GM UNIVERSITY

COURSE DOCUMENT

2023 - SCHEME

B. Tech.
in
Electrical and Electronics Engineering

GM UNIVERSITY
Innovating Minds

School of Engineering
Faculty of Engineering & Technology

Semester-1			
S. No.	**Course Code**	**Course Title**	**Credits**
1	UE23EC101	Advanced Calculus and Linear Algebra	4.5
2	UE23EC102	Applied Physics for Engineering	4
3	UE23EC103	Semiconductor Devices and Circuits	3
4	UE23PSC104	Problem Solving through C-Programming	4
5	UE23IDT105	Innovative Design Thinking	1
6	UE23SSP106	Soft Skills and Professional Communication	1.5
7	23ECL17	Semiconductor Devices and Circuits Lab	1
8	23ECS18	Seminar	1
9	23ECR19	Presentation on Research Paper	1
10	HG23TCXXXX	Technical Skills	0
11	HG23TPYYYY	Life Skills	0
12	HG23CIVVVV	Innovation and Entrepreneurial Skills	0
13	HG23SAKKKK	Environmental Awareness and Community Services	0
14	HG23SAKKKK	Athletics, Sports, Yoga, Gymnasium	0
15	HG23SAKKKK	Cultural & Literary Activities	0
16	HG23CC####	Co-Curricular Activities (Seminar/Conference/Exhibition/Technical Competition)	0
17	HG23TPYYYY	Placement Training	0
		Total	**21**

Course Code	UE23EC101
Course Title	Advanced Calculus and Linear Algebra

Course Content

Series expansion and partial differentiation: Introduction to Calculus, Polar Coordinates and Parametric Equations. Taylor's and Maclaurin's series expansion for one variable (Statement only) – problems. Indeterminate forms - Hospital's rule - Problems. Partial differentiation, total derivative - differentiation of composite functions. Jacobian and problems. Maxima and minima for a function of two variables. Problems.

Activity: 2D plots for Cartesian and polar curves, Find the partial derivatives and Jacobians, Applications of Maxima and Minima.

Linear algebra: Elementary row transformation of a matrix, Rank of a matrix. Consistency and Solution of system of linear equations - Gauss-elimination method, Gauss-Jordan method and approximate solution by Gauss-Seidel method. Eigen values and Eigen vectors, Rayleigh's power method to find the dominant Eigen value and Eigen vector, Applications of Linear Algebra in Engineering.

Activity: Solution of system of linear equations using Gauss-Seidel iteration, Compute Eigen values and Eigen vectors and find the largest and smallest eigenvalues by Rayleigh power method.

Vector Space: Definition and examples, subspace, linear span, linearly independent and dependent sets, Basis and dimension.

Linear transformations: Definition and examples, Algebra of transformations, Matrix of a linear transformation. Change of coordinates, Rank and nullity of a linear operator, Rank-Nullity theorem. Projections and least squares, Inner product spaces and orthogonality, Gram-Schmidt orthogonalization.

Activity: Computation of basis and dimension for a vector space and graphical representation of linear transformation, Visualization in time and frequency domain of standard functions.

Integral Calculus: Multiple Integrals: Evaluation of double and triple integrals, evaluation of double integrals by change of order of integration, changing into polar coordinates. Applications to find Area and Volume by double integral, Problems.

Beta and Gamma functions: Definitions, properties, relation between Beta and Gamma functions. Problems.

Activity: Program to compute area and volume, Evaluation of improper integrals.

Vector Differentiation: Scalar and vector fields. Gradient, directional derivative, curl and divergence - physical interpretation, solenoidal and irrotational vector fields. Problems.

Vector Integration: Line integrals, Surface integrals, Volume integrals. Applications to work done by a force and flux. Statement of Green's theorem and Stoke's theorem. Problems.

Activity: Find the Gradient, divergent, curl and their geometrical interpretation and verification of Green's theorem.

Course Code	UE23EC102
Course Title	Applied Physics for Engineering

Course Content

Electrical Properties of Materials:

Conductors: Quantum Free Electron Theory of Metals: Assumptions, Fermi-energy, Fermi factor, Variation of Fermi Factor with Temperature and Energy, Mention of expression for electrical conductivity.

Superconductivity: Introduction to Superconductors, Temperature dependence of resistivity, Meissner Effect, Critical Field, Temperature dependence of Critical field, Types of Super Conductors, BCS theory (Qualitative), High-Temperature superconductivity, SQUID, Numerical problems.

Activity:

- Create a graph showing how the Fermi factor varies with temperature and energy. Discuss the implications of these variations on the conductivity of metals.
- Research and present examples of superconducting materials. Discuss their applications and significance in various fields.

Semiconductors : Semiconductors: Fermi level in Intrinsic and extrinsic Semiconductor, Expression for concentration of electrons in conduction band & holes concentration in valance band (only mention the expression), Relation between Fermi energy & Energy gap in intrinsic semiconductors (derivation), Law of mass action, Electrical conductivity of a semiconductor (derivation), Hall effect, Expression for Hall coefficient (derivation) and its application. Numerical problems.

Activity:

- Discuss how the Hall coefficient can provide information about the type and concentration of charge carriers in a semiconductor.
- Conduct a hands-on experiment demonstrating the concept of Fermi level. Use a model or simulation to show how the Fermi level changes in an intrinsic and extrinsic semiconductor.

Optical Communication: LASER: Characteristic properties of a LASER beam, Interaction of Radiation with Matter, Einstein's A and B Coefficients and Expression for Energy Density (Derivation), Laser Action, Population Inversion, Metastable State, Requisites of a laser system, Semiconductor Diode Laser, Applications: Bar code scanner, Laser Printer, Numerical Problems.

Activity:

- Set up a simple laser apparatus in the laboratory and demonstrate the properties of a laser beam, such as coherence, mono chromaticity, and directionality.

- Divide students into groups and assign each group a specific application of lasers (e.g., bar code scanner or laser printer). Have them research and present the working principles and advantages of the assigned application.

Optical Fiber: Principle and Structure, Propagation of Light, Acceptance angle and Numerical Aperture (NA), Derivation of Expression for NA, Modes of Propagation, RI Profile, Classification of Optical Fibers, Attenuation and Fiber Losses, Applications: Fiber Optic networking Numerical Problems.

Activity:

- Guide students through the derivation of the expression for Numerical Aperture. Discuss the significance of NA in determining the light-gathering ability of an optical fiber.
- Use a visual aid or simulation to illustrate the different modes of propagation in optical fibers.

Nanotechnology & Nano electronics Devices

Introduction to Nano Materials: Nanomaterial and nanocomposites.

Nano-electronics Devices: Introduction – electron density in bulk material – Size dependence of Fermi energy– quantum confinement – quantum structures – Density of states in quantum well, quantum wire and quantum dot structures, Carbon Nano Tubes and their properties.

Activity:

- Engage students in a brainstorming session on the challenges and opportunities in scaling down electronic devices to the Nanoscale.
- Conduct a hands-on activity where students create models or visual representations of quantum well, quantum wire, and quantum dot structures.

Course Code	UE23EC103
Course Title	Semiconductor Devices and Circuits

Course Content

Semiconductor Diodes and Applications: p-n junction diode, Equivalent circuit of diode, Rectification-Half wave rectifier, Full wave rectifier, Bridge rectifier, Capacitor filter circuit, Zener Diode, Zener diode as a voltage regulator. Photodiode, LED, Photo coupler.

BJT Applications, Feedback Amplifiers and Oscillators: Introduction to BJT, BJT as an amplifier, BJT as a switch, Transistor switch circuit to switch ON/OFF an LED and a lamp in a power circuit using a relay.

Feedback Amplifiers: Principle, Properties and advantages of Negative Feedback, Types of feedback, Voltage series feedback, Gain stability with feedback

Oscillators: Barkhaunsen's criteria for oscillation, RC Phase Shift oscillator, Wien Bridge oscillator, IC 555 Timer and Astable Oscillator using IC 555.

FET and SCR: Introduction, JFET: Construction and operation, JFET Drain Characteristics and Parameters, JFET Transfer Characteristic, Square law expression for I/O, Input resistance, MOSFET: Depletion and Enhancement type MOSFET-Construction, Operation, Characteristics and Symbols, Silicon Controlled Rectifier (SCR): Two-transistor model, Switching action, Characteristics.

Operational Amplifiers and Applications: Introduction to Op-Amp, Op-Amp Input Modes, Op-Amp Parameters - CMRR, Input Offset Voltage and Current, Input Bias Current, Input and Output Impedance, Slew Rate, Applications of Op-Amp: Inverting amplifier, Non-Inverting amplifier, Summer, Voltage follower.

Communication Basics: Modern communication system scheme, Information source, Input transducer, Transmitter, Channel – Hardwired and Soft-wired, Noise, Receiver, Multiplexing, Types of communication systems, Types of modulation (only concepts) – AM, FM, PM, Digital Modulation Schemes – ASK, FSK, PSK, Cellular Wireless Networks – Introduction, Cellular telephone system, cellular concept and frequency reuse.

Course Code	UE23EC104
Course Title	Problem Solving through C-Programming

Course Content

Introduction to Computers and C Programming: Introduction to computers, input and output devices, designing efficient programs. Introduction to C, Structure of C program, Files used in a C program, Compilers, Compiling and executing C programs, keywords, identifiers, Basic Data Types in C, variables, constants, Input/output statements in C.

Operators and Decision-making statements: Operators in C, Type conversion and typecasting. Introduction to decision control, Conditional branching statements, iterative statements, nested loops, break and continue statements, go to statement, Programming Examples.

Function: Introduction to functions, function definition, function declaration, function call, return statement, passing parameters to functions, storage classes, recursive functions., Programming Examples.

Arrays: Declaration of arrays, accessing the elements of an array, storing values in arrays, operations on arrays, passing arrays to functions, two dimensional arrays, operations on two-dimensional arrays, passing two dimensional arrays to functions, multidimensional arrays, Programming Examples.

Strings Introduction to strings, Suppressing Input, string taxonomy, and operations on strings, miscellaneous string and character functions, arrays of strings, Programming Examples.

Pointers: Introduction to pointers, declaring pointer variables, null pointers, generic pointers, passing arguments to functions using pointers, Programming Examples.

Structure, Union and files: Introduction to structures, union and files, Programming Examples.

Course Code	UE23IDT105
Course Title	Innovative Design Thinking

Course Content

Introduction to Design thinking: What is design thinking, Principles of design thinking, The process of design thinking.

Understand and Define Problem: How to understand problem, Search field determination, Problem clarification, understanding of the problem, How to define problem-point of view phase,

Finding and Selection of Ideas: How to find & select ideas, Ideate phase, The creative process & creative principles, creativity techniques-Brainstorming & Mind mapping, Evaluation of ideas-Strength Weakness and Opportunities Threats (SWOT) analysis.

Prototyping and Testing: How to prototype, prototype phase, Lean startup method for prototype development-Principles & Benefits, Visualization and presentation techniques, Test phase, Tips for prototype testing.

Design Thinking Activity Based Learning: Design thinking activities on understand and Define problem, Ideate, prototype and presentation.

Course Code	UE23SSP106
Course Title	Soft Skills and Professional Communication

Course Content

Introduction to Soft Skills: Introduction to Soft skills vs Hard skills**,** Personality development: knowing you, positive thinking, Johari's window, communication skills, non-verbal communication, and physical fitness.

