SCHEME OF TEACHING AND EXAMINATION (Effective from 2020 – 2024 Batch)

B Tech (Eighth Semester, Electrical Engineering)

Sl. No.	Board of Studies (BOS)	Courses (Subjects)	Course Code	Period per Week			Scheme of Examination Theory/Lab			Total Marks	Credit
				L	T	P	ESE	CT	TA		
1.	Electrical Engineering	High Voltage Engineering	**EE104801**	3	1	-	100	20	30	150	4
2.	Electrical Engineering	**Professional Elective-IV**	**Refer Table -IV**	2	1	-	100	20	30	150	3
3.	Electrical Engineering	**Open Elective-III**	**Refer Table -V**	3	-	-	100	20	30	150	3
4.	Electrical Engineering	High Voltage Engineering Lab	**EE104891**	-		2	25	-	25	50	1
5.	Electrical Engineering	Utilization of Electrical Engineering Lab	**EE104892**	-		2	25	-	25	50	1
6.	Electrical Engineering	Major Project Phase-II	**EE104893**	-		16	300	-	150	450	8
	Total			**8**	**2**	**20**	**650**	**60**	**290**	**1000**	**20**

Table-IV Professional Elective-IV

S.N	Board of Studies (BOS)	Subject Code	Program Elective-I
1	Electrical Engineering	**EE104821**	**Utilization of Electrical Engineering**
2	Electrical Engineering	**EE104822**	Power System Dynamics
3	Electrical Engineering	**EE104823**	Computer Aided Power System
4	Electrical Engineering	**EE104824**	VLSI Design
5	Electrical Engineering	**EE104825**	Artificial Neural Network & Fuzzy Logic

L-Lecture **T-Tutorial** **P-Practical**
CT-Class Test **TA-Teachers Assessment** **ESE-End Semester Exam**

		July 2022	1.00	Applicable for AY 2022-23 Onwards
Chairman (AC)	Chairman (BoS)	Date of Release	Version	

Table-V Open Elective-III

S.N	Board of Studies (BOS)	Subject Code	Open Elective-III
1	Electrical Engineering	EE100841	**Energy Auditing and Management**
2	Electrical Engineering	EE100842	Power System Planning & Management

Subject Code	EE104801	L = 2	T = 1	P = 2	Credits = 3
Subject	High Voltage Engineering	CT	TA	Total	ESE Duration
Evaluation Scheme	100	20	30	150	3 Hrs

COURSE OBJECTIVES	COURSE OUTCOMES
1. To get a fair knowledge about the generation and measurement of high voltages and currents. 2. Understand the concept of solid, liquid and gaseous dielectrics 3. Determining economic sharing of generations for a given loading condition. 4. Gain knowledge in testing of high voltage equipments.	**Students will be able to:-** **CO1:** Describe the principles behind generating high DC – AC and impulse voltages. **CO2:** Develop equivalent circuit models of the different high voltage generators. **CO3:** Perform a dynamic response analysis of high voltage measurement systems. **CO4:** Compute the breakdown strength of gas, liquids and solids insulation systems. **CO5:** Evaluate Insulation life and accelerated tests.

UNIT I: Conduction and Breakdown in Gases: [CO1] Gases as insulating media, Ionisation processes. Townsend current growth equation. Current growth in the presence of secondary processes. Townsend's criterion for breakdown. Experimental determination of ionization coefficients. Breakdown in electronegative gases, time lags for breakdown, streamer theory of breakdown in gases, Paschen's law, Breakdown in non-uniform field and corona discharges, Post breakdown phenomena and applications, practical considerations in using gases for insulation purposes.	**[8Hrs]**
UNIT II: Conduction and breakdown in liquid dielectrics: [CO2] Pure liquids and commercial liquids, conduction and breakdown in pure liquids. **Breakdown in solid dielectrics**: Introduction, Intrinsic breakdown. Electromechanical breakdown,Thermal break down. Breakdown of solid dielectrics in practice.	**[8Hrs]**
UNIT III: Generation of high voltage and currents: [CO3] Generation of high D.C, voltages, Generation of high alternating voltages, Generation of Impulse voltages. Tripping and control of impulse generators. Generation of Impulse currents.	**[8Hrs]**
UNIT IV: Measurement of High Voltages and Current: [CO4] Measurement of high D.C. voltages. Measurement of high D.C. and impulse voltages. Introduction. Measurement of high D.C. A.C. and impulse currents, cathode ray oscillographs for impulse voltages and currents measurements.	**[6Hrs]**
UNIT V: Non-destructive testing of materials and electrical apparatus: [CO5] Introduction. Measurement of D.C. resistivity. Measurement of dielectric constant and loss factor. Partial discharge measurements. **High voltage testing of electrical apparatus**: Testing of insulators and bushings. Testing of isolators and circuit breakers, cables. Testing of transformers, surge diverter Radio Interference measurements.	**[6Hrs]**

