 Understand the power converters used in hybrid electric vehicles

CO_5 Know different batteries and other energy storage systems.

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
		L	T	P	Credits
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:

CO_1 Know the concepts of the Microprocessor capability in general and explore the evaluation of microprocessors.

CO_2 Analyse the instruction sets - addressing modes - minimum and maximum modes operations of 8086 Microprocessors.

CO_3 Analyse the Microcontroller and interfacing capability.

CO_4 Describe the architecture and interfacing of 8051 controller.

CO_5 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
		L	T	P	Credits
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 lighting 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:

CO_1 Analyze the effect of symmetrical faults and unsymmetrical faults.

CO_2 Illustrate the principles of arc interruption for application to high voltage circuit breakers of air - oil - vacuum - SF6 gas type.

CO_3 Analyse the working principle and operation of different types of electromagnetic protective relays.

CO_4 Acquire knowledge of protective schemes for generator and transformers for different fault conditions.

CO_5 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
		L	T	P	Credits
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, GonzaloSalgueiro, 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, CunoPfister, 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:

CO_1 know the various fundamentals, architectures and technologies of Internet of Things.

CO_2 discuss about various communication technologies used in the Internet of Things.

CO_3 acquire knowledge on the various device connectivity methods using web and internet in the IoT environment.

CO_4 explore various data acquisition methods, data handling using cloud for IoT applications.

CO_5 apply IoT to design Smart Home, Smart city, agriculture practices etc.

Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
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:

CO_1 Demonstrate the history, purpose and application areas of embedded systems.

CO_2 Understand the selection procedure of Processors in the embedded domain.

CO_3 Design Procedure for Embedded Firmware.

CO_4 Visualize the role of Real time Operating Systems in Embedded Systems.

CO_5 Evaluate the Correlation between task synchronization and latency issues.

Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
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 earning, 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:

CO_1 Illustrate and comprehend the basics of Machine Learning with Python

CO_2 Demonstrate the algorithms of Supervised Learning and be able to differentiate linear and logistic regressions

CO_3 Demonstrate the algorithms of Unsupervised Learning and be able to understand the clustering algorithms

CO_4 Evaluate the concepts of binning, pipeline Interfaces with examples

CO_5 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:

CO_1 Describe the construction and operation of different batteries for EV applications

CO_2 Describe charging algorithms of different batteries and balancing methods of battery packs

CO_3 Describe the different kinds of infrastructure needed in the charging stations

CO_4 Describe the requirements of battery management and their maintenance

CO_5 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):

CLO_{01}	To observe the concepts of feed forward neural networks and about feedback neural networks.
CLO_{02}	To learn various learning algorithms of neural network
CLO_{03}	To practice the concept of fuzziness involved in various systems and comprehensive knowledge of fuzzy logic control and to design the fuzzy control.
CLO_{04}	To analyze genetic algorithm, genetic operations and genetic mutations.
CLO_{05}	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:

CO_{01}	Understand feed forward neural networks and feedback neural networks.
CO_{02}	Understand various learning methods of neural network
CO_{03}	Analyze and appreciate the concepts of fuzzy set over classical set theory.
CO_{04}	Examine the concept of genetic algorithm.
CO_{05}	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 sectionalizes 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:

CO_1 discuss about various factors of distribution system.

CO_2 design the substation and feeders.

CO_3 determine the voltage drop and power loss

CO_4 apply the protection and coordination of distribution system.

CO_5 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:

CO_1 analyze solar radiation data, extraterrestrial radiation, and radiation on earth's surface.

CO_2 design solar photo voltaic systems and develop maximum power point techniques.

CO_3 explain wind energy conversion systems, wind generators.

CO_4 Illustrate the concept of Energy Production from Hydro and other sources.

CO_5 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			
		L	T	P	Credits
EE3PC07	Project -II	0	0	20	10

Project Implementation Plan

Finalizing the Choice for New Project/ Continuation of Old Project	• Finalize Title • Finalize supervisor • Presentation I	1st week
Implementation	• Interfaces • Databases • Full Implementation • Presentation II	6th week
Testing and Deployment	• Test Cases • Test Reporting • Presentation III	10th week
Report in Format (Spiral Binding)	• Evaluation by supervisor and 2 additional teachers	
Final Presentation	• 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	• 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.

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).