Emotional Intelligence: Meaning and Definition Need for Emotional Intelligence, Intelligence Quotient Versus Emotional Intelligence Quotient, Components of Emotional Intelligence, Competencies of Emotional Intelligence, Skills to Develop Emotional Intelligence.

Etiquette, Mannerism and Communication: Etiquette and Mannerism: Introduction, Professional Etiquette, Technology Etiquette.

Communication Today: Significance of Communication, GSC's 3M Model of Communication, Vitality of the Communication Process, Virtues of Listening, Fundamentals of Good Listening, Nature of Non-Verbal Communication, Need for Intercultural Communication, Communicating Digital World.

Academic Skills: Employment Communication: Introduction, Resume, Curriculum Vitae, Scannable Resume, Developing an Impressive Resume, Formats of Resume, Job Application or Cover Letter.

Professional Presentation: Nature of Oral Presentation, Planning a Presentation, Preparing the Presentation, Delivering the Presentation.

Job Interviews: Introduction, Importance of Resume, Definition of Interview, Background Information, Types of Interviews, Preparatory Steps for Job Interviews, Interview Skill Tips, Changes in the Interview Process, FAQ During Interviews.

Course Code	23ECL17
Course Title	Semiconductor Devices and Circuits Lab

Course Content

1. Realize the characteristics of PN junction diode and Zener diode.
2. Realize Half-wave and Full-Wave Rectifier with and without Filters.
3. Design and implement a 5V power supply unit using regulate IC.
4. Study the output and transfer characteristics of JFET.
5. Study the static characteristics of SCR.
6. Determine the transfer and drain characteristics of an enhancement and depletion mode MOSFET.
7. Design a BJT amplifier and determine its gain, bandwidth for a given input.
8. RealizeAstable multi-vibrator circuit using 555 timer for a given frequency and duty cycle.
9. Realize all Op-Amp applications using IC 741. (Inverting, Non-Inverting, Differentiator, Integrator circuit.)
10. Realize RC Phase Shift and Wien Bridge Oscillator

Semester-2			
S. No.	**Course Code**	**Course Title**	**Credits**
1	UE23EC1201	Engineering Mathematics - II	3
2	UE23EC1202	Chemistry for Electronics Engineering	2
3	UE23EE1203	Introduction to Electrical Engineering	3
4	UE23EE1204	Renewable Energy Sources	3
5	UE23EE1205	Problem Solving through Python Programming	3
6	UE23EE1206	Basic Electrical Practice	1
7	UE23EE1207	Basics of CAED practice	1
8	HG23TCXXXX	Technical Skills	2
9	HG23TPYYYY	Life Skills	1
10	HG23CIVVVV	Innovation and Entrepreneurial Skills	0
11	HG23SAKKKK	Environmental Awareness and Community Services	1
12	HG23SAKKKK	Athletics, Sports, Yoga, Gymnasium	0
13	HG23SAKKKK	Cultural & Literary Activities	0
14	HG23CC####	Co-Curricular Activities (Seminar/Conference/Exhibition/Technical Competition)	0
15	HG23TPYYYY	Placement Training	0
		Total	**20**

Course Code	UE23EE1201
Course Title	Engineering Mathematics - II

Course Content

Numerical Methods -I: Interpolation using Newton's forward and backward difference formulae, Newton's divided difference formula and Lagrange's interpolation formula (All formulae without proof), Problems.

Numerical integration: Simpson's $(1/3)^{rd}$ and $(3/8)^{th}$ rules , Weddle's rule (without proof).

Numerical Methods –II: Numerical Solution of Ordinary Differential Equations (ODE's): Taylor's series method, Modified Euler's method, Runge-Kutta method of fourth order, Milne's predictor-corrector method and Adam's- Bashforth method (No derivations), Problems.

Higher Order differential equations: Higher-order linear ODE's with constant coefficients - Inverse differential operator, method of variation of parameters, Cauchy's and Legendre homogeneous differential equations, Problems.

Partial Differential Equations: Formation of PDE's by elimination of arbitrary constants and functions, Solution of non-homogeneous PDE by direct integration, Homogeneous PDEs involving derivative with respect to one independent variable only. Solution of Lagrange's linear PDE, Derivation of one-dimensional heat equation and wave equation.

Laplace Transform: Existence and Uniqueness of Laplace transform (LT), transform of elementary functions and region of convergence.

Properties–Linearity, Scaling, t-shift property, s-domain shift, differentiation in the s-domain, division by t, differentiation and integration in the time domain. LT of special functions of periodic functions (square wave, saw-tooth wave, triangular wave, full & half wave rectifier), Heaviside Unit step function, Unit impulse function.

Inverse Laplace Transforms: Definition, properties, evaluation using different methods, convolution theorem (without proof), problems, and applications to solve ordinary differential equations.

Course Code	UE23EE1202
Course Title	Chemistry for Electronics Engineering

Course Content

Energy Conversion and Storage

Electrode System: Introduction, Ion selective electrode – definition, construction, working and applications of glass electrode. Reference electrode- Introduction, calomel electrode– construction, working and applications of calomel electrode. Electrolyte Concentration cell– Definition, construction and Numerical problems.

Battery technology: Introduction, Classification of batteries, Explain the Construction, working and applications Lithium ion and Sodium – ion batteries.

Green fuel: Construction, working and applications of PV cell.

Fuel cells: Types of fuel cells. Construction, working and application of Methanol-Oxygen fuel cell and polymer electrolyte membrane (PEM) fuel cell.

Corrosion Science and Surface Modification

Corrosion science: Definition, Chemical corrosion and Electro-chemical theory of corrosion, Types of corrosion, Differential metal corrosion, Differential aeration corrosion (pitting and water line corrosion).

Corrosion control: Inorganic coatings-Anodization. Metal coatings-Galvanization and its disadvantages. Cathodic protection of Corrosion, Sacrificial anode method and current impression method. Corrosion Penetration Rate (CPR) - introduction and numerical problem.

Surface Modification Techniques: Definition, Technological importance of metal finishing. Electroplating of Chromium. Electro less Plating. Difference between electroplating and Electro less plating.

Printed Circuit Boards: Electro less plating of copper in the manufacture of double –sided PCB and its applications.

Nano Materials and Display Systems

Nanomaterials: Introduction, size dependent properties of nanomaterials (Surface area, Catalytic, Conducting), preparation of nanomaterials by sol-gel and precipitation method with example. Introduction, properties and applications. Nano-photonics and Nano-sensors.

Display Systems: Liquid crystals (LC's)-Introduction, classification, properties and application in Liquid Crystal Displays (LCD's). Properties and application of Organic Light Emitting Diodes (OLED's) and Quantum Light emitting diodes (QLED's).

Perovskite Materials: Introduction, properties and applications in optoelectronic devices.

Polymers Materials in Hardware

Polymers: Introduction to polymers, structure and property relationship. Synthesis, properties and applications of Kevlar fiber, preparation, properties and commercial applications of carbon fibre.

Conducting polymers: Definition, mechanism of conduction in oxyacetylene. Structure and applications of conducting polyaniline and its commercial applications.

Composites: Introduction, properties and industrial applications of carbon-based reinforced composites (grapheme/carbon Nano-tubes as fillers) and metal matrix polymer composites.

Analytical Techniques and E-waste management

Analytical Techniques: Introduction, principle and in instrumentation of Colorimetric sensors; its application in the estimation of copper, principle and instrumentation of Potentiometric sensors; principle and instrumentation of its application in the estimation of iron, Conduct metric sensors; its application in the estimation of weak acid.

E-Waste: Introduction, sources of e-waste, Composition and Need of E-waste Management. Toxic materials used in manufacturing electronic and electrical products, health hazards due to exposure to e-waste. Recycling of E-waste by hydro-metallurgical and pyro-metallurgical methods. Role of stakeholders in the environmental management of e-waste: producers, consumers, recyclers, and statutory bodies.

Course Code	UE23EE1203
Course Title	Introduction to Electrical Engineering

Course content

DC Circuits: Ohm's law and Kirchhoff's laws and its limitations, Simple Analysis of series, parallel and series-parallel circuits, Definitions of Power and Energy and numerical.

Electromagnetism: Faraday's Laws of Electromagnetic Induction, Lenz's Law, Fleming's rules, statically and dynamically induced EMF, concepts of self and mutual inductance, coefficient of coupling, energy stored in magnetic field and numerical.

AC Fundamentals: Equation of AC Voltage and current, waveform, time period, frequency, amplitude, phase, phase difference, average value, RMS value, form factor, peak factor .

AC Circuits: Voltage and Current relationship of R, L and C circuits with Phasor diagrams, analysis of R-L, R-C, R-L-C Series circuits, numerical.

Three-phase circuits: Advantages of three phase systems, generations of three phase power, balanced supply and balanced load, relation between phase and line values of balanced star and delta connection, power in balanced three phase circuit, Measurement of three-phase power by two-wattmeter method.

DC Generator: Principle of operation, constructional details, induced emf expression, relation between induced emf and terminal voltage and numerical.

DC Motors: Construction, Principle of operation, back emf and its significance, Torque equation, types of DC motors and applications and numerical.

Single Phase Transformers: Construction and principle of operation, emf equation, losses, efficiency, condition for maximum efficiency, illustrative examples.

Three-phase Induction Motors: Concept of rotating magnetic field, Principle of operation, constructional features of motor, types – squirrel cage and wound rotor, slip and problems on the slip, significance of slip, applications.

Electricity Bill: Power rating of household appliances including air conditioners, PCs, laptops, printers, etc. Definition of "unit" used for consumption of electrical energy, two-part electricity tariff, calculation of electricity bill for domestic consumers.

Equipment Safety Measures: Electric Shock, Earthing and its types, working principle of Fuse and Miniature circuit breaker (MCB), merits and demerits.

Course Code	UE23EE1204
Course Title	Renewable Energy Sources

Course Content

Introduction: Principles of renewable energy; energy and sustainable development, Fundamentals and social implications. Worldwide renewable energy availability, Renewable energy availability in India, Brief descriptions on solar energy, Wind energy, Tidal energy, Wave energy, Ocean thermal energy, Biomass energy, Geothermal energy, oil shale, Introduction to Internet of energy (IOE).

Solar Energy: Fundamentals; Solar Radiation; Estimation of solar radiation on horizontal and inclined surfaces; solar radiation Measurements- Pyrheliometer, Pyrometer, Sunshine Recorder. Solar Thermal systems: Flat plate collector; solar distillation; solar pond electric power plant.

Solar Electric Power Generation: Principle of Solar cell, Photovoltaic system for electric power generation, advantages, Disadvantages and applications of solar photovoltaic system.

Wind Energy: Properties of wind, Availability of wind energy in India, Wind velocity and power from wind, Major problems associated with wind power, Basic components of wind energy conversion system (WECS); Classification of WECS- Horizontal axis- single, double and multiblade system, Vertical axis- Savonius and Darrius types.

Biomass Energy: Introduction, Photosynthesis Process, Biofuels, Biomass Resources Biomass conversion technologies-fixed dome, urban waste to energy conversion, Biomass gasification (Downdraft).

Green Energy: Introduction, Fuel cells: Classification of fuel cells – H2; Operating principles, Zero energy concepts, Benefits of hydrogen energy, Hydrogen production technologies (electrolysis method only), Hydrogen energy storage, Applications of hydrogen energy, Problem associated with hydrogen energy.