Text Books:

S. No.	Title	Author(s)	Publisher
1.	High Voltage Engineering	M.S. Naidu & V.Kamraju	TMH Pbs.
2.	An Introduction to High Voltage Engineering	Subir Ray	PHI.
3.	High Voltage Engineering	C.L.Wadhwa	New Age International Publishers

Reference Books:

S. No.	Title	Author(s)	Publisher
1.	High voltage Insulation Engineering	Ravindra Arora	New Age International
2.	High Voltage Engineering	Dr.R.S.Jha	DhanpatRai and Co. (P) Ltd.
3.	Extra High Voltage A.C. Transmission Engineering	R.D. Begamudre	Wiley Eastern Limited.
4.	High voltage Engineering,	D. V. Razevig and Chaurasia	khanna pbs.

Subject Code	EE104821	L = 2	T = 1	P = 2	Credits = 3
Subject	Utilization of Electrical Energy	CT	TA	Total	ESE Duration
Evaluation Scheme	100	20	30	150	3 Hrs

Course Objectives	Course Outcomes
The objective of the course to: 1. This course provides an introduction to the principles of electrical drives and their applications. 2. This course deals with the fundamentals of illumination and its classification. 3. This course provides knowledge on electrical traction systems.	**Students will be able to:** **CO1:**To understand the operating principles and characteristics of traction motors with respect to speed, temperature, loading condition. **CO2:**To acquaint with the different types of heating techniques. **CO3:**To study the basic principles of illumination and its measurement. **CO4:** Design and develop smart electrical heating and welding systems through the use of modern Electrical Engineering **CO5:**To understand the method of calculation of various traction system for braking, acceleration and other related parameters, including demand side management.

UNIT 1 Electric Drives, Elevators and Its Industrial Applications: **[CO1]** Introduction, Factors affecting selection of Motor, Types of Load, Steady State Characteristics of Drives, Transient Characteristics, Size of Motor, Load Equalization, Industrial Applications, Speed Control Systems.	**[8 Hrs]**
UNIT 2 Electric Heating: **[CO2]** Heating methods: Resistance heating – direct and indirect resistance heating, electric ovens, their temperature range, properties of resistance heating elements, domestic water heaters and other heating appliances and thermostat control circuit, Induction heating; principle of core type and coreless induction furnace.	**[8 Hrs]**
UNIT 3 Illumination: **[CO3]** Introduction, terms used in illumination, laws of illumination, polar curves, photometry, integrating sphere, sources of light. Discharge lamps, MV and SV lamps comparison between tungsten filament lamps and fluorescent tubes, Basic principles of light control, Types and design of lighting and flood lighting.	**[6 Hrs]**
UNIT 4 Electric Welding: **[CO4]** Advantages of electric welding, Welding method, Principles of resistance welding, types, Principle of arc production, electric arc welding, characteristics of arc; carbon arc, metal arc, hydrogen arc welding method of and their applications.	**[8 Hrs]**
UNIT 5 Electric Traction: **[CO5]** System of electric traction and track electrification. Methods of electric braking – plugging, rheostatic braking and regenerative braking. Mechanics of train movement. Speed-time curves for different services – trapezoidal and quadrilateral speed time curves. Effect of varying acceleration and braking retardation.	**[6 Hrs]**

Text Books:

S. No.	Title	Author(s)	Publisher
1	Utilization of Electrical Energy	E. Opens haw Taylor	University Press
2	Art & Science of Utilization of Electrical Energy	H. Partab	Pritam Surat & Sons.

