EE401U – ELECTRIC DRIVES

Teaching Scheme: 03L, Total: 03 **Credits:** 03

Evaluation Scheme: 30 MSE + 10 ISA + 60 ESE **Total marks:** 100

Duration of ESE: 03 Hrs

COURSE DESCRIPTION:

This course contains different industrial drives, load characteristics, factors for selection of drives depending upon their electrical and mechanical characteristics. The subject also provides the knowledge of solid state microprocessor based electric drives. The course consists of general factors of electrical drives, material classification, temperature rise and rating of machines.

DESIRABLE AWARENESS/SKILLS:

Knowledge of DC Machines, Transformer, AC Machines and Power Electronics.

COURSE OBJECTIVES:

The objectives of the course are to:

1. provide basic knowledge of topology, hardware configuration, control techniques of DC and AC variable speed drives.
2. impart skills to select suitable drive for particular application.
3. develops ability to repair and maintain the drive panels.
4. gives exposure to advanced Electrical Drives.

COURSE OUTCOMES:

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

1. understanding the various concepts used in AC and DC drives.
2. apply the control techniques for AC and DC drives for speed control.
3. analyze the problems of AC and DC drives based on topology.
4. evaluate the control techniques for AC and DC drives.

Course Outcomes (COs) and Program Outcomes (POs) mapping with strength of correlation:

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	1								1				1	2	
2		1		1				1			2		2	1	1
3					2				2			1	2	1	
4			3							1				2	1

1-Weakly correlated 2 - Moderately correlated 3 - Strongly correlated

Course Content

Basics of Drives: Types & parts of the Electrical drives, Selection criteria of drives, motor rating, selection based on duty cycle, selection of converter rating, fundamental torque equation, speed torques characteristics DC motor & Induction motor, multi quadrant operation of the drive, classification of mechanical load torques, steady state stability of the drive, constant torque and constant HP operation of the drive, closed loop speed control.

DC Motor Drives: Methods of speed control, starting and breaking operation, single phase and three phase full controlled and half controlled converter fed DC drives, Multi quadrant operation of separately excited DC shunt motor, dual converter fed DC drives, circulating and non – circulating mode of operation, converter fed DC series motor drive, chopper control of DC shunt and series motor drives, four quadrant operation of chopper fed DC shunt motor drive.

Induction Motor Drives: Closed loop speed control of induction motor by stator voltage control, multi quadrant operation of drive with AC voltage controller, phase angle and integral cycle control of stator voltage controlled induction motor drive VSI fed induction motor drive, constant torque (constant E/F and constant V/F), constant HP operation, closed loop speed control block diagram., CSI fed induction motor drive, speed torque characteristics of CSI fed drive, closed loop speed control block diagram, comparison of CSI fed and VSI fed induction motor drive. Analysis of inverter fed induction motor drive using harmonic equivalent circuit, harmonic slip, harmonic torques and losses with inverter fed induction motor. Introduction to field oriented control and direct torque control.

Slip Ring Induction Motor Drives: Chopper controlled resistance in rotor circuit, slip power recovery using converter cascade in rotor circuit, sub synchronous and super synchronous speed control, Kramer speed control, cyclo - converter in rotor circuit.

Synchronous Motor Drives and Brushless DC Drives: VSI fed synchronous motor drives, true synchronous and self-control mode, open loop and closed loop speed control of Permanent Magnet Synchronous Machine, Brushless DC Motor Drives: working principal operation performance advantages and disadvantages.

Text Books:

1. Fundamentals of Electrical Drive, G. K. Dubey, Narosa publication, 2nd edition,2002
2. Electric Drives, N. K. De, P. K. Sen, Prentice Hall of India Eastern Economy Edition
3. Analysis of Thyristor Power Conditioned Motors, S. K. Pillai, University Press,1996
4. Electric Motor Drives – Modeling Analysis and Control, R. Krishnan, Pearson,1st edition,2001

Reference Books:

1. Modern Power Electronics and AC drives, B. K. Bose, Prentice Hall of India, 2001
2. Power Electronics - Converter application, N. Mohan T.M. undeland and W. P. Robbins, John Wiley and sons, 3rs edition, 2002
3. Electrical Drives - Concept and application, Vedam Subramanyam,TMH, 1st edition, 1996

EE402U – POWER SYSTEM OPERATION AND CONTROL

Teaching Scheme: 03L, Total: 03 **Credits:** 03
Evaluation Scheme: 30 MSE + 10 ISA + 60 ESE **Total marks:** 100
Duration of ESE: 03 Hrs

COURSE DESCRIPTION:

This course contains economic load scheduling and dispatch. It also discusses power system operation, voltage and frequency control. It explores the basic concept of voltage stability, voltage collapse.