Course Code	UE23EE1205
Course Title	Problem Solving through Python Programming

Course Content

Python Basics

Entering Expressions into the Interactive Shell, The Integer, Floating-Point, and String Data Types, String Concatenation and Replication, Storing Values in Variables, Your First Program, Dissecting Your Program, Flow control: Boolean Values, Comparison Operators, Boolean Operators, Mixing Boolean and Comparison Operators, Elements of Flow Control, Program Execution, Flow Control Statements, Importing Modules, Ending a Program Early with sys.exit(), Functions: def Statements with Parameters, Return Values and return Statements, The None Value, Keyword Arguments and print(), Local and Global Scope, The global Statement, Exception Handling, A Short Program: Guess the Number.

Lists, Dictionaries and Structuring Data

The List Data Type, Working with Lists, Augmented Assignment Operators, Methods, Example Program: Magic 8 Ball with a List, List-like Types: Strings and Tuples, References, Dictionary Data Type, Pretty Printing, Using Data Structures to Model Real-World Things.

Manipulating Strings and Pattern Matching with Regular Expressions

Working with Strings, Useful String Methods, Project: Password Locker, Project: Adding Bullets to Wiki Markup, Finding Patterns of Text without and with Regular Expressions, More Pattern Matching with Regular Expressions, Greedy and Non-greedy Matching, The findall() Method, Character Classes, Making Your Own Character Classes, The Caret and Dollar Sign Characters, The Wildcard Character, Case-Insensitive Matching, Substituting Strings with the sub() Method, Combining re.IGNORECASE, re.DOTALL, and re.VERBOSE, Project: Phone Number and Email Address Extractor.

Reading, Writing and Organizing Files

Files and File Paths, The os.path Module, The File Reading/Writing Process, Saving Variables with the shelve Module, Saving Variables with the print.format() Function, Project: Generating Random Quiz Files, Project: Multiclipboard. The shutil Module, Walking a Directory Tree, Compressing Files with the zipfile Module, Project: Renaming Files with American-Style Dates to European-Style Dates, Project: Backing Up a Folder into a ZIP File.

Object Oriented Programming concepts in Python

Classes and objects: Programmer-defined types, Attributes, Rectangles, Instances as return values, Objects are mutable, Copying, Classes and functions: Time, Pure functions, Modifiers, Prototyping

versus planning, Classes and methods: Object-oriented features, Printing objects, Another example, A more complicated example, The _init_ method, The __str__ method, Operator overloading.

Course Code	UE23EE1206
Course Title	Basic Electrical Practice

Course Contents:

1. Conduct experiment to test diode clipping (single/double ended) and clamping circuits (positive/negative).
2. Realize BJT Darlington Emitter follower with and without bootstrapping and determine the gain, input and output impedances.
3. Design and set-up the crystal oscillator and determine the frequency of oscillation.
4. Design active second order Butterworth low pass and high pass filters.
5. Design 4-bit R – 2R Op-Amp Digital to Analog Converter (i) for a 4-bit binary input using toggle switches (ii) by generating digital inputs using mod-16.
6. Design and construct Schmitt trigger circuit for the UTP=4V and LTP=2V.
7. Design and test half wave and Full wave precision rectifiers using Op-Amp.
8. Determine Heartbeat Measurement using op-amp LM-358.
9. Design and test Full wave Controlled rectifier using RC triggering circuit.
10. Half wave rectifier using UJT Triggering circuit.
11. Design and test AC voltage controller using TRIAC/DIAC combination.
12. Design and test Monostable multivibrator using 555 timers.

Course Code	UE23EE1207
Course Title	Basics of CAED Practice

Course Content

1. **Introduction to CAED**: Introduction to CAED commands like line type, line weight, scale, unit, layer, filter, pan and view etc. Basics of using the software interface for electrical drawing.
2. **Electrical Symbols**: Standard symbols used in electrical circuits, components, and diagrams.
3. **Basic Design and Drafting Skills:** Creating layouts, applying scaling, and dimensioning in electrical drawings while utilizing layers and blocks efficiently.
4. Draw the cross section of underground cable.
5. Draw the residential wiring layouts (lighting circuit diagrams).
6. Draw the earthling setup for buildings or industrial.
7. Draw a layout for electrical distribution panels, including breakers, fuses, and bus bars.
8. Draw the single line diagram of 11kV substation.
9. Draw and Create BOM (Bill of Material): Electrical wiring of a residential building.
10. Draw the winding diagram of a DC machine having 4 poles, 14 slots and double layer lap winding.
11. Draw the top view and front view of three phase core type transformer.
12. Draw the rotor of an alternator.

Semester-3			
S. No.	**Course Code**	**Course Title**	**Credits**
1	UE23EE2301	Engineering Mathematics – III	3
2	UE23EE2302	Analog Circuit Design	3
3	UE23EE2303	Network Theory & Analysis	3
4	UE23EE2304	Transformers and Generators	3
5	UE23EE2305	Digital System Design	3
6	UE23EE2306	Analog and Digital Practice	1
7	UE23EE2307	Electrical Machines Practice	1
8	HG23TCXXXX	Technical Skills	2
9	HG23TPYYYY	Life Skills	1
10	HG23CIVVVV	Innovation and Entrepreneurial Skills	0
11	HG23SAKKKK	Environmental Awareness and Community Services	1
12	HG23SAKKKK	Athletics, Sports, Yoga, Gymnasium	1
13	HG23SAKKKK	Cultural & Literary Activities	0
14	HG23CC####	Co-Curricular Activities (Seminar/Conference/ Exhibition/Technical Competition)	0
15	HG23TPYYYY	Placement Training	1
		Total	**22**

Course Code	UE23EE2301
Course Title	Engineering Mathematics - III

Course Content

Fourier series: Introduction to infinite series, convergence and divergence. Periodic functions, Dirichlet's condition. Fourier series of periodic functions with period 2π and arbitrary period. Half range Fourier series. Practical harmonic analysis.

Fourier Transform: Infinite Fourier transforms: definition, Fourier sine and cosine transforms. Inverse Fourier transforms Inverse Fourier cosine and sine transforms. Problems.

Statistical Methods: Correlation and regression-Karl Pearson's coefficient of correlation and rank correlation, problems. Regression analysis, lines of regression, problems.

Curve Fitting: Curve fitting by the method of least squares- fitting the curves of the form- $y = ax + b$, y= ax^b, $y = ax^2 + bx + c$

Probability Distribution: Review of basic probability theory. Random variables (discrete and continuous), probability mass/density functions. Binomial, Poisson (derivation for mean and standard deviation), exponential and normal distributions- problems (No derivation for mean and standard deviation)-Illustrative examples.

Joint probability distribution: Joint Probability distribution for two discrete random variables, expectation, covariance and correlation.

Course Code	UE23EE2302
Course Title	Analog Circuit Design

Course Content

Transistor Biasing and stabilization: The operating point, load line analysis, DC analysis & design of transistor bias circuits, bias stabilization and stability factors for transistor bias circuits (Excluding Stability Factors Derivation).

Transistor at Low Frequencies: Hybrid model, h-parameter for Common Emitter, CC and CB modes, mid-band analysis of single stage amplifier, simplified model, analysis for CE, CB and CC (emitter voltage follower circuit) modes Miller Theorem and it's dual.

Multistage Amplifiers: Transistor as an amplifier, cascade and cascode connections, Darlington circuits analysis and design.

Power Amplifiers: Classification of Power Amplifiers, analysis and design of Class A – directly coupled and Transformer Coupled, Class B- complementary symmetry and Push Pull, class C and class AB. distortion in amplifiers, second harmonic distortion.

MOSFETs: Construction, working and characteristics MOSFETs (enhance and Depletion type).

Course Code	UE23EE2303
Course Title	Network Theory and Analysis

Course Content

Practical Sources and Network Transformations: Active and passive elements, Concept of ideal and practical sources. Source transformation and Source shifting, Analysis of networks by Network reduction method including star delta transformation.

Activity: Understanding the behavior of a given network by Source shifting.

Analysis Techniques for DC and AC Networks: Concept of Mesh and Node voltage methods, Super-Mesh and Super node analysis for ac and DC circuits with independent and dependent sources.

Activity: Verification of current and voltages of a given network.

Network Theorems: Superposition theorem, Thevenin's theorem, Norton's theorem and Maximum power transfer theorem.

Activity : Understanding of Millman's theorem.

Resonant Circuits: Analysis of simple series RLC and parallel RLC circuits under resonances. Problems on Resonant frequency, Bandwidth and Quality factor at resonance.

Transient Analysis: Transient analysis of RL and RC circuits under DC excitations: Behavior of circuit elements under switching action, Evaluation of initial conditions.

Laplace Transform: Laplace transform (LT), LT of Impulse, Step, Ramp, Sinusoidal signals and shifted functions. Initial and final value theorems.

Two Port networks: Definition, Open circuit impedance, Short circuit admittance and Transmission parameters and their evaluation for simple circuits.

Course Code	UE23EE2304
Course Title	Transformers and Generators

Course Content

Single Phase Transformers: Necessity of transformer, Types of transformer Construction and working of single phase transformer. EMF equation, Equivalent circuit, Operation of practical transformer under no-load and on-load with phasor diagrams. Open circuit and Short circuit tests, Calculation of equivalent circuit parameters and Predetermination of efficiency commercial and all-day efficiency. Voltage regulation and its significance, Numerical.

Three-Phase Transformers: Introduction, Constructional features of three-phase transformers. Choice between single unit three-phase transformer and a bank of three single-phase transformers. Transformer connection for three phase operation– star/star, delta/delta, star/delta, zigzag/star and V/V, comparative features. Phase conversion-Scott connection for three-phase to two-phase conversion. Labeling of three- phase transformer terminals, Vector groups, Numerical.

Tests & Parallel Operation of Transformer: Polarity test, Sumpner's test, Separation of hysteresis and Eddy current losses Numerical, Necessity of Parallel operation, Conditions for parallel operation– Single Phase and Three Phase, Load sharing in case of Similar and Dissimilar transformers, Numerical.

Auto Transformer Three-Winding Transformers & Cooling of Transformers: Introduction to auto transformer-copper economy, Equivalent circuit, NO load and ON load tap changing transformers Numerical. Three-winding transformers. Cooling of transformers, Numerical.

Synchronous Generators: Armature windings, Winding factors, E.M.F equation, Harmonics–causes, Reduction and elimination, Armature reaction, Synchronous reactance, Equivalent circuit.

Synchronous Generators Analysis: Alternator on load, Excitation control for constant terminal voltage, Voltage regulation, Open circuit and Short circuit characteristics, Assessment of reactance-Short circuit ratio, Synchronous Reactance, Voltage regulation by EMF, MMF and ZPF.

Synchronous Generators (Salient Pole): Effects of saliency, Two-reaction theory, Parallel operation of generators and load sharing, Methods of Synchronization, Synchronizing power, Determination of Xd &Xq – slip test.

Performance of Synchronous Generators: Power angle characteristic (salient and non-salient pole), power angle diagram, Reluctance power, Capability curve for large turbo generators. Hunting and Damper windings.