Reference Books:

S.No.	Title	Author(s)	Publisher
1	Utilization of Electrical Power and Electric Traction	J.B. Gupta	S.K.Kataria & Sons
2	Utilization of Electrical Power and Electric Traction	G. C .Garg	Khanna Publishers

Subject Code	EE104822	L = 2	T = 1	P = 2	Credits = 3
Subject	Power System Dynamics	CT	TA	Total	ESE Duration
Evaluation Scheme	100	20	30	150	3 Hrs

Course Objectives	Course Outcomes
The objective of the course to: 1. This course provides an introduction to the mathematical models of machines. 2. This course deals with the fundamentals of synchronous machines and their modelling. 3. This course provides knowledge on excitation system and multimachine systems.	**Students will be able to:** **CO1:**To understand the operating principles and models of machines. **CO2:**To acquaint with the different types of synchronous machines and its modelling. **CO3:**To study the basic principles of excitation system. **CO4:** Design and develop multimachine systems with constant impedance load.

UNIT 1 Elementary Mathematical Model: Swing Equation , Units , Mechanical Torque , Electrical Torque , PowerAngle Curve of a Synchronous Machine , Natural Frequencies of Oscillation of a Synchronous Machine , System of One Machine against an Infinite Bus-The Classical Model , Equal Area Criterion , Classical Model of a Multimachine System, Classical Stability Study of a Nine-Bus System, Shortcomings of the Classical Model, Block Diagram of One Machine.	**[8 Hrs]**
UNIT 2Synchronous Machine: Park’s Transformation , Flux Linkage Equations , Voltage Equations , Formulation of State - Space Equations , Current Formula tion , Per Unit Conversion , Normalizing the Voltage Equations , Normalizing the Torque Equations , Torque and Power , Equivalent Circuit of a Synchronous Machine , The Flux Linkage State-Space Model , Loaf Equations , Sub transient and Transient Inductances and Time Constants , Turbine Generator Dynamic Models	**[8 Hrs]**
UNIT-3 Simulation of Synchronous Machine: Steady-State Equations and Phasor Diagrams, Machine Connected to an Infinite Bus through a Transmission Line, Machine Connected to an Infinite Bus with Local Load at Machine Terminal, Determining Steady- State Conditions, Initial Conditions for a Multimachine System , Determination of Machine Parameters from Manufacturers’ Data , Analog Computer Simulation of the Synchronous Machine, Digital Simulation of Syn chronous Machines . Linear Model of Synchronous Machine: Linearization of the Generator State -Space Current Model, Linearization of the Load Equation for the One-Machine Problem, Linearization of the Flux Linkage Model, Simplified Linear Model, Block Diagrams, State-Space Representation of Simplified Model.	**[6 Hrs]**
UNIT-4 Excitation Systems: Simplified View of Excitation Control, Control Configurations, Typical Excitation Configurations, Excitation Control System Definitions, Voltage Regulator, Exciter Buildup, Excitation System response, State – Space Description of the Excitation System, State Space Representation of the Excitation system, Computer Representation of Excitation Systems, Typical Systems Constants, The effect of Excitation on Generator Performance. Effect of Excitation on Stability: Effect of Excitation on Generator Power limits, Effect of the Excitation System on Transient Stability, Effect of Excitation on Dynamic Stability, Root – Locus Analysis of a Regulated Machine Connected to an Infinite Bus , Approximate System Representation, Supplementary Stabilizing Signals, Liner Analysis of the Stabilized Generator. General Comments on the Effect of Excitation on Stability.	**[8 Hrs]**
UNIT-5 Multimachine Systems with Constant Impedance Load: Statement of the Problem, Matrix representation of a Passive Network, Converting Machine Coordinates to System Reference, Relation Between Machine Currents & Voltages, System Order, Machines Represented by Classical Methods, Linearized Model for the Network, Hybrid Formulation, Network Equation with Flux Linkage Model, Total System Equation, Multimachine System Study.	**[6 Hrs]**

Text Books:

S. No.	Title	Author(s)	Publisher
1	Power System Control and Stability	P. M. Anderson & A. A. Fouad	
2	Power System Stability and Control	Prabha Kundur- EPRI.	Mc Graw Hill Inc.