DESIRABLE AWARENESS/SKILLS:

Knowledge of Electrical Machines and Power System.

COURSE OBJECTIVES:

The objectives of the course are to:
1. study power system operation and control.
2. analyze the stability problem for complex and large capacity units.
3. understand voltage and frequency control,
4. know enhancement of power handling capacity by use of FACTs
5. understand need of reactive power compensation

COURSE OUTCOMES:

On the successful completion of this course, student will be able to:
1. understand the operational constraints (equipment and stability), control objectives and their implementation, under normal and abnormal states of a power system.
2. enable the students to analyze economic dispatch of thermal units and methods of solution, Unit commitment- Solution methods
3. impart the knowledge of automatic generation control and automatic voltage regulation
4. understanding of interchange of power and energy- Economy interchange between interconnected utilities
5. create awareness of power system security -factors affecting power system security - contingency analysis

Course Outcomes (COs) and Program Outcomes (POs) mapping with strength of correlation:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1			1						1			1		2
2		2					1				2		3	2	
3		1			1				1				1		2
4			2							2		2	2	2	
5	2			2							1			1	

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Generator Voltage control: Automatic voltage control, generator controllers, Cross coupling between P-F and Q-V control channel, automatic voltage regulator, types of exciters and excitation system, exciter modeling, transfer function modeling for control static performance and dynamic response of AVR loops.

Load Frequency Control: Automatic load frequency control, speed governing system and hydraulic valve actuator for individual generator, turbine modeling, generator and load modeling, transfer function representation of power control mechanism of generator.

Electric Power Control: Concept of control area, division of power system into control areas, load frequency of single area, two area and multi area power system without integral control Advantage of pool operation , tie line bias control area exchange.

Voltage Stability and Compensation: Power system security, Operating stage (state transition diagram), voltage stability, Comparison of angle and voltage stability, reactive power flow and voltage collapse, voltage stability analysis and prevention of voltage collapse. Compensation in power system: load compensation, load ability of compensated and uncompensated over head transmission line, shunt & series compensation of transmission line.

Economic Load Dispatch and Optimal Operation of Power System: Input output characteristics, heat-rate characteristics, Incremental fuel rate and cost, Incremental Production cost, optimum scheduling of generation between different units. (Neglecting transmission losses), Transmission loss as a function of plant generation and incremental transmission loss for optimum economy, calculation of loss coefficients (two plant system), Optimum scheduling of generation between different plant considering transmission loss concept and significance of penalty factor, Automatic load dispatch, function and applications.

Text Books:

1. Modern Power System Analysis,I. J. Nagrath, D. P. Kothari, TMH New Delhi, 2nd edition, 2000
2. Economic Operation of Power System, L. K. Kirchamayor, Wiley Eastern Pvt. Ltd., New Delhi 2009

References:

1. Electric Energy Systems Theory: An Introduction, O. L. Elgerd, McGraw-Hill Book Comp. N.Y.,2nd edition, 2nd edition, 2017.
2. Power System Analysis, Hadi Saadat, WCB/McGraw-Hill International Edition, 1998
3. http://www.nptel.iitm.ac.in/

EE403U A – POWER SYSTEM DESIGN

Teaching Scheme: 03L, Total: 03 **Credits:** 03
Evaluation Scheme: 30 MSE + 10 ISA + 60 ESE **Total marks:** 100
Duration of ESE: 03 Hrs

COURSE DESCRIPTION:

This course contains design aspects of the transmission and Distribution sector. Electric power systems including power flow analysis. The course has abundant information about tender filling requirements of various equipment along with their testing. The course sets high standards in the corporate sector as it deals with on field concepts of power systems.

DESIRABLE AWARENESS/SKILLS:

Knowledge of Power system and switchgear protection

COURSE OBJECTIVES:

The objectives of the course are to:
1. educate students about the process of restructuring of power system
2. familiarize students about the operation of power system
3. teach students about designing concepts
4. gain knowledge of the fundamental concept of protection devices.
5. analyze the terms required for tender filing.