Course Code	UE23EE2305
Course Title	Digital System Design

Course Content

Principles of Combinational logic circuits

Definition of combinational logic, canonical forms, Generation of switching equations from truth tables, Karnaugh maps, incompletely specified functions (don‘t care terms simplifying Maxterm equations Quine-Mc Clusky techniques).

Design of Combinational Logic

General approach to combinational logic design, decoders, encoders, priority encoders, multiplexers using multiplexers as Boolean function generators, adders and subtractors, cascading full adders, look ahead carry, comparators.

Flip-Flops and Applications

Basic Bi-stable element, latches, master-slave flip-flops (pulse-triggered flip-flops): SR flip-flops, JK flip-flops, characteristic equations, registers, binary ripple counters, and synchronous binary counters.

Sequential Circuit Design: Design of asynchronous counter, design of asynchronous mod-n counter using clocked SR, JK, D, T flip-flops, Mealy and Moore models.

Course Code	UE23EE2306
Course Title	Analog and Digital Practice

Course Content:

1. Conduct experiment to test diode clipping (single/double ended) and clamping circuits (positive/negative).

2. Realize BJT Darlington Emitter follower with and without bootstrapping and determine the gain, input and output impedances.

3. Static Transistor characteristics for CE, CB and CC modes and determination of h-parameters.

4. Design and testing of class A and Class B Power amplifier and to determine conversion efficiency.

5. Frequency response of single stage BJT RC coupled amplifier & determination of half power points, bandwidth, input and output impedances.

6. Verify DE Morgan's Theorem for 2 variables.

7. The sum-of-product and product-of-sum expressions using universal gates.

8. Design and test circuits a) Half adder and full adder implementations using logic gates. b) Half subtract or and full subtract or implementations using logic gates.

9. Design and Implementation of a) 1bit digital comparator circuit that compares two binary numbers and produces comparison outputs (greater than, equal, or less than). b) 5 bit magnitude comparator using IC 7485.

10. Build and test circuits for 2-to-1 and 4-to-1 multiplexers, as well as 1-to-4 multiplexers.

11. Create a BCD-to-7-segment decoder circuit to convert binary-coded decimal inputs to outputs for driving a 7-segment display.

12. Construct following flip-flops like D, JK, T and SR flip-flops. Observe their behaviour with clock inputs and input changes.

13. Realize the following shift register i) SISO ii) SIPO iii) PISO iv) PIPO v) Ring vi) Johnson Counter.

14. Design Mod–N Synchronous Up counter and down counter. 15. Design Pseudo Random Sequence Generator.

Course Code	UE23EE2307
Course Title	Electrical Machines Practice

Course Content

1.Open Circuit and Short circuit tests on single phase step up or step down transformer and predetermination of (i) Efficiency and regulation (ii) Calculation of parameters for equivalent circuit.

2. Sumpner's test on similar transformers and determination of combined and individual transformer efficiency.

3. Parallel operation of two dissimilar single-phase transformers of different kVA and determination of load.

4. Polarity test and connection of 3 single-phase transformers in star – delta and determination of efficiency and regulation under balanced resistive load.

5. Comparison of performance of 3 single-phase transformers in delta – delta and V – V (open delta) connection under load. To determine experimentally the transfer function of the lag compensating network.

6. Investigate the voltage and current ratios of a multi-tapped transformer and verify the ideal transformer ratio.

7. Voltage regulation of an alternator by EMF and MMF methods.

8. Power angle curve of synchronous generator or direct load test on three phase synchronous generator to determine efficiency and regulation.

9.Model in Sim scape for Automatic Voltage Regulation. 10. Simulate power angle curve generator in MATLAB

Semester-4			
S. No.	**Course Code**	**Course Title**	**Credits**
1	UE23EE2401	Measurements and Instrumentation	2
2	UE23EE2402	Electric Motors	3
3	UE23EE2403	Embedded systems	4
4	UE23EE2404	Electromagnetic Field Theory	2
5	UE23EE2405	Power Plant Engineering	3
6	UE23EE2406	Electric Motors Laboratory	1
7	HG23TCXXXX	Technical Skills	2
8	HG23TPYYYY	Life Skills	1
9	HG23CIVVVV	Innovation and Entrepreneurial Skills	1
10	HG23SAKKKK	Environmental Awareness and Community Services	1
11	HG23SAKKKK	Athletics, Sports, Yoga, Gymnasium	1
12	HG23SAKKKK	Cultural & Literary Activities	1
13	HG23CC####	Co-Curricular Activities (Seminar/Conference/ Exhibition/Technical Competition)	0
14	HG23TPYYYY	Placement Training	1
		Total	**23**

Course Code	UE23EE2401
Course Title	Measurements and Instrumentation

Course Content

Measurement Standards: Sensitivity, Resolution, Accuracy and precision, absolute and Relative types of errors, Statistical analysis, Probability and Limiting errors, Linearity.

Review of indicating and integrating instruments: essentials of indicating instruments - deflecting, damping, controlling torques. Ammeters and voltmeters - moving coil, moving iron, constructional details and operation, principles shunts and multipliers – extension of range.

Measurement of Resistance Inductance and Capacitance: Measurement of low, medium and high resistances-Ammeter voltmeter method (for low and medium resistance measurements)-Kelvin's double bridge, Wheat stones bridge- loss of charge method. AC bridges for inductance and capacitance measurement. Measurement of frequency- Wien's bridge.

Instrument Transformers: Current and Potential transformers, ratio and phase angle errors, design considerations and testing.

Electronic Measurements: Electronic voltmeter, multi-meter, wattmeter, amp and energy meter. Time, Frequency and phase angle measurements using CRO: Spectrum & Wave analyzer. Digital counter, frequency meter, voltmeter, multi-meter and storage oscilloscope.

Instrumentation: Transducers, classification & selection of transducers, strain gauges, inductive and amp, capacitive transducers, piezoelectric and Hall-effect transducers, thermostats, thermocouples, photodiodes & amp, photo-transistors, encoder type digital transducers, signal conditioning and telemetry, basic concepts of smart sensors and application, data acquisition systems.

Course Code	UE23EE2402
Course Title	Electrical Motors

Course Content

DC Motors: Classification, Back emf, Torque equation, and significance of back emf, Characteristics of shunt, series & compound motors. Speed control of shunt, series and compound motors. Application of motors. DC motor starters – 3 point and 4 point. Losses and Efficiency- Losses in DC motors, power flow diagram, efficiency, condition for maximum efficiency.

Testing of DC Motors: Direct & indirect methods of testing of DC motors-Brake test, Swinburne's test, Retardation test, Hopkinson's test, Field's test, merits and demerits of tests.

Three Phase Induction Motors: Review of concept and generation of rotating magnetic field, Principle of operation, construction, classification and types; squirrel-cage, slip-ring (No question shall be set from the review portion). Slip, Torque equation, torque-slip characteristic covering motoring, generating and braking regions of operation, Maximum torque, significance of slip.

Performance of Three-Phase Induction Motor: Phasor diagram of induction motor on no-load and on load, equivalent circuit, losses, efficiency, No-load and blocked rotor tests. Performance of the motor from the circle diagram and equivalent circuit. Cogging and crawling. High torque rotors-double cage and deep rotor bars. Equivalent circuit and performance evaluation of double cage induction motor. Induction motor working as induction generator.

Starting and Speed Control of Three-Phase Induction Motors: Need for starter. Direct on line, Star-Delta, and autotransformer starting. Rotor resistance starting. Speed control by voltage, frequency, and rotor resistance methods Single-Phase Induction Motor: Double revolving field theory and principle of operation. Construction and operation of split-phase, capacitor start, capacitor run, and shaded pole motors. Comparison of single phase motors and applications.

Synchronous Motor: Principle of operation, phasor diagrams, torque and torque angle, Blondel diagram, effect of change in load, effect of change in excitation, V and inverted V curves. Synchronous condenser, hunting and damping. Methods of starting synchronous motors. Other Motors: Construction and operation of Universal motor, AC servomotor, Linear induction motor, and stepper motors.

Course Code	UE23EE2403
Course Title	Embedded Systems

Course Content

Introduction to Embedded System: Microprocessor Vs Microcontroller, Embedded Microcontrollers, 8051 Architecture- Registers, Pin diagram, I/O ports functions, Internal Memory organization, External Memory (ROM & RAM) interfacing.

Assembly Language Programming for 8051: Introduction to assembly language programming, Instruction set and addressing modes, writing simple programs for the 8051, Debugging and simulation tools.

8051 Timers and Serial Port:8051 Timers and Counters – Operation and Assembly language programming to generate a various signal on a port pin.8051 Serial Communication- Basics of Serial Data Communication, RS-232 standard,9 pin RS232 signals, Simple Serial Port programming in Assembly to transmit message and to receive data serially. Programming in C for 8051.

Programmable Logic Controllers: Introduction, Parts of a PLC, Principles of Operation, Modifying the Operation, PLCs versus Computers, PLC Size and Application. PLC Hardware Components: The I/O Section, Discrete I/O Modules, Analog I/O Modules, Special I/O Modules, I/O Specifications, The Central Processing Unit (CPU), Memory Design, Memory Types, ProgrammingTerminalDevices,RecordingandRetrievingData,HumanMachine Interfaces (HMIs).

Process Control, Network Systems, and SCADA: Types of Processes, Structure of Control Systems, On/Off Control, PID Control, Motion Control, Data Communications, Supervisory Control and Data Acquisition (SCADA).

Course Code	UE23EE2404
Course Title	Electromagnetic Field Theory

Course Content

Vector Analysis: Scalars and Vectors, Vector algebra, Sources and effects of electromagnetic fields, Coordinate Systems, Vector fields, Gradient, Divergence, Curl – theorems and applications.

Electrostatics: Electrostatic Fields, Coulomb's Law, Electric Field Intensity(EFI) due to point, Line, Surface and Volume charges, Work Done in Moving a Point Charge in Electrostatic Field, Electric Potential due to point charges, line charges and Volume Charges, Potential Gradient, Gauss's Law, Application of Gauss's Law, Maxwell's First Law, Divergence theorem – Numerical. Energy and Potential, Conductor and Dielectrics - Only Basics (Fundamental Approach).

Poisson's and Laplace Equations: Derivations and problems, Uniqueness theorem.

Steady magnetic fields: Biot-Savart's law, Ampere's circuital law, Concept of Curl, Stokes theorem, Magnetic flux and flux density, Scalar and vector magnetic potentials - Numerical.

Magnetic forces: Force on a moving charge and differential current element, Force between differential current elements. Force and torque on a closed circuit - Numerical.

Magnetic Materials and Magnetism: Nature of magnetic materials, magnetisation and permeability, Magnetic boundary conditions, Magnetic circuit, inductance and mutual inductance – Numerical.

Time Varying Fields and Maxwell's Equations: Faraday's law, Displacement current, Maxwell's equations in point form and integral form – Simple Problems.

Uniform plane wave: Uniform Plane Wave Motion in Free Space, Conductors and Dielectrics, Velocity - Wave Length - Intrinsic Impedance and Skin Depth (skin effect), Poynting Theorem – Poynting Vector (power considerations) and its Significance.

Course Code	UE23EE2405
Course Title	Power Plant Engineering

Course Content

Introduction: Energy resources and their availability, Types of power plant, Selection of the plants, Review of basic thermodynamic cycles used in power plants.