Subject Code	EE104823	L = 2	T = 1	P = 2	Credits = 3
Subject	Computer Aided Power System	CT	TA	Total	ESE Duration
Evaluation Scheme	100	20	30	150	3 Hrs

Course Objectives	Course Outcomes
The objective of the course to: To introduce computer applications in the analysis of power systems. To understand the solution methods and techniques used in power system studies.	**Students will be able to:** **CO1:** The students will gain the ability to critically analyse the solution methods used in power system studies.

UNIT 1 Overview of Graph theory -tree, co-tree and incidence matrix, Development of network matrices from Graph theoretic approach. Review of solution of Linear System of equations by Gauss Jordan method, Gauss elimination, LDU factorization.	**[8 Hrs]**
UNIT 2 Bus Reference Frame: Injections and Loads. Zbus and Y bus. Formulation of Bus Impedance matrix for elements without Mutual Coupling.	**[8 Hrs]**
UNIT-3 Inversion of YBUS for large systems using LDU factors, Tinney's Optimal ordering. Review of Gauss-Seidel Iteration using YBUS, Newton-Raphson method, Fast Decoupled Load Flow (FDLF) DC load flow, Three-phase Load Flow	**[6 Hrs]**
UNIT-4 Adjustment of network operating conditions, Optimal power flow: concepts, active/reactive power objectives (Economic dispatch, MW and MVAr loss minimization) – applications- security constrained optimal power flow	**[8 Hrs]**
UNIT-5 State Network fault calculations using ZBUS and YBUS Table of Factors, Algorithm for calculating system conditions after fault – three phase short circuit, three phase to ground, double line to ground, line to line and single line to ground fault. Contingency analysis in Power systems : Contingency Calculations using ZBUS and YBUS Table of Factors. State estimation – least square and weighted least square estimation methods for linear systems.	**[6 Hrs]**

Text Books:

S. No.	Title	Author(s)	Publisher
1	Power Systems Analysis	Arthur R. Bergen, Vijay Vittal	Pearson Higher Education
2	Computer Aided Power System Analysis	G.L.Kusic	PHI
3	Power System Analysis	John J. Grainger, William D. Stevenson, Jr	Tata McGraw-Hill Series in Electrical and Computer Engineering

Reference Books:

S. No.	Title	Author(s)	Publisher
1	Modern Power System Analysis	I. J. Nagrath and D.P.Kothari	Tata McGraw Hill
2	Computer modelling of Electrical power systems	J. Arriliga and N.R. Watson	John Wiley
3	Advanced Power System Analysis and Dynamics	LP. Singh	New Age Intl

Subject Code	EE104824	L = 2	T = 1	P = 2	Credits = 3
Subject	VLSI Design	CT	TA	Total	ESE Duration
Evaluation Scheme	100	20	30	150	3 Hrs

Course Objectives	Course Outcomes
The objective of the course to: 1. This course provides an introduction to logic circuit layouts for both static CMOS and dynamic clocked CMOS circuits, analog parasitic elements from the layout and analyze the circuit timing using a logic simulator and an analog simulator 2. This course provides build a cell library to be used by other chip designers ith elementary testing hardware into the VLSI chip.	**Students will be able to:** **CO1:** An ability to design logic circuit layouts for both static CMOS and dynamic clocked CMOS circuits. **CO2:** An ability to extract the analog parasitic elements from the layout and analyze the circuit timing using a logic simulator and an analog simulator. **CO3:** An ability to build a cell library to be used by other chip designers. **CO4:** An ability to insert elementary testing hardware into the VLSI chip. **CO5:** An ability to analyze VLSI circuit timing using Logical Effort analysis. **CO6:** An ability to design elementary data paths for microprocessors, including moderate-speed adders, subtracters, and multipliers.