COURSE OUTCOMES:

On the successful completion of this course, student will be able to:
1. analyze the aspects of designing various electrical systems
2. model the distribution systems with complex technical constraints.
3. identify different abnormal conditions and design protection systems.
4. file the tenders for several power system sectors.
5. classify different Earthing systems and design it.

Course Outcomes (COs) and Program Outcomes (POs) mapping with strength of correlation:

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1				1			1						1		2
2	1					3		2			3			1	
3		1			1					1			2		
4			2				1					2			1
5									1					2	

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Design of Transmission System: Selection of insulation parameters, selection of voltage level, choice of type of conductor, Design aspects of Transmission systems. Types of insulators. Distribution of potential over a string of suspension insulators, methods to improve string efficiency.

Design of DC Distribution System: Types of distribution system arrangements, Primary and secondary distribution design, calculation of distribution sizes: voltage drops, efficiency, voltage regulation, types of cables used, design of rural and industrial distribution systems.

Design of Protection Systems: Operating mechanism, ratings and specifications, types of circuit breakers. Operating mechanism, ratings and specifications, types of Lightning Arrestors

Tenders Filing in Power System: Special characteristics to be defined in tender filing of Circuit Breakers, Lightning Arrestors, Transformers, Cables, Shunt Capacitors. Testing of Circuit Breakers, Lightning Arrestors, Shunt Capacitors.

Earthing Systems: Need of Earthing, various ways of Earthing according to voltage levels. Different Earthing done for transmission and distribution lines. Earthing Systems- step potential, touch potential, transfer potential.

Text Books:

1. Restructured Electrical Power System Design, M. V. Deshpande, Tata McGraw Hill, 2014.
2. Power System Analysis and Design, B. R. Gupta, S. Chand & Company, 2005.

Reference Books:

1. Substation Design Equipment, Pratap Singh Satnam, P. V. Gupta,Dhanpat Rai and Sons, 1994
2. Electrical Design-Estimation and Costing, K. B Raina and S. K. Bhattacharya, New age international publishers, 2nd edition, 2007.

EE403U B – ELECTRICAL MACHINE DESIGN

Teaching Scheme: 03L, Total: 03 **Credits:** 03
Evaluation Scheme: 30 MSE + 10 ISA + 60 ESE **Total marks:** 100
Duration of ESE: 03 Hrs

COURSE DESCRIPTION:

This course contains general factors of electrical machine design, material classification, temperature rise and rating of machines. It explores the design concept of transformer core, windings overall dimension, performance and cooling design of transformer. The course also provides sound understanding and basic concepts of rotating machine design.

DESIRABLE AWARENESS/SKILLS:

Knowledge of Electrical Machines -I and Electrical Machines –II

COURSE OBJECTIVES:

The objectives of the course are to:
1. apply concept of specific loading
2. design single phase and three phase transformer
3. design starters of rotating machines
4. design rotating machines
5. aware them about use of latest software in electrical machine design

COURSE OUTCOMES:

On the successful completion of this course, student will be able to:
1. differentiate between power and distribution transformer
2. determine main dimensions of rotating machines
3. design windings of rotating machines
4. differentiate between power and distribution transformer
5. differentiate between the design specifications of asynchronous and synchronous machines

Course Outcomes (COs) and Program Outcomes (POs) mapping with strength of correlation:

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1				2				1		2			3	1	1
2		1			3				2			3	1	2	
3	2				2		1			1	2				3
4			3			2			3			1	1	2	
5	1			1		2		1						1	

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

General Transformer Design

Modes of heat dissipation. Heating and cooling curves. Calculations of heating and cooling time constants, calculation of short time and continuous rating of electrical machine. Types and constructional features of core and windings used in transformers. Transformer auxiliaries such as tap changer, pressure release valve, breather and conservator. Specifications of transformers as per IS 2026(Part I). Output equation with usual notations, design of main dimensions, core, yoke and windings of the transformer. Methods of cooling and Tank design. Estimation of resistance and leakage reactance of transformer.

Performance parameters of Transformer:

Estimation of no-load current, losses, efficiency and regulation of transformers. Calculation of mechanical forces developed under short circuit conditions, measures to overcome this effect. Introduction to Computer aided design of transformer and induction motor, generalised flow charts for design of electrical machines.