Thermal Power Plants: List the factors to be considered for selection of site, Draw the general layout of thermal (steam) power plant, Explain the construction and working of thermal power plant, Advantages and disadvantages of thermal power plant, Combustion process: properties of coal- overfeed and underfeed fuel beds, Pulverized fuel burning system and its components, Dust collectors, Cooling towers and heat rejection, Environmental impact of thermal power plant.

Nuclear Power Plants: List the factors to be considered for selection of site, Schematic diagram and working of nuclear power plant, Nuclear reaction, nuclear fission process, Nuclear chain reaction, Nuclear energy, Nuclear reactor and its control, Nuclear wastes and nuclear waste disposal list.

Hydroelectric Power Plants: Introduction, List the factors to be considered for selection of site. Classify hydroelectric power plants based on the available head of water, plant capacity, load and construction. Draw the general layout of hydro power plant, briefly explain the main components- catchment area, Reservoir, Fore bay, Dam, Spillway, Trash rack, Surge tank, Penstock, Prime mover, Alternator, Draft tube and Tailrace, Environmental impact of hydro power plant.

Solar Energy: Principle of conversion of solar radiation in to heat, Applications- solar heating system, Solar cooker, Solar furnace, Solar green house, Photovoltaic (PV) module, construction and working of solar PV system, Efficiency of the PV module, Energy balance equations of PV modules, Series and parallel combination of PV Modules, storage batteries and ultra-capacitors.

Wind Energy: Introduction, Wind and its Properties, History of Wind Energy, Wind Energy Scenario – World and India, Basic principles of Wind Energy Conversion Systems (WECS), Classification of WECS, Construction and working of horizontal and vertical axis WECS, wind site selection consideration, Advantages and Disadvantages of WECS.

Course Code	UE23EE2406
Course Title	Electric Motors Laboratory

Course Content

1. Load test on DC shunt motor to draw speed–torque and horse power–efficiency characteristics.
2. Field Test on DC series machines.
3. Speed control of DC shunt motor by armature and field control.
4. Swin burne's Test on DC motor.
5. Retardation test on DC shunt motor.
6. Regenerative test on DC shunt machines.
7. Load test on three phase induction motor.
8. No-load and Blocked rotor test on three phase induction motor to draw (i) equivalent circuit and (ii) circle diagram.
9. Determination of performance parameters at different load conditions.
10. Load test on induction generator.
11. Load test on single phase induction motor to draw output versus torque, current, power and efficiency characteristics.
12. Conduct suitable tests to draw thee equivalent circuit of single phase induction motor and determine performance parameters.

Semester-5			
Sl. No.	**Course Code**	**Course Title**	**Credits**
1	UE23EE3501	Transmission and Distribution	3
2	UE23EE3502	Power Electronics	3
3	UE23EE3503	Electrical Machine Design	3
4	UE23EE3504	Digital Signal Processing	4
5	UE23EE3505	Power Electronics Laboratory	1
6	UE23EE3540	HVDC Transmission	3
7	UE23EE3541	Intelligent Control Systems	
8	UE23EE3542	Estimation & Costing	
9	HG23TCXXXX	Technical Skills	2
10	HG23TPYYYY	Life Skills	0
11	HG23CIVVVV	Innovation and Entrepreneurial Skills	0
12	HG23SAKKKK	Environmental Awareness and Community Services	0
13	HG23SAKKKK	Athletics, Sports, Yoga, Gymnasium	1
14	HG23SAKKKK	Cultural & Literary Activities	0
15	HG23CC####	Co-Curricular Activities (Seminar/Conference/Exhibition/Technical Competition)	0
16	HG23TPYYYY	Placement Training	1
		Total	**21**

Course Code	UE23E3501
Course Title	Transmission and Distribution

Course Content

Introduction to Power System Structure of electric power system: Generation, transmission and distribution. Advantages of higher voltage transmission: HVAC, EHVAC, UHVAC and HVDC. Interconnection. Feeders, distributors and service mains.

Overhead Transmission Lines: A brief introduction to types of supporting structures and line conductors Conventional conductors Bundle conductor and its advantages. Importance of sag, Sag calculation – supports at same and different levels, effect of wind and ice. Line vibration and vibration dampers. Overhead line protection against lightening; ground wires.

Overhead Line Insulators: A brief introduction to types of insulators, material used- porcelain, toughened glass and polymer (composite). Potential distribution over a string of suspension insulators. String efficiency, Methods of increasing string efficiency. Arcing horns.

Line Parameters: Introduction to line parameters- resistance, inductance and capacitance. Calculation of inductance of single phase and three phase lines with equilateral spacing, unsymmetrical spacing, double circuit and transposed lines. Inductance of composite – conductors, geometric mean radius (GMR) and geometric mean distance (GMD). Calculation of capacitance of single phase and three phase lines with equilateral spacing, unsymmetrical spacing, double circuit and transposed lines. Advantages of single circuit and double circuit lines.

Performance of Transmission Lines: Classification of lines – short, medium and long. Current and voltage relations, line regulation and Ferranti effect in short length lines, medium length lines considering Nominal T and nominal circuits, and long lines considering hyperbolic form equations. Equivalent circuit of a long line. ABCD constants in all cases.

Corona: Phenomena, disruptive and visual critical voltages, corona loss. Advantages and disadvantages of corona. Methods of reducing corona.

Underground Cable: Types of cables, constructional features, insulation resistance, thermal rating, charging current, grading of cables – capacitance and inter-sheath. Dielectricloss. Comparison between ac and DC cables. Limitations of cables. Specification of power cables.

Specification of power cables, Distribution: Primary AC distribution systems – Radial feeders, parallel feeders, loop feeders and interconnected network system. Secondary AC distribution systems – Three phase 4 wire system and single phase 2 wire distribution, AC distributors with concentrated loads. Effect of disconnection of neutral in a 3 phase four wire system.

Course Code	UE23EE3502
Course Title	Power Electronics

Course Content

Introduction: Concept and Applications of power electronics, Classification of Power Converters, Types of power semiconductor devices and control characteristics of power semiconductor devices

Power Semiconductor devices: Power Semiconductor types-BJTs, MOSFETs, IGBTs-VI Characteristics, switching characteristics and Applications, Gate drive and base drive control, Isolation of Power and gate circuit using pulse transformer and opto-coupler.

Thyristors: VI characteristics, Turn-on methods, Two-transistor model, switching characteristics, di/dt and dv/dt protection, Gate triggering circuits, Series and parallel operation of thyristors.

Controlled Rectifiers: Single-phase Half wave circuit, single-phase Full wave converter- R, RL, Freewheeling diode, Single-phase Dual converters.

AC voltage controllers: Principal of Integral cycle and phase control, single phase full wave controlled Rectifier with Resistive and Inductive loads.

Inverters: Single-phase half and full bridge inverters with R, RL loads, VSI, PWM techniques, CSI.

Choppers: Principle of operation of Step- down and step-up choppers, Performance parameters, DC-DC Converter classification.

Power supplies and Stabilizers: SMPS and its operation, BUCK, BOOST, BUCK-BOOST and Fly back converter, Power line disturbances, Sources and effects of power conditioners, Relay type stabilizers, AC servo-voltage stabilizers, UPS- Battery size and required voltage, off-line and online UPS.

Course Code	UE23EE3503
Course Title	Electrical Machine Design

Course Content

Fundamental Aspects of Electrical Machine Design: Design of Machines, Design Factors, Limitations in design. Electrical Engineering Materials: Desirabilities of Conducting Materials, Comparison of Aluminium and Copper wires. Ferromagnetic Materials: Soft Magnetic materials – Solid Core Materials, Electrical Sheet and Strip, Cold Rolled Grain Oriented Steel. Insulating Materials: Desirable Properties, Temperature Rise and Insulating Materials, Classification of Insulating materials based on Thermal Consideration.

Design of DC Machines: Output Equation, Choice of Specific Loadings and Choice of Number of Poles, Main Dimensions of armature, Design of Armature Slot Dimensions, Commutator and Brushes. Estimation of Ampere Turns for the Magnetic Circuit. Design of Shunt and Series Field Windings.

Design of Transformers: Output Equations of Single Phase and Three Phase Transformers, Choice of Specific Loadings, Expression for Volts/Turn, Determination of Main Dimensions of the Core, Estimation of Number of Turns and Conductor Cross Sectional area of Primary and Secondary Windings. Design of Tank and Cooling (Round and Rectangular) Tubes

Design of Three Phase Induction Motors: Output Equation, Choice of Specific Loadings, Main Dimensions of Stator. Design of stator slots and Winding, Choice of Length Air Gap, Estimation of Number of Slots for Squirrel Cage Rotor. Design of Rotor Bars and End Ring.

Design of Three Phase Synchronous Machines: Output Equation, Choice of Specific Loadings, Short Circuit Ratio, Main Dimensions of Stator. Design of stator slots and Winding. Design of Salient and non- salient Pole Rotors, and Field Winding. Introduction, Logic Verification Principles, Manufacturing Test Principles, Design for testability.

Course Code	UE23EE3504
Course Title	Digital signal processing

Course Content

Introduction to Digital Signal Processing: Definition of signals and systems, Classification of Signals, Elementary signals: Exponential, sinusoidal, step, impulse and ramp, basic operations on signals, Numerical Problems. Time domain representation of LTI System: Discrete-time LTI systems: The convolution sum, Continuous-time LTI systems: The convolution integral.

Properties of LTI systems: Causal LTI systems described by difference equations (Natural, and Forced Response) **Discrete Fourier Transforms (DFT):** The Discrete Fourier Transform, DFT as a linear transformation, Properties of DFT: Periodicity, Linearity and Symmetry for real valued sequence,

Additional DFT Properties: Time reversal of a sequence, Circular Time shift of a sequence, Circular frequency shift, Complex conjugate property, Multiplication of two sequences, Perceval's theorem. Linear Filtering Methods, Filtering of Long data Sequences. Overlap-add Method, Overlap-save Method.

Fast Fourier Transforms: Fast Fourier Transforms (FFT) - Radix-2 Decimation-in-Time and Decimation-in-Frequency FFT Algorithms. Digital Filters Design: FIR filters: Linear phase filters, Windowing techniques for design of Linear Phase FIR filters – Rectangular, Blackman, and Hamming and Hanning windows, Realization of FIR Systems: Direct form, cascade form.

IIR Filter Design: Infinite Impulse response Filter Format, Bilinear Transformation Design Method, Bilinear Transformation and Frequency Warping, Bilinear Transformation Design Procedure, Realization of IIR Filters in Direct form I and II.

Course Code	UE23EE3505
Course Title	Power Electronics Laboratory

Course Content

1) Static Characteristics of SCR.
2) Static Characteristics of MOSFET and IGBT.
3) Characteristic of TRIAC.
4) SCR turn on circuit using synchronized UJT relaxation oscillator for a single-phase controlled rectifier
5) SCR digital triggering circuit for a single-phase controlled rectifier.
6) Single phase controlled full wave rectifier with R load, R –L load, R-L-E load with and without freewheeling diode
7) AC voltage controller using TRIAC and DIAC combination connected to R and RL loads.
8) Speed control of DC motor using single semi converter.
9) Speed control of stepper motor.
10) Speed control of universal motor using ac voltage regulator.
11) Speed control of a separately excited D.C. Motor using an IGBT or MOSFET chopper.
12) Single phase MOSFET/IGBT based PWM inverter.