UNIT 1 Introduction to MOS Transistor MOS Transistor, CMOS logic, Inverter, Pass Transistor, Transmission gate, Layout Design Rules, Gate Layouts, Stick Diagrams, Long-Channel I-V Charters tics, C-V Charters tics, Non ideal I-V Effects, DC Transfer characteristics, RC Delay Model, Elmore Delay, Linear Delay Model, Logical effort, Parasitic Delay, Delay in Logic Gate, Scaling.	**[8 Hrs]**
UNIT 2 Combinational MOS Logic Circuits Circuit Families: Static CMOS, Ratioed Circuits, Cascode Voltage Switch Logic, Dynamic Circuits, Pass Transistor Logic, Transmission Gates, Domino, Dual Rail Domino, CPL, DCVSPG, DPL, Circuit Pitfalls. Power: Dynamic Power, Static Power, Low Power Architecture.	**[8 Hrs]**
UNIT 3 Sequential Circuit Design Static latches and Registers, Dynamic latches and Registers, Pulse Registers, Sense Amplifier Based Register, Pipelining, Schmitt Trigger, Monostable Sequential Circuits, Astable Sequential Circuits. Timing Issues : Timing Classification Of Digital System, Synchronous Design.	**[6 Hrs]**
UNIT IV Design of Arithmetic Building Blocks and Subsystem Arithmetic Building Blocks: Data Paths, Adders, Multipliers, Shifters, ALUs, power and speed tradeoffs, Case Study: Design as a tradeoff.Designing Memory and Array structures: Memory Architectures and Building Blocks, Memory Core, Memory Peripheral Circuitry.	**[8 Hrs]**
UNIT V Implementation Strategies and Testing FPGA Building Block Architectures, FPGA Interconnect Routing Procedures. Design for Testability: Ad Hoc Testing, Scan Design, BIST, IDDQ Testing, Design for Manufacturability, Boundary Scan.	**[6 Hrs]**

Text Books:

S. No.	Title	Author(s)	Publisher
1	Numerical Methods for Scientific and Engineering Computation	M.K Jain, S.R.K Iyengar and R.KJain	New Age Pvt. Pub
2	Linear Algebra and its Applications	G. Strang	Cengage LearningPvt Ltd
3	An Introduction to Optimization	E. K. P. Chong and S. H. Zak	Wiley India Pvt. Ltd

Reference Books:

S. No.	Title	Author(s)	Publisher
1	Applied Numerical Analysis	C.F Gerald and P. O Wheatly	Wesley
2	Linear Algebra	K Hoffman and R. Kunze	Pearson Education

Subject Code	EE104825	L = 2	T = 1	P = 2	Credits = 3
Subject	**Artificial Neural Network and Fuzzy Logic**	**CT**	**TA**	**Total**	**ESE Duration**
Evaluation Scheme	**100**	**20**	**30**	**150**	**3 Hrs**

Course Objectives	Course Outcomes
The objective of the course to: 1. This course provides concept of fuzziness involved in various systems, fuzzy set theory 2. This course provides fuzzy logic control and adaptive fuzzy logic and using algorithms, fuzzy logic control to real time systems.	After learning the course the students should be able to: **CO1:** Apply the concept of fuzziness involved in various systems. **CO2:** Apply the knowledge of fuzzy set theory. **CO3:** Design fuzzy logic control and adaptive fuzzy logic and using algorithms. **CO4:** Apply knowledge of application of fuzzy logic control to real time systems.