Three phase Induction Motor Design : Part I

Constructional features, types of ac windings, output equation with usual notations, specific electrical and magnetic loadings, ranges of specific loadings, turns per phase, number of stator slots. Harmonic field effect on the performance of three phase induction motors, suitable combinations of stator and rotor slots. Specifications of Induction motor.

Three phase Induction Motor Design : Part II

Calculations for main dimensions and stator design parameters. Selection of length of air gap, factors affecting length of air gap, unbalanced magnetic pull. Design of rotor slots, size of bars, end rings for cage rotor and rotor slots, turns and area of cross section of conductor for wound rotor.

Performance parameters of Three Phase Induction motor

Leakage flux and leakage reactance: Slot leakage, tooth top leakage, zig-zag leakage, overhang leakage, leakage reactance calculation for three phase machines. MMF Calculation for air gap, stator teeth, stator core, rotor teeth and rotor core, effect of saturation, effects of ducts on calculations of magnetizing current and no-load current. Calculations of losses and efficiency.

Text books:

1. A Course in Electrical Machine Design, A.K. Sawhney, Dhanpat Rai & sons New Delhi, 10th edition,2016
2. Theory and Performance & Design of A.C. Machines, M.G. Say, ELBS London 3rd edition, 2002
3. Performance and Design of DC Machine, A.E.Clayton, , ELBS, ISAAC Pitman Sons. 3rd edition

Reference books:

1. Principles of Electrical Machine Design with computer programmes, S. K. Sen, Oxford and IBH Company Pvt. Ltd., New Delhi, 2006
2. Electrical Machine Design Data Book, A Shanmugasundaram, G. Gangadharan, R. Palani,Wiley Eastern Ltd., New Delhi , 3rd edition, 3rd reprint, 1988

EE403U C – OPTIMISATION TECHNIQUES

Teaching Scheme: 03L, Total: 03 **Credits:** 03
Evaluation Scheme: 30 MSE + 10 ISA + 60 ESE **Total marks:** 100
Duration of ESE: 03 Hrs

COURSE DESCRIPTION:

This course contains optimization techniques that are essential in the planning of large electrical systems, optimization of power flows, and a wide variety of other electrical engineering problems. The course covers linear programming methods for the optimal allocation of electrical resources, constrained and unconstrained methods applied to the design of optimal power systems, nonlinear programming methods for the optimisation of power flows, genetic and evolutionary algorithms applied to a variety of electrical engineering tasks.

DESIRABLE AWARENESS/SKILLS:

Knowledge of Feedback Control System, Power System

COURSE OBJECTIVES:

The objectives of the course are to:
1. solve different optimization problems
2. write a program with convex analysis, least-squares, linear and quadratic programs, etc.
3. solve a variety of electrical engineering applications problems.
4. develop the mathematical model of electrical problem using optimization
5. apply the techniques to solve optimization problems.

COURSE OUTCOMES:

On the successful completion of this course, student will be able to:
1. recognize and formulate problems that arise in engineering in terms of optimization problems.
2. present the basic theory of such problems related to the power system.
3. understand, and solve problems using optimization techniques.
4. implement different techniques to the electrical engineering field.
5. write algorithms for electrical engineering application problem

Course Outcomes (COs) and Program Outcomes (POs) mapping with strength of correlation:

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1				2					2			3	3		2
2		1			3		1			1		1		2	
3					2				1		2		1	2	
4	1		2			2					1			2	3
5						2				1		2	1	1	

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Introduction: Concept of optimization and classification of optimization techniques. Linear Programming: Standard form of LPP Simplex Method of solving LPP, duality, sensitivity analysis, Decomposition principle, transportation problem and application of LPP to Electrical Engineering.

Nonlinear Programming: One dimensional methods, elimination methods, Fibonacci Method, Golden Section Method interpolation methods, quadratic and cubic interpolation Methods. Unconstrained optimization techniques, direct search and descent methods, constrained optimization techniques, direct and indirect methods.

Dynamic Programming: Multistage decision processes, concept of sub-optimization and principle of optimality, conversion of final value problem into an initial value problem. Constrained Optimization, Complex Method, Cutting Plane Method, Method of feasible directions, integer programming, quadratic Programming**.**

Genetic Algorithm: Introduction to genetic Algorithm, working principle, coding of variables, fitness function. GA operators; Similarities and differences between GAs and traditional methods; Unconstrained and constrained optimization using Genetic Algorithm, global optimization using GA.