Course Code	UE23EE3540
Course Title	HVDC Transmission

Course Content

GENERAL ASPECTS OF DC TRANSMISSION AND COMPARISON OF IT WITH AC TRANSMISSION: Historical sketch, constitution of EHV AC and DC links, Limitations and Advantages of AC and DC Transmission.

CONVERTER CIRCUITS: Valve Characteristics, Properties of converter circuits, assumptions, single phase, three phase converters, choice of best circuits for HV DC circuits.

ANALYSIS OF THE BRIDGE CONVERTER: Analysis with grid control but no over lap, Analysis with grid control and with over lap less than 60 deg, Analysis with overlap greater than 60 deg, complete characteristics of rectifier, Inversion.

CONTROL OF HVDC CONVERTERS AND SYSTEMS: grid control, basic means of control, power reversal, limitations of manual control, constant current versus constant voltage, desired feature of control, actual control characteristics, constant -minimum -Ignition –angle control, constant –current control, constant –extinction –angle control, stability of control.

Course Code	UE23EE3541
Course Title	Intelligent Control Systems

Course Content

Introduction to Intelligent Control

Review of classical control systems, Need for intelligent control, Comparison of conventional vs intelligent control, Applications in electrical engineering (power systems, drives, etc.).

Fuzzy Logic Control

Fuzzy sets and membership functions, Fuzzy logic operations and inference, Fuzzy rule-based systems, Design of fuzzy controllers, Application: Fuzzy control of DC motor / inverter

Lab/Software: MATLAB Fuzzy Logic Toolbox.

Artificial Neural Networks (ANN)

Introduction to ANN and biological neuron, Supervised learning: Perceptron, Multi-layer Perceptron (MLP), Backpropagation algorithm, Control applications using ANN, ANN-based system identification and control.

Genetic Algorithms (GA) and Evolutionary Computation

Basics of genetic algorithms, Selection, crossover, mutation, Fitness function design, GA-based controller tuning, Hybrid GA with fuzzy/ANN.

Adaptive Control and Reinforcement Learning (RL)

Concept of adaptive control, Model Reference Adaptive Control (MRAC), Introduction to RL and Q-learning, RL for dynamic system control.

Hybrid Intelligent Control Systems

Neuro-fuzzy systems, GA-fuzzy systems, Case studies: smart grid control, renewable energy systems, robotic systems.

Course Code	UE23EE3542
Course Title	Estimation and costing

Course Content

Principles of Estimation: Introduction to Estimation and Costing, Electrical Schedule, , Labor Conditions, Purchase System, Purchase Enquiry and Selection of Appropriate Purchase Mode, Purchase Orders, Payment Of Bills, Tender Form, General Idea about IE Rule, Indian Electricity(IE) Act and IE Rules -29,30,45,46,47,50,51,54,55,77 and79 Determination of Required Quantity of Material, Determination of Cost Material and labour, Contingencies, Overhead Charges, Profit, Market Survey and Source Selection, Comparative Statement

Wiring: Introduction, Distribution of energy in a Building, Desir abilities of Wiring. Multi Strand Cables, Voltage Grading and Specification of Cables Main Switch and Distribution Board, Conduits and its accessories and Fittings. Lighting Accessories and Fittings, Types of Fuses, Earthing Conductor. PVC Casing and Capping, Conduit Wiring, Types of cables used in Internal Wiring

Internal Wiring: General rules for wiring, Design of Lighting Points, Number of Points, Main Switch and Distribution Board and Size of Conductor. Current Density, Layout Service Mains: Introduction, Types, Estimation of Underground and Overhead Service Connections.

Design and Estimation of Power Circuits: Introduction, Important Considerations Regarding Motor Installation Wiring, Input Power, Input Current to Motors, Rating of Cables, Rating of Fuse, Distribution Board Main Switch and Starter

Estimation of Overhead Transmission and Distribution Lines: Dead End Clamps, Positioning of Conductors and Attachment to Insulators, Jumpers, TeeOffs, Earthing of Transmission Lines, Guarding of Overhead Lines, Clearances of Conductor from Ground, Spacing Between Conductors, Important Specifications, Estimation problems, Repairing and Jointing of Conductors.

Estimation of Substations: Main Electrical connection, Graphical Symbols for Various Types of Apparatus and Circuit Elements on Substation main Connection Diagram, equipment for Substation, Substation Auxiliaries Supply, Substation earthing, Single Line Diagram of Typical Substations.

Semester-6			
Sl. No.	**Course Code**	**Course Title**	**Credits**
1	UE23EE3601	Power System Analysis & Stability	4
2	UE23EE3602	Control Systems Engineering	3
3	UE23EE3603	Special Electric machines	3
4	UE23EE3604	IOT Applications	2
5	UE23EE3605	Control Systems Engineering laboratory	1
6	UE23EE3640	Industrial Drives and Automation	3
7	UE23EE3641	Smart Grid Technology	
8	UE23EE3642	Programmable Logic Controller	
9	HG23TCXXXX	Technical Skills	2
10	HG23TPYYYY	Life Skills	0
11	HG23CIVVVV	Innovation and Entrepreneurial Skills	1
12	HG23SAKKKK	Environmental Awareness and Community Services	0
13	HG23SAKKKK	Athletics, Sports, Yoga, Gymnasium	0
14	HG23SAKKKK	Cultural & Literary Activities	1
14	HG23CC####	Co-Curricular Activities (Seminar/Conference/ Exhibition/Technical Competition)	0
15	HG23TPYYYY	Placement Training	0
		Total	**20**

Course Code	UE23EE3601
Course Title	Power System Analysis & stability

Course Content

Representation of Power System Components: Introduction, Single-phase Representation of Balanced Three Phase Networks, One-Line Diagram and Impedance or Reactance Diagram, Per Unit (PU) System, Steady State Model of Synchronous Machine, Power Transformer, Transmission of Electrical Power, Representation of Loads.

Symmetrical Fault Analysis: Introduction, Transient on a Transmission Line, Short Circuit of a Synchronous Machine(On No Load), Short Circuit of a Loaded Synchronous Machine, Illustrative simple examples on power systems. Selection of Circuit Breakers.

Symmetrical Components: Introduction, Symmetrical Component Transformation, Phase Shift in Star-Delta Transformers, Sequence Impedances of Transmission Lines, Sequence Impedances and Sequence Network of Power System, Sequence Impedances and Networks of Synchronous Machine, Sequence Impedances of Transmission Lines, Sequence Impedances and Networks of Transformers.

Unsymmetrical Fault Analysis: Introduction, Symmetrical Component Analysis of Unsymmetrical Faults, Single Line-To-Ground (LG) Fault, Line-To-Line (LL) Fault, Double Line-To-Ground (LLG) Fault, Open Conductor Faults.

Power System Stability: Introduction, Dynamics of a Synchronous Machine, Review of Power Angle Equation, Simple Systems, Steady State Stability, Transient Stability, Equal Area Criterion, Factors Affecting Transient Stability, Multi machine stability studies, classical representation.

Course Code	UE23EE3602
Course Title	Control System Engineering

Course Content

Introduction to Control Systems: Types of Control Systems, Effect of Feedback Systems, Mathematical modelling – Mechanical Systems, Electrical Systems, Analogous Systems. Block diagrams and signal flow graphs: Block diagram reduction techniques, Masson's gain formula, and Transfer functions.

Time Response of feedback control systems: Standard test signals, Unit step response of First and second order Systems. Time response specifications, steady state errors and error constants, Introduction to PI, PD and PID Controllers.

Stability Analysis: Concepts of stability, Necessary conditions for Stability, Routh stability criterion, Relative stability analysis, Introduction to Root-Locus Techniques, The root locus concepts, Construction of root loci.

Frequency domain analysis and stability: Correlation between time and frequency response, Bode Plots, Introduction to Polar Plots, (Inverse Polar Plots excluded) Nyquist Stability criterion, (Systems with transportation lag excluded) Introduction to lead, lag and lead-lag compensating networks (excluding design).

Introduction to State variable analysis: Introduction, Concept of State, State variables & State model, State model for Linear Continuous & Discrete time systems, Diaganolisation.

Course Code	UE23EE3603
Course Title	Special Electric Machines

Course Content

Stepper Motor: Introduction, constructional features, principal of operation, types, Variable Reluctance Stepper Motor, Permanent Magnet Stepper Motor, Hybrid Stepper Motor, Other Types of Stepper Motor, Windings in Stepper Motors, Torque Equation, Characteristics of Stepper Motor, Microprocessor–Based Control of Stepper motor, Applications of Stepper Motor.

Single phase special electrical machines: AC series motor construction, principle of working phasor diagram, universal motor and Hysteresis motor- constructional details, principle of operation, torque slip characteristics, applications.

Permanent Magnet DC Motor: Permanent Magnet DC (PMDC) motor, construction, principle of working.

Brushless DC Motor: construction, principle of working, Commutation in DC motors, Electronic Commutation, Difference between mechanical and electronic commutators, Hall sensors, Optical sensors, Construction and principle of PMBL DC Motor.

Permanent Magnet Synchronous Motor (PMSM): Construction, Principle of operation, EMF equation, Torque equation, Phasor diagram, Comparison of conventional and PMSM, Control of PMSM, Applications.

Course Code	UE23EE3604
Course Title	IOT Applications

Course Content

Network Basics: Introduction, Network Types-Connection types, Physical Topology, Network Reachability, Layered Network Models-OSI Model, IP suite.

Emergence of IoT: Introduction, Evolution of IoT, Enabling IoT and the Complex Interdependence of Technologies, IoT Networking Components.

IoT Sensing and Actuation: Introduction, Sensors, Sensor Characteristics, Sensorial Deviations, Sensing Types, Sensing Considerations, Actuators, Actuator Types, Actuator Characteristics.

IoT Processing Topologies and Types: Data Format, Importance of Processing in IoT, Processing Topologies, IoT Device Design and Selection Considerations, Processing Offloading.

IOT Connectivity Technologies: Introduction, IEEE 802.15.4, Zigbee, Wireless HART, RFID,NFC,Z-Wave, LoRa, Wi-Fi, Bluetooth.

Data Protocols: MQTT, COAP, AMQP, XMPP, REST, Web Socket.

Associate IOT Technology: Cloud Computing: Introduction, Virtualization, Cloud Models, Service-Level Agreement in Cloud Computing, Cloud Implementation, Sensor-Cloud: Sensors-as-a-Service. Challenges associated with IOT.

IOT Case Studies and Future Trends: Agricultural IoT–Introduction and Case Studies, Vehicular IoT–Introduction and Case Studies, Healthcare IoT-Introduction and Case Studies.

Course Code	UE23EE3605
Course Title	Control System Engineering Laboratory

Course Content

1. Experiment to draw speed-torque characteristics of i) DC servo motor ii) AC Servomotor
2. Experiment to draw synchro pair characteristics.
3. Experiment to determine frequency response of second order system.
4. To design a passive RC lead compensating network for the given specifications, viz, the maximumphaseleadandthefrequencyatwhichitoccursandtoobtainthefrequencyresponse
5. To design a passive RC lag compensating network for the given specifications, viz, the maximum phase lag and the frequency at which it occurs and to obtain the frequency response.
6. To determine experimentally the transfer function of the lag compensating network.
7. Experimenttodrawthefrequencyresponsecharacteristicsofthelag–leadcompensator network and determination of its transfer function.
8. To simulate a typical second order system and determine step response and evaluate time response specifications.
9. To examine the relationship between open-loop frequency response and stability.
10. To study the effect of open-loop frequency and closed loop transient response.
11. To study the effect of open loop gain on transient response of closed loop system using root locus.