Unit 1: Introduction to classical sets – properties, Operations and relations: Fuzzy sets, Membership, Uncertainty, Operations, properties, fuzzy relations, cardinalities, membership functions.Fuzzy Logic System Components: Fuzzification, Membership value assignment, development of rule base and decision making system, Defuzzification to crisp sets, Defuzzification methods. Fuzzy logic applications: Fuzzy logic control and Fuzzy classification.	**[8 Hrs]**
Unit 2: Introduction to Neural Networks: Humans and Computers, Organization of the Brain, Biological Neuron, Biological and Artificial Neuron Models, Hodgkin-Huxley Neuron Model, Integrate-and-Fire Neuron Model, Spiking Neuron Model, Characteristics of ANN, McCulloch-Pitts Model, Historical Developments, Potential Applications of ANN.	**[8 Hrs]**
Unit 3: Essentials of Artificial Neural Networks: Artificial Neuron Model, Operations of Artificial Neuron, Types of Neuron Activation Function, ANN Architectures, Classification Taxonomy of ANN – Connectivity, Neural Dynamics (Activation and Synaptic), Learning Strategy (Supervised, Unsupervised, Reinforcement), Learning Rules, Types of Application.	**[6 Hrs]**
Unit 4 : Single Layer Feed Forward Neural Networks : Introduction, Perceptron Models: Discrete, Continuous and Multi-Category, Training Algorithms: Discrete and Continuous Perceptron Networks, Perceptron Convergence theorem, Limitations of the Perceptron Model, Applications. Multilayer Feed forward Neural Networks: Credit Assignment Problem, Generalized Delta Rule, Derivation of Backpropagation (BP) Training, Summary of Backpropagation Algorithm, Kolmogorov Theorem, Learning Difficulties and Improvements.	**[8 Hrs]**
Unit 5 : Architecture of Hopfield Network: Discrete and Continuous versions, Storage and Recall Algorithm,Stability Analysis, Capacity of the Hopfield Network Neural network applications: Process identification, control, fault diagnosis and load forecasting.	**[6 Hrs]**

Text Books:

S. No.	Title	Author(s)	Publisher
1	Neural Networks	James A Freeman and Davis Skapura	Pearson Education
2	Neural Networks	Simon Hakins	Pearson Education

Reference Books:

S. No.	Title	Author(s)	Publisher
1	Neural Engineering	C. Eliasmith and C. H. Anderson	Wesley

Subject Code	EE100841	L = 2	T = 1	P = 0	Credits = 3
Subject	Energy Auditing and Management	CT	TA	Total	ESE Duration
Evaluation Scheme	100	20	30	150	3 Hours

Course Objectives	Course Outcomes
1. Familiarizing with management especially with management in energy sector engineering. 2. Fundamentals of product strategy management. 3. Studying methods of energy accounting and energy auditing in energy sector, industry and final consumption. **4.** Finding opportunities to increase the rational use of energy.	After successful completion of this course, student will be able to**:** **CO1:** Understanding basics of demand side management and mechanisms (technical, legal or financial) that influences energy consumption. **CO2:** Recognizing opportunities for increasing rational use of energy. **CO3**:Learning the basics of energy auditing with application on different sectors.

UNIT 1: Overview **[CO1]** History of Energy Management: Energy forecasting, Load management. Energy management. Energy conservation, Concept and methods of energy conservation.	**[8 Hrs]**
UNIT 2: Energy Situation and Global Energy Sources **[CO1,2]** Firewood crises, World energy consumption. Energy in developing countries, Limitations of energy resources. Renewable energy resources, Potential of renewable energy sources.	**[8 Hrs]**
UNIT 3 : Energy Auditing as Applicable to an Industry **[CO1,2]** Energy audit process, Power factor improvement. Preventive maintenance. Process modification. Electricity tariffs. Types of off-peak tariffs, Time of day pricing, Time of day pricing models for planning.	**[8Hrs]**
UNIT 4 : Elements of Energy Auditing and Metering Methodologies: **[CO1,2,3]** Energy audit instruments, capacity utilization. Technology up-gradation. Fine tuning,.	**[6 Hrs]**
UNIT 5: Demand Side Management **[CO1,2,3]** Introduction to DSM, Concept of DSM, Benefits from DSM,DSM techniques. Peak clipping. Peak shifting. Valley filling. Strategic conservation. Energy efficient equipment, Socio-economic awareness programs.	**[6 Hrs]**

Text Books:

S. No.	Title	Authors	Edition	Publisher
1.	Energy Demand: Analysis, Management and Conservation	Ashok.V.Desai	2006	Wiley Eastern Ltd, New Delhi
2.	Energy technology	S. Rao, Parulekar	2013	Khanna Pbs.