Applications to Power system: Economic Load Dispatch in thermal and Hydro-thermal system using GA and classical optimization techniques, Unit commitment problem, reactive power optimization. Optimal power flow, LPP and NLP techniques to optimal flow problems.

Text books:

1. Optimization Theory and Applications, S. S. Rao, New Age International (P) Ltd., 2000
2. Operation Research, H. A. Taha, Prentice Hall of India Pvt. Ltd., 7th Edition, 2003
3. Optimization Methods for Engineering Design, R. L. Fox, Addison-Wesley, 1971.

Reference Books:

1. Genetic Algorithms in Search, Optimisation, D. E. Goldberg And Machine Learning, Addison-Wesley, 1989
2. The Mathworks, Optimisation Toolbox, Users Guide, 1996
3. Applied Nonlinear Programming, Himmelblau, D.M. McGraw-Hill, New York, 1972

EE404U A SMART GRID TECHNOLOGY

Teaching Scheme: 03L, Total: 03 **Credits:** 03
Evaluation Scheme: 30 MSE + 10 ISA + 60 ESE **Total marks:** 100
Duration of ESE: 03 Hrs

COURSE DESCRIPTION:

This course contains technologies used in today's power system for grid interconnection. This course introduces conventional and modern methods. It also deals with current development of smart grid at national and international level. Further the role of communication and information technology in smart grid is also discussed.

DESIRABLE AWARENESS/SKILLS:

Knowledge of power systems, generation and transmission, electrical and electronic measurement

COURSE OBJECTIVES:

The objectives of the course are to:

1. study the various aspects of the smart grid, including technologies, components, architectures and applications.
2. study the issues and challenges involved in smart grid technology.
3. take initiatives in the current development of smart grid at national and international level.
4. know the role of communication and information technology in the smart grid.
5. understand the smart real time pricing

COURSE OUTCOMES:

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

1. various aspects of the smart grid, including technologies, components, architectures and applications.
2. the issues and challenges involved in smart grid.
3. current initiatives in the development of smart grid at national and international level.
4. the role of communication and information technology in the smart grid.
5. work of real time various smart meters.

Course Outcomes (COs) and Program Outcomes (POs) mapping with strength of correlation:

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1				2					2			3	3		2
2		1			3		1			1		1		2	
3					2				1		2		1	2	
4	1		2			2					1			2	3
5						2				1		2	1	1	

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Introduction to Smart Grid:
Evolution of Electric Grid, Concept of Smart Grid, Definitions, Need of Smart Grid, Functions of Smart Grid, Opportunities & Barriers of Smart Grid, Drivers of SG in India, Challenges for SG, Difference between conventional & smart grid, Smart Grid Vision & Roadmap for India, Concept of Resilient and Self Healing Grid, Present development & International policies in Smart Grid, Smart Cities, Pilot projects in India.

Smart Grid Technologies:
Remote Terminal Unit (RTU), Intelligent Electronic Devices (IED), Phase Measurement Unit (PMU). Smart Substations, Substation and Feeder Automation, application for monitoring, protection and control, Plug in Hybrid Electric Vehicles(PHEV), Vehicle to Grid(V2G), Grid to vehicles(G2V), Smart storage technologies – Battery(flow and advanced), SMES, Super Capacitors, Pumped Hydro, Compressed Air Energy Storage(CAES) and its comparison, Optimal Location of PMUs for Complete Observability.

Smart Meters and Advanced Metering Infrastructure:
Introduction to Smart Meters, Advanced Metering Infrastructure (AMI), Real Time Pricing, Automatic Meter Reading (AMR), Outage Management System (OMS) Smart Sensors, Smart Appliances, Home & Building Automation, Geographic Information System (GIS).

Microgrids and Power Quality Management in Smart Grid:
Concept of Microgrid, need & applications of Microgrid, Microgrid Architecture, DC Microgrid, Formation of Microgrid, Issues of interconnection, protection & control of Microgrid, Integration of renewable energy sources, Smart Microgrid, Microgrid and Smart Grid Comparison, Smart Microgrid Renewable Green Energy System, Cyber Controlled Smart Grid Power Quality and EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit

Communication Technology for Smart Grid:
Communication Architecture of SG, Wide Area Measurement System (WAMS), Home Area Network (HAN), Neighbourhood Area Network (NAN), Wide Area Network (WAN). Bluetooth, ZigBee, GPS, Wi-Fi, Wi-Max based communication, Wireless Mesh Network, Basics of CLOUD Computing & Cyber Security for Smart Grid, Broadband over Power line (BPL), IP based protocols.