Course Code	UE23EE3640
Course Title	Industrial Drives and Automation

Course Content

Introduction to Electric Drives:

Basic concepts of electric drives and their importance in industrial applications. Advantages of Electrical Drives. Parts of Electrical Drives, Choice of Electrical Drives, Status of DC and AC Drives. Modes of Operation, Speed Control and Drive Classifications, Closed loop Control of Drives. Fundamental torque equations, Speed Torque conventions and multiquadrant operation. Understand the concept of Industrial Automation and exposure on its components.

DC Motor Drives:

DC motor drive using half controlled and fully controlled single phase and three phase rectifiers, Continuous and discontinuous conduction modes of operation. 4- quadrant operation using dual converter-Braking. Analysis of closed loop control of DC Motor.

Induction Motor Drives:

Analysis of Induction Motor Fed from Non-Sinusoidal Voltage Supply, Variable frequency operation, constant v/f operation. Speed Control Techniques-Stator Voltage Control, variable Voltage Frequency Control from Voltage Sources. Voltage Source Inverter (VSI) Control, Cycloconverter Control, Closed Loop Speed Control and Converter Rating for VSI and Cycloconverter Induction Motor Drives, Variable Frequency Control from a Current Source, Current Source (CSI) Control, current regulated voltage source inverter control, and speed control of single phase induction motors.

Synchronous Motor Drives:

Synchronous motor drive with voltage source inverter, load commutated thyristor inverter and cyclo converter- control strategies- Constant torque angle control- unity power factor control – Unity power factor control-constant mutual flux linkage control.

Application-Specific Drives Energy Efficiency in Industrial Drives:

Drives in conveyor systems, Drives in pumps and compressors, Drives in fans and blowers, Elevator and escalator drives. Importance of energy efficiency in industrial applications Energy-efficient motor designs, Variable speed drives for energy savings.

Industrial Automation and Integration:

Integration of drives with PLCs and SCADA systems, Communication protocols in industrial drives, Case studies on integrated drive systems, Internet of Things (IoT) in industrial drives, Artificial Intelligence (AI) in drive systems, Industry 4.0 and its impact on industrial drives.

Course Code	UE23EE3641
Course Title	Smart Grid Technology

Course Content

Introduction: Concept of Smart Grid, Difference between conventional and smart grid, Early smart grid initiatives, Opportunities and barriers of smart grid, technologies required for smart grid, core applications of smart grid, demand response and demand side integration, representative architecture of smart grid, functions of various smart grid components.

Measurements and monitoring in smart grid: Smart meters: Evolution of smart meters, communication infrastructure for smart grid, Meter data management.

Wide area monitoring: Phasor Measurement unit, Data acquisition, delivery and processing, overview of WAM applications, Implementation of WAMS.

Communication Technologies for smart grid: Wireless technologies: WPANs, LAN, Wireless metropolitan area network, cellular network, satellite communication, Zigbee, Bluetooth, LAN, NAN, HAN.

Wireless Communication: Phone line technology, power line technology, co-axial cable technology, Optical communication, TCP/IP networks.

Energy storage for Smart Grid: Penetration and variability issues associated with renewable energy, batteries, flow batteries, fuel cell and hydrogen electrolyser, Superconducting magnetic storage systems, super capacitor, selection of storage technology, Demand response (DR) programs are recent and emerging applications for demand-side management (DSM).

Cyber security and standards: Cyber security requirements of smart grid, encryption and decryption for security, authentication, digital signatures, cyber security standards and risks.

Course Code	UE23EE3642
Course Title	Programmable Logic Controller

Course Content

Introduction to PLCs: • Definition, History, and Evolution of PLCs, Architecture and Components of a PLC, Types of PLCs: Modular, Compact, Rack-mounted, Comparison with Relay Logic Systems, Advantages, Limitations, and Applications of PLCs

PLC Hardware and Wiring: • Power Supply, CPU, Input/Output Modules, Discrete vs Analog Inputs/Outputs, Sensor and Actuator Interfacing, Wiring Diagrams and Input/Output Addressing Safety and Grounding Practices

Programming Basics: Programming Languages (IEC 61131-3): Ladder Logic, FBD, STL, Logic Gates in PLC Programming, Bit-level Programming: Latch, Unlatch, Set/Reset, Timers and Counters (TON, TOF, CTU, CTD)

Intermediate Programming Techniques: Comparison, Arithmetic Instructions, Move and Logical Instructions, Sequencing and Process Control, Subroutines, Jump Instructions, Data Handling: Shift Registers, Arrays

Advanced PLC Functions and Communication: Analog Signal Processing in PLCs, PID Control using PLC, SCADA Integration Basics, Communication Protocols (RS-232, Modbus, Profibus), HMI Design and Data Logging

Industrial Applications and Troubleshooting: PLC in Conveyor Systems, Packing Machines, Elevators, Debugging Techniques and Diagnostics, Error Codes and Troubleshooting Methods, Energy Management with PLCs

Capstone Project and Emerging Trends: Smart Home Automation using PLC, PLC-based Industrial Sorting System, IoT Integration with PLC, Industry 4.0 and Smart Manufacturing, Future Trends: Cloud PLCs, Edge Devices, Cybersecurity.

Semester-7			
Sl. No.	**Course Code**	**Course Title**	**Credits**
1	UE23EE4701	Computer Techniques in Power System	3
2	UE23EE4702	Energy Storage and Technologies	3
3	UE23EE4703	High Voltage & Power System Protection	3
5	UE23EE4780	Electrical installation and safety	2
6	UE23EE4781	Psychology for everyday life	
7	UE23EE4782	Aptitude Development for Career Readiness	
8	UE23EE4704	Capstone Project Phase-1	4
9	HG23TCXXXX	Technical Skills	0
10	HG23TPYYYY	Life Skills	0
11	HG23CIVVVV	Innovation and Entrepreneurial Skills	0
12	HG23SAKKKK	Environmental Awareness and Community Services	0
13	HG23SAKKKK	Athletics, Sports, Yoga, Gymnasium	0
14	HG23SAKKKK	Cultural & Literary Activities	1
15	HG23CC####	Co-Curricular Activities (Seminar/Conference/ Exhibition/Technical Competition)	1
16	HG23TPYYYY	Placement Training	0
		Total	**17**

Course Code	UE23EE4701
Course Title	Computer Techniques in Power System

Course Content

Network Topology: Introduction and basic definitions of Elementary graph theory Tree, cut-set, loop analysis. Formation of Incidence Matrices. Primitive network- Impedance form and admittance form, Formation of Y Bus by Singular Transformation. Ybus by Inspection Method. Illustrative examples.

Fundamentals of Load Flow Studies: Introduction, Classification of buses. Power flow equation, Operating Constraints, Data for Load flow, Gauss Seidal iterative method. Illustrative examples. Newton-Raphson method derivation in Polar form, Fast decoupled load flow method, Flow charts of LFS methods. Comparison of Load Flow Methods. Illustrative examples.

Economic Operation of Power System: Introduction and Performance curves Economic generation scheduling neglecting losses and generator limits Economic generation scheduling including generator limits and neglecting losses Economic dispatch including transmission losses Derivation of transmission loss formula. Illustrative examples.

Unit Commitment: Introduction, Constraints and unit commitment solution by prior list method and dynamic forward DP approach (Flow chart and Algorithm only).

Symmetrical Fault Analysis: Z Bus Formulation by Step by step building algorithm without mutual coupling between the elements by addition of link and addition of branch. Illustrative examples. Z bus Algorithm for Short Circuit Studies excluding numerical.

Course Code	UE23EE4702
Course Title	Energy storage technologies

Course Content

Introduction to Energy Storage Systems: Need for energy storage in modern power systems**,** Classification of energy storage technologies**,** Performance metrics: energy density, power density, efficiency, and cycle life**,** Applications in renewable energy integration, grid stability, and electric vehicles

Electrochemical Energy Storage: Fundamentals of electrochemical storage**,** Battery technologies: Lead-Acid, Nickel-Cadmium, Nickel-Metal Hydride, Lithium-Ion, and Solid-State Batteries**,** Battery performance characteristics and degradation mechanisms**,** Battery management systems (BMS) and safety considerations

Mechanical and Thermal Energy Storage: Mechanical Storage: Flywheels, Compressed Air Energy Storage (CAES), and Pumped Hydro Storage (PHS)**, Thermal Storage:** Sensible heat storage, Latent heat storage, and Thermochemical storage**,** Efficiency, advantages, and limitations of mechanical and thermal storage

Electrical and Thermal Storage Technologies: Electrical Storage: Supercapacitors and superconducting magnetic energy storage (SMES)**,** Thermal storage: Sensible heat, Latent heat, Thermochemical, Use in solar and industrial systems

Applications of Energy Storage: Grid applications: Load levelling, peak shaving, frequency regulation, Renewable energy integration: Solar PV, Wind, EVs and hybrid systems, UPS and power quality systems, Micro grids and off-grid systems.

Course Code	UE23EE4703
Course Title	High voltage & Power System Protection

Course Content

Conduction and Breakdown in Gases, liquid, solid dielectrics: Gases as Insulating Media, Ionization Processes, Townsend's Current Growth Equation Townsend's Criterion for Breakdown, Streamer Theory of Breakdown in Gases, Paschen's Law, Breakdown in Non- Uniform Fields and Corona Discharges, Conduction and Breakdown in Pure Liquids, Conduction and Breakdown in Commercial Liquids, Different types of break studies in solid dielectics.

Generation of High Voltages and Currents: Generation of High Direct Current Voltages, Generation of High Alternating Voltages, Generation of Impulse Voltages, Generation of Impulse Currents, Tripping and Control of Impulse Generators.

Measurement of High Voltages and Currents: Measurement of High Voltages: DC, AC and Impulse, Measurement of High Currents – Direct, Alternating and Impulse, Cathode Ray Oscillography for Impulse Voltage and Current Measurements.

Introduction to power system protection: Need for protective systems, nature and causes of faults, types of faults and it's effects, zones of protection, primary and back-up protection, essential qualities of protection, classification of protective relays, current transformers (ct) for protection, voltage transformers (vt)

Overcurrent protection: Time-current characteristics, current setting, time setting, overcurrent protective, directional relays, protection of parallel feeders, earth fault and phase fault protection, directional earth fault relay, static overcurrent relays, numerical overcurrent relays

Distance protection, differential protection and pilot relaying: Introduction, impedance relay, differential relays- Simple differential relay, Percentage differential relay, Balanced voltage differential relay, wire pilot protection and carrier current protection.

Transformer and Bus zone Protection: Types of Faults Encountered in Transformers, Percentage Differential Protection, Overheating Protection, Protection against Magnetizing Inrush Current, Buchholz Relay, Protection of earthing transformer, BUSZONE PROTECTION: Differential Current Protection, High Impedance Relay Scheme.

Course Code	UE25EE4780
Course Title	Electrical installation and safety

Course Content

Basics of Electrical Installations: Types of electrical installations: Residential, Commercial, Industrial Standard voltages and systems (single-phase, three-phase). Wiring systems: PVC conduit, surface and concealed wiring, Electrical symbols, wiring diagrams, and installation drawings, Selection of wires and cables, ratings, and current-carrying capacity, Introduction to IE Rules and IS codes.