Reference Books:

S. No.	Title	Authors	Edition	Publisher
1.	Demand Side Management	Jyothi Prakash,	1998	Tata McGraw-Hill Publishers.
2.	Renewable Energy Sources and Conservation Technology	N.K.Bansal, Kleeman Millin		Tata McGraw-Hill Publishers

Subject Code	EE100842	L = 2	T = 1	P = 0	Credits = 3
Subject	Power System Planning and Management	CT	TA	Total	ESE Duration
Evaluation Scheme	100	20	30	150	3 Hours

Course Objectives	Course Outcomes
1. Familiarizing components of power system planning, planning methodology for optimum power system expansion, various types of generation, transmission and distribution. 2. Fundamentals of knowledge of forecasting of future load requirements of both demand and energy by deterministic and statistical techniques using forecasting tools. 3. Studying methods of economic appraisal to allocate the resources efficiently and appreciate the investment decisions.	After successful completion of this course, student will be able to: **CO1:** Discuss primary components of power system planning, planning methodology for optimum power system expansion, various types of generation, transmission and distribution. **CO2:** Show knowledge of forecasting of future load requirements of both demand and energy by deterministic and statistical techniques using forecasting tools. **CO3:** Discuss methods to mobilize resources to meet the investment requirement for the power sector. **CO4:** Understand economic appraisal to allocate the resources efficiently and appreciate the investment decisions. **CO5:** Discuss expansion of power generation and planning for system energy in the country, evaluation of operating states of transmission system, their associated contingencies and the stability of the system.

UNIT 1: Power System: Power Systems, Planning Principles, Planning Process, Project Planning, Power Development, Power Growth, National and Regional Planning, Enterprise Resources Planning, Structure of a Power System, Power Resources, Planning Tools, Power Planning Organisation, Regulation, Scenario Planning. **Electricity Forecasting:** Load Requirement, System Load, Electricity Forecasting, Forecasting Techniques, Forecasting Modelling, Spatial – Load Forecasting, Peak Load - Forecast, Reactive – Load Forecast, Unloading of a System.	**[8 Hrs]**
UNIT 2: Power-System Economics: Financial Planning, Techno – Economic Viability, Private Participation, Financial Analysis, Economic Analysis, Economic Characteristics – Generation Units, Transmission, Rural Electrification Investment, Total System Analysis, Credit - Risk Assessment, Optimum Investment, Tariffs. **Generation Expansion:** Generation Capacity and Energy, Generation Mix, Conventional Generation Resources, Nuclear Energy, Clean Coal Technologies.	**[8 Hrs]**
UNIT 3: Generation Expansion (continued): Distributed Power Generation, Renovation and Modernisation of Power Plants. **Transmission Planning:** Transmission Planning Criteria, Right – of – Way, Network Studies, High – Voltage Transmission, Conductors, Sub – Stations, Power Grid, Reactive Power Planning, Energy Storage.	**[8Hrs]**
UNIT 4: Distribution: Distribution Deregulation, Planning Principles, Electricity – Supply Rules, Criteria and Standards, Sub – Transmission, Basic Network, Low Voltage Direct Current Electricity, Distribution(continued): Upgradation of Existing Lines and Sub – Stations, Network Development, System Studies, Urban Distribution, Rural Electrification, Villages Self – Sufficiency in Energy, Community Power, Self – Generation. **Reliability and Quality:**Reliability Models, System Reliability, Reliability and Quality Planning, Functional Zones, Generation Reliability Planning Criteria, Transmission Reliability Criteria, Distribution Reliability, Reliability Evaluation, Grid Reliability, Reliability Target, Security Requirement, Disaster Management, Quality of Supply, Reliability and Quality Roadmap.	**[6 Hrs]**
UNIT 5 : Demand-Side Planning: Demand Response, Demand – Response Programmes, Demand– Response Technologies, Energy Efficiency, Energy - Economical Products, Efficient – Energy Users, Supply – Side Efficiency, Energy Audit. **Electricity Market:** Market Principles, Power Pool, Independent System Operator, Distribution System Operator, Power Balancing, Market Participants, Power Markets, Market Rules, Bidding, Trading, Settlement System, Locational Marginal Pricing, Transmission Charges, Merchant Power, Differential Electricity, Congestion Management, Ancillary Services, Hedging, Smart Power Market.	**[6 Hrs]**

Text Books:

S. No.	Title	Authors	Edition	Publisher
1.	Electric Power Planning	A. S. Pabla	2006	McGraw Hill, 2nd Edition
2.	Power System Planning Technologies and Applications: Concepts, Solutions and Management	Elkarmi, Fawwaz, AbuShikhah	2013	Khanna Pbs.