Text books:
1. Smart Grid: Technology and Applications, Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, Wiley, March 2012.
2. Smart Grids, Jean Claude Sabonnadiere, Nouredine Hadjsaid, Wiley Blackwell,2012

Reference Books:

1. Smart Grid: Fundamentals of Design and Analysis, James Momoh IEEE Press Series on Power Engineering, Wiley-IEEE Press, 1st edition, 2012.
2. Integration of Green and Renewable Energy in Electric Power Systems,Ali Keyhani, Mohammad N. Marwali, Min Dai Wiley,1st edition, 2010.
3. Smart Grids (Power Engineering), Stuart Borlase, CRC Press, 1st edition, 2012.
4. The Smart Grid: Enabling Energy Efficiency and Demand Response, Clark W. Gellings, River Publishers, 1st edition, 2009,

EE404U B INDUSTRIAL SAFETY

Teaching Scheme: 03L, Total: 03 **Credits:** 03
Evaluation Scheme: 30 MSE + 10 ISA + 60 ESE **Total marks:** 100
Duration of ESE: 03 Hrs

COURSE DESCRIPTION:

This course contains identification of components needed to provide a safe environment, analyzing result safety and health issues.

DESIRABLE AWARENESS/SKILLS:

Knowledge of Electrical Machines and Power Electronics

COURSE OBJECTIVES:

The objectives of the course are to:
1. identify the components through case studies and review of injury statistics
2. analyze safety and health issues resulting from worker complaints
3. identify potential workplace safety and health hazards
4. determine how to mitigate the hazards through engineering controls, administrative controls and personal protective equipment.
5. conduct basic safety inspections using strategies that they have developed though hazard identification and job hazard analysis.

COURSE OUTCOMES:

1. understand the basics of safety and its needs and objectives in industries.
2. learn the role and responsibility of safety management and its activities.
3. apply the knowledge of safety for awareness and training programs.
4. apply the safety practices and inspections using strategies that developed through hazard identification analysis.
5. categorize the different hazards and its safety precautions and action in different types of industry.

Course Outcomes (COs) and Program Outcomes (POs) mapping with strength of correlation:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1				2									3		
2					3									2	
3					2									2	
4						2								2	
5						2								1	

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Concepts And Statutory Requirements: Introduction – electrostatics, electromagnetism, stored energy, energy radiation and electromagnetic interference – Working principles of electrical equipment-Indian electricity act and rules-statutory requirements from electrical inspectorate-international standards on electrical safety – first aid-cardiopulmonary resuscitation(CPR).

Electrical Hazards : Primary and secondary hazards-shocks, burns, scalds, falls-human safety in the use of electricity. Energy leakage-clearances and insulation-classes of insulation-voltage classifications excess energy-current surges-Safety in handling of war equipments-over current and short circuit current-heating effects of current-electromagnetic forces-corona effect-static electricity – definition, sources, hazardous conditions, control, electrical causes of fire and explosion ionization, spark and arc-ignition energy-national electrical safety code ANSI. Lightning, hazards, lightning arrestor, installation – earthing, specifications, earth resistance,
earth pit maintenance**.**

Protection Systems: Fuse, circuit breakers and overload relays – protection against over voltage and under voltage – safe limits of amperage – voltage –safe distance from lines-capacity and protection of conductor-joints-and connections, overload and short circuit protection-no load protection earth fault protection. FRLS insulation-insulation and continuity test-system grounding-equipment grounding earth leakage circuit breaker (ELCB)-cable wires-maintenance of ground-ground fault circuit interrupter-use of low voltage-electrical guards-Personal protective equipment – safety in handling hand held electrical appliances tools and medical equipments.

Selection, Installation, Operation And Maintenance: Role of environment in selection-safety aspects in application - protection and interlock self diagnostic features and fail safe concepts-lock out and work permit system-discharge rod and earthing devices-safety in the use of portable tools-cabling and cable joints preventive maintenance.

Hazardous Zones: Classification of hazardous zones -intrinsically safe and explosion proof electrical apparatus (IS, API and OSHA standard) -increase safe equipment-their selection for different zones temperature classification-grouping of gases-use of barriers and isolators-equipment **C**ertifying agencies.