Components and Wiring Practices: Switches, sockets, MCBs, ELCBs, RCCBs, Fuses – types and applications, Earthing: Purpose, types (plate, pipe, strip), IS standards, Estimation and costing of wiring installations, Load calculations and demand factor, Overview of lighting systems: LED, fluorescent, emergency lighting. Tools and instruments for electrical installation.

Electrical Safety Fundamentals: Electric shock: Causes, effects, and treatment (first aid), Safety signs, colour codes, and personal protective equipment (PPE), Fire hazards and fire extinguishers in electrical environments, Safe operating procedures and lock-out/tag-out systems, Safety in overhead and underground installations, Importance of insulation, grounding, and isolation.

Testing, Inspection & Maintenance: Testing of wiring installations: Insulation resistance, polarity, earth continuity, Periodic inspection and documentation, Preventive and predictive maintenance of installations, Introduction to fault detection and troubleshooting, Megger and other testing instruments, Legal and regulatory requirements: BIS, IE Rules, IS 732

Codes, Standards & Case Studies: Overview of national and international standards (IS 3043, IS 732, NEC, IEC), Electrical installation in hazardous areas (Zone classifications), Recent trends in electrical safety: Smart safety devices, Case studies on electrical accidents and their root cause analysis, Role of safety audit and certification, Energy conservation and safe design principles.

Course Code	UE25EE4781
Course Title	Psychology for everyday life

Course Content

Introduction to Psychology and Self-Awareness

What is Psychology? Branches and real-life relevance, Psychology in engineering, technology, and innovation, Self-concept, self-esteem, and self-awareness, Growth vs. fixed mindset (Carol Dweck), Personality types (Big Five Traits, MBTI basics), Reflection and journaling exercises.

Emotional Intelligence and Stress Management

Understanding emotions and emotional intelligence (Daniel Goleman),Self-regulation, motivation, empathy, social skills, Identifying stress triggers in student life, Coping mechanisms and stress reduction techniques, Mindfulness, relaxation, and breathing techniques

Communication and Interpersonal Skills

Verbal and non-verbal communication, Active listening and assertiveness, Conflict resolution and giving/receiving feedback, Team dynamics in academic and engineering projects, Empathy and cultural sensitivity.

Decision-Making, Habits, and Behavior Change

Cognitive biases in decision-making (confirmation bias, availability heuristic), Goal setting using SMART and WOOP frameworks, Habit formation and breaking bad habits (cue-routine-reward), Time management and procrastination, Willpower and self-control.

Motivation, Well-being, and Life Skills

Intrinsic vs. extrinsic motivation, building resilience and optimism, Flow theory and finding purpose, Balancing academic, social, and personal life, psychological well-being and happiness.

Course Code	UE25EE4782
Course Title	Aptitude Development for Career Readiness

Course Content

Quantitative Aptitude – I: Number Systems, HCF & LCM, Simplifications, Ratio & Proportion, Percentages, Profit & Loss, Simple & Compound Interest, Time & Work, Time & Distance, Averages, Mixtures, and Allegations.

Quantitative Aptitude – II: Permutations & Combinations, Probability, Algebra (Linear & Quadratic Equations), Geometry & Mensuration Basics, Data Interpretation (Bar, Line, Pie charts).

Logical Reasoning: Series, Coding-Decoding, Blood Relations, Directions, Puzzles, Seating Arrangements, Syllogisms, Statements & Conclusions, Clocks & Calendars, Data Sufficiency, Venn Diagrams.

Verbal Ability: Vocabulary Building (Synonyms, Antonyms), Reading Comprehension, Para Jumbles, Sentence Correction, Idioms & Phrases, Spotting Errors, Cloze Tests, Basics of Technical Writing (Resume/Email).

Career Readiness & Employability Skills: Resume Writing, Cover Letters, Group Discussion Techniques, Personal Interview Skills (Mock Interviews), Presentation Skills, Goal Setting & Time Management.

Semester-8			
Sl. No.	**Course Code**	**Course Title**	**Credits**
1	UE23EE4801	AI Techniques in Electrical Engineering	2
2	UE23EE4880	Green Mobility	2
3	UE23EE4881	Leadership and Team Management	
4	UE23EE4882	Art, Culture, and Human Civilization	
5	UE23EE4802	Capstone Project Phase-II	6
6	UE23EE4803	Internship	4
7	HG23TCXXXX	Technical Skills	0
8	HG23TPYYYY	Life Skills	0
9	HG23CIVVVV	Innovation and Entrepreneurial Skills	1
10	HG23SAKKKK	Environmental Awareness and Community Services	0
11	HG23SAKKKK	Athletics, Sports, Yoga, Gymnasium	0
12	HG23SAKKKK	Cultural & Literary Activities	0
13	HG23CC####	Co-Curricular Activities (Seminar/Conference/ Exhibition/Technical Competition)	1
14	HG23TPYYYY	Placement Training	0
		Total	**16**

Course Code	UE23EE4801
Course Title	AI techniques in electrical engineering

Course Content

Sparsity oriented Programming: Introduction, physical structure and sparsity, pivoting, conservation of sparsity by optimal ordering of buses, schemes for ordering, UD table storage scheme.

Artificial Intelligence: What is AI? Definitions, history and evolution, essential abilities of intelligence, AI applications.

Problem solving: problem characteristics, problem search strategies, forward and backward reasoning, AND-OR graphs, game trees, search methods- informed and uninformed search, bread the first search and depth first search methods

Knowledge representation: logical formalisms: propositional and predicate logic: syntax and semantics, wffs, clause form expression s, resolution-use of RRTs for proofs and answers, examples from electric power systems, Non monotonic logic: TMS, modal, temporal and fuzzy logic.

a) Structured representation of knowledge: ISA/ISPART trees, semantic nets, frames and scripts, examples from electric systems.

b) Expert systems: Basic components, forward and backward chaining, ES features, ES development, ES categories, ES tools and examples from electric drive systems.

AI languages: LISP and ProLog- Introduction, sample segments, Lisp primitives, list manipulation functions, function predicates, variables, iteration and recursion, property lists, sample programs for examples from electric power systems.

Course Code	UE25EE4880
Course Title	Green Mobility

Course Content

Fundamentals of Green Mobility: Definition and scope of green mobility**,** Sustainable transport systems**,** Need for green mobility: Environmental, economic & social impacts**,** Carbon footprint and emissions in the transport sector**,** Policy frameworks: National Electric Mobility Mission Plan (NEMMP), FAME India Scheme**,** Global best practices .

Electric Vehicles and Clean Fuels: Basics of electric vehicles (EVs): BEVs, PHEVs, HEVs, Hydrogen fuel cell vehicles, Biofuels, CNG, LNG – potential and challenges, Vehicle efficiency standards and regulations, Lifecycle analysis: EVs vs. Internal Combustion Engines, Battery technologies & energy storage systems.

Infrastructure for Green Mobility: Public transport systems and non-motorized transport (NMT),Charging infrastructure and renewable energy integration, Smart cities and green mobility planning, Urban mobility plans (UMPs),Last-mile connectivity and rural mobility, Role of smart grids and IoT in mobility.

Mobility as a Service (MaaS) & Policy Integration: Shared mobility: Ride-hailing, carpooling, bike-sharing, Integration of multi-modal transport systems, Data-driven mobility planning, Policies promoting green logistics and supply chains, Institutional roles: NITI Aayog, MoRTH, state-level transport authorities, Green mobility indicators and measurement tools.

Challenges, Innovations & Future Trends: Challenges in implementation: financial, behavioral, policy,Role of startups in green mobility (e.g., Ather, Yulu, BluSmart),Innovations in sustainable transport: autonomous EVs, hyperloop, drone logistics, International case studies: Amsterdam, Copenhagen, Singapore, Research frontiers in green mobility, Career & entrepreneurship opportunities**Advanced techniques for 4G deployment and beyond:** Multi-antenna Techniques: Smart antennas, Multiple input multiple output systems. Cognitive radio: Architecture, spectrum sensing. Software Defined Radio (SDR): Components and Applications. Introduction to 5G network and technologies used in 5G such as small cell concept, Massive MIMO, Beam forming, NOMA, and mm-Wave).

Course Code	UE24EE4881
Course Title	Leadership and Team Management

Course Content

Introduction to Leadership: Definition and Importance of Leadership, Characteristics of Effective Leaders, Leadership vs Management, Leadership Styles (Autocratic, Democratic, Transformational, etc.), Leadership in Engineering Context

Self-Leadership & Emotional Intelligence: Self-awareness and Personal Leadership Style, Emotional Intelligence and its Role in Leadership, Self-regulation, Motivation, Empathy, and Social Skills, Tools for Self-Assessment and Reflection, Case study on Leadership Journey

Team Building and Group Dynamics: Characteristics of Effective Teams, Stages of Team Development (Forming, Storming, Norming, Performing), Roles in a Team (Belbin's Team Roles), Team Communication and Conflict Resolution, Case study and Role Play Activity

Leadership in Action (4 hours): Decision Making and Problem Solving Techniques, Delegation and Empowerment, Time Management and Goal Setting, Agile Leadership in Project Management, Leadership in Startups and Innovation

Communication & Influencing Skills : Verbal and Non-verbal Communication, Public Speaking and Presentation Skills, Persuasion and Negotiation, Cross-cultural Communication in Teams, Leadership Communication Simulation

Ethical Leadership & Social Responsibility : Ethics and Values in Leadership, Leadership Failures and Ethical Dilemmas, Sustainable Leadership, Leadership for Social Impact.

Leadership for Career Growth: Building Leadership Portfolio, Leadership in Professional Organizations, Networking and Mentoring, Resume Building and Interview Tips for Leadership Roles.

Course Code	UE25EE4882
Course Title	Art, Culture and Human Civilization

Course Content

Introduction to Culture and Civilization: Definitions and scope of culture and civilization, Evolution of human societies: From nomadic to agrarian to industrial, Characteristics of early civilizations: Mesopotamia, Egypt, Indus Valley, and China, Culture vs. civilization: Interrelationships and distinctions, Role of language, religion, and family in shaping cultures, Importance of intangible and tangible heritage.

Indian Art and Culture: Overview of Indian cultural heritage, Vedic and classical traditions: Literature, philosophy, and performing arts, Indian architecture: From Harappan to modern times, Dance, music, and folk traditions across India, Festivals and rituals as expressions of cultural identity, Unity in diversity: Regional and linguistic plurality.

World Art and Cultural Movements: Western classical civilization: Greek, Roman contributions, Renaissance, Enlightenment, and Romanticism, Islamic Art and Architecture, African, East Asian, and Latin American cultural contributions, Modern and Postmodern art movements, Cross-cultural influences in the age of globalization.

Science, Technology, and Human Civilization: Interplay of science, art, and culture, Industrial revolution and its socio-cultural impact, Inventions that transformed societies (printing press, electricity, and internet), Ethical dimensions of scientific progress, Contemporary digital culture and virtual communities, Technology and cultural preservation.

Contemporary Issues and Cultural Responsibility: Cultural conflicts and global peace, Cultural imperialism and resistance, Role of media and cinema in shaping culture ,Environmental ethics and sustainable civilization, Art, activism, and social change, Promoting cultural literacy and sensitivity in engineering.

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