Subject Code	EE104891	L = 0	T = 0	P = 2	Credits = 1
Subject	**High Voltage Engineering Lab**	**CT**	**TA**	**Total**	**ESE Duration**
Evaluation Scheme	**50**	**25**	**25**	**50**	

COURSE OBJECTIVES	COURSE OUTCOMES
5. To get a fair knowledge about the generation and measurement of high voltages and currents. 6. Understand the concept of solid, liquid and gaseous dielectrics 7. Determining economic sharing of generations for a given loading condition. 8. Gain knowledge in testing of high voltage equipments.	**Students will be able to:-** **CO1:** Describe the principles behind generating high DC – AC and impulse voltages. **CO2:** Develop equivalent circuit models of the different high voltage generators. **CO3:** Perform a dynamic response analysis of high voltage measurement systems. **CO4:** Compute the breakdown strength of gas, liquids and solids insulation systems. **CO5:** Evaluate Insulation life and accelerated tests.

List of experiments: (Minimum 10 experiments to be performed)

1. To study the heating time constant for a Continuous Duty Motor
2. To Study the heating time constant of a Short time Duty Motor
3. To Study the cooling time constant of a Short time Duty Motor
4. To Study the heating time constant of a Short Time Duty Motor
5. To Study the cooling time constant for an Intermittent Duty Motor
6. Performance and speed control of D.C drive using 3-phase full converter
7. Performance and operation of a four quadrant chopper on D.C drive
8. Study and performance of electrical Dynamic braking and Plugging of D.C shunt motor
9. Study of V/F control operation of 3-ϕ Induction motor
10. Simulation of PWM VSI/CSI fed 3-ϕ Induction motor control using MATLAB/PSPICE/PSIM software.
11. Study of solid state stator voltage control of 3-ϕ Induction motor (using AC voltageregulator)
12. Performance and speed control of 3-ϕ Induction motor using 3-ϕ voltage source inverter
13. To study frequency control Synchronous motor drive 14. Study of AC motors for 25KV Ac traction
14. Study of Resistance wielding and Arc welding Apparatus.

Required
1. AC motor speed control trainer
2. DC motor speed control trainer
3. Heating cooling time constant unit
4. V/f control of Induction motor

Subject Code	EE104892	L = 2	T = 1	P = 2	Credits = 3
Subject	Utilization of Electrical Energy Lab	CT	TA	Total	ESE Duration
Evaluation Scheme	50	25	25	50	

Course Objectives	Course Outcomes
The objective of the course to: 1. This course provides an introduction to the principles of electrical drives and their applications. 2. This course deals with the fundamentals of illumination and its classification. 3. This course provides knowledge on electrical traction systems.	**Students will be able to:** **CO1:**To understand the operating principles and characteristics of traction motors with respect to speed, temperature, loading condition. **CO2:**To acquaint with the different types of heating techniques. **CO3:**To study the basic principles of illumination and its measurement. **CO4:** Design and develop smart electrical heating and welding systems through the use of modern Electrical Engineering **CO5:**To understand the method of calculation of various traction system for braking, acceleration and other related parameters, including demand side management.

List of Experiments

1. Measurement of Transformer Turns Ratio.
2. Power factor improvement of a single-phase load using capacitor bank
3. Perform dynamic braking of DC motor using MATLAB simulation
4. Testing of Dielectric Strength of Transformer Oil.
5. Installation, Maintenance and Testing of HPMV/ Sodium Vapour/ Metal Halide Lamp.
6. Identify the different components required for various types heating furnaces.
7. Identify the different accessories and safety devices required for various types of welding system.
8. Prepare Energy Bill based on energy consumption of residence/ Institute
9. Prepare a report /chart on various types of traction systems.
10. Verify the Inverse Square Law of illumination and compare the luminance of different types of luminous bodies
11. Study of an electric locomotive by visiting any railway repair shop at a nearby station
12. Study of different types of sources of light and make connections, and to measure intensity of light with lux-meter