Text Books:

1. R.S. Gupta, Handbook of Fire Technology, National Safety Council of India.
2. Major hazard control, A Practical Manual, Inter National Labour Office, 3rd impression
3. Encyclopedia of occupational health and safety, Inter National Labor Office, 4th edition, 1990.

Reference Books:

1. Industrial Safety -National Safety Council of India.
2. The Factories Act with amendments 1987, Govt. of India Publications DGFASLI,Mumbai Grimaldi and Simonds, Safety Management, AITBS Publishers, New Delhi, 2001.
3. Industrial Safety and Pollution Control Handbook: National Safety Council and Associate Publishers Pvt. Ltd, Hyderabad (1993).
4. Risk Assessment and Environmental Management: D. Kofi Asvite- Dualy, John Willey & Sons, West Sussex, England (1998).
5. Gilbert M. M., Pearson, "Introduction to Environmental Engineering & Science": Education, Singapore (2004).
6. R.S. Gupta," Fire Technology", National Safety Council of India.
7. Major hazard control, Inter National Labor Office.
8. Encyclopedia of occupational health and safety, Inter National Labor Office.
9. Safety, health and working condition in the transfer of technology, Inter National Office.

EE404U C INDUSTRIAL ELECTRICAL SYSTEMS

Teaching Scheme: 03L, Total: 03 **Credits:** 03
Evaluation Scheme: 30 MSE + 10 ISA + 60 ESE **Total marks:** 100
Duration of ESE: 03 Hrs

COURSE DESCRIPTION:

This course contains Electrical System Components, Residential and Commercial Electrical Systems, Industrial Electrical Systems: HT connection, Industrial Electrical System Automation. Recognize the need for technical change & ability to learn in the broadest knowledge of Technical Advancement in Electrical System.

DESIRABLE AWARENESS/SKILLS:

Knowledge of Electrical Machines and Power Electronics

COURSE OBJECTIVES:

The objectives of the course are to:
1. provide in-depth understanding of Electrical System Components, Residential and Commercial Electrical Systems
2. industrial Electrical Systems: HT connection, industrial substation, transformer selection,
3. role of Engineer in automation
4. advantages of process automation

COURSE OUTCOMES:

On the successful completion of this course, student will be able to:
1. understand the electrical wiring systems for residential, commercial and industrial consumers, representing the systems with standard symbols and drawings, SLD.
2. understand various terms regarding light, lumen, intensity, candle power, lamp efficiency, and specific consumption.
3. understand various components of industrial electrical systems, Industrial loads, Switchgear selection
4. analyze and select the proper size of the transformer.
5. understand Role of in automation, PLC based control system design, Panel Metering

Course Outcomes (COs) and Program Outcomes (POs) mapping with strength of correlation:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1				2									3		
2					3									2	
3					2									2	
4						2								2	
5						2								1	

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Electrical System Components: LT system wiring components, selection of cables, wires, switches, distribution box, metering system, Tariff structure, protection components- Fuse, MCB, MCCB, ELCB, inverse current characteristics, symbols, single line diagram (SLD) of a wiring system, Contactor, Isolator, Relays, MPCB, Electric shock and Electrical safety practices.

Residential and Commercial Electrical Systems: Types of residential and commercial wiring systems, general rules and guidelines for installation, load calculation and sizing of wire, rating of main switch, distribution board and protection devices, earthing system calculations, requirements of commercial installation, deciding lighting scheme and number of lamps, earthing of commercial installation, selection and sizing of components.

Illumination Systems: Understanding various terms regarding light, lumen, intensity, candle power, lamp efficiency, specific consumption, glare, space to height ratio, waste light factor, depreciation factor, various illumination schemes, Incandescent lamps and modern luminaries like CFL, LED and their operation, energy saving in illumination systems, design of a lighting scheme for a residential and commercial premises, flood lighting

Industrial Electrical Systems: HT connection, industrial substation, Transformer selection, Industrial loads, motors, starting of motors, SLD, Cable and Switchgear selection, Lightning Protection, Earthing design, Power factor correction – kVAR calculations, type of compensation, Introduction to PCC, MCC panels. Specifications of LT Breakers, MCB and other LT panel components.

Industrial Electrical System Automation: Study of basic PLC, Role of in automation, advantages of process automation, PLC based control system design, Panel Metering and Introduction to SCADA system for distribution automation

Text Books:

1. S. L. Uppal, G. C. Garg, "Electrical Wiring, Estimating & costing", Khanna publishers, 6th edition, 2008.

Reference Books:

1. K. B. Raina, "Electrical Design, Estimating & Costing", New age International, 1st edition, 2007.
2. S. Singh, R. D. Singh, "Electrical estimating and costing", Dhanpat Rai & Co., 2nd edition, 2010.
3. J. B. Gupta, "Utilization of Electric Power & Electric Traction", S.K. Kataria & Sons, 2nd edition, 2014.
4. H. Joshi, "Residential Commercial and Industrial Systems", Volume I, McGraw Hill Education, 2008.

EE405U A - ELECTRIFICATION OF BUILDINGS

Teaching Scheme: 03L, Total: 03 **Credits:** 03
Evaluation Scheme: 30 MSE + 10 ISA + 60 ESE **Total marks:** 100
Duration of ESE: 03 Hrs

COURSE DESCRIPTION:

This course contains electrification of high rise buildings and complexes. Studying this course will enable the diploma pass outs to plan, design, and estimate and execute the electrification of multistoried buildings and commercial complexes independently and professionally as per IE rules.

DESIRABLE AWARENESS/SKILLS:

Knowledge of Electrical Machines and Power Electronics

COURSE OBJECTIVES:

The objectives of the course are to:

1. prepare drawing and layout for an underground service connection.
2. calculate Load specifications for an underground service connection of multistoried buildings.
3. calculate the size of bus bar, cables, panels, wiring system, type of wire
4. decide Mounting arrangements and positioning of switchboards, distribution boards main switch
5. estimate the cost of multistoried buildings

COURSE OUTCOMES:

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

1. interpret plan and wiring diagrams of electrification of buildings and complexes.
2. calculate the average and peak power requirement of building complexes.
3. test wiring installation of a multistoried building and commercial complexes.
4. estimate the materials and cost of electrification for different buildings.
5. test the safety devices in a multistoried building and commercial complexes.

Course Outcomes (COs) and Program Outcomes (POs) mapping with strength of correlation:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1				2									3		
2					3									2	
3					2									2	
4						2								2	
5						2								1	

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Electrical Control of Light Sources:
Ballast, ignitors and dimmers for different types of lamps, Photometric Control of Light Sources and their Quantification: Types of Luminaries, factors to be considered for designing luminaries Types of lighting fixtures. Optical control schemes, design procedure of reflecting and refracting type of luminaries. Lighting Fixture types, use of reflectors and refractors, physical protection of lighting fixtures, types of lighting fixtures according to installation type, types of lighting fixtures according to photometric usages, luminaries standard (IEC-598-Part I).

Indoor Lighting designs: Zonal cavity method for general lighting design, determination for zonal cavities and different shaped ceilings using COU (coefficient of utilization), beam angles and polar diagrams. Factors to be considered for design of indoor illumination scheme,

I**ndoor illumination design for installations** : Residential (Numerical), Educational institute, Commercial installation and Hospital, Industrial lighting: Special purpose lighting schemes, Decorative lighting, Theatre lighting, Aquarium and swimming pool lighting, Factors to be considered for design of outdoor illumination scheme.

Outdoor Lighting Designs: Road classifications according to BIS, pole arrangement, terminology, lamp and luminaire selection, different design procedures, beam lumen method, point by point method, isolux diagram, problems on point by point method.

Outdoor illumination design for installations: Road lighting (Numerical), Flood lighting (Numerical), Stadium and sports complex, Lighting for advertisement/hoardings, Modern trends in illumination, LED luminary designs, Intelligent LED fixtures, Natural light conduiting, Organic lighting system, LASERS, characteristics, features and applications, non-lighting lamps, Optical fiber, its construction as a light guide, features and applications

Text Books:

1. Electrical Wiring Estimating and Costing. by S. L. Uppal, Paperback.
2. A Course in Electrical Installation Estimating and Costing. by J.B. Gupta, : S K Kataria & Sons.
3. Raina. K. B.& Bhattacharya. S.K. Electrical Design Estimating and Costing: New Age International.

Reference Books:

1. Software/Learning Websites
2. www.nptel.iitm.ac.in
3. http://www.edumedia-sciences.com
4. www.youtube
5. http://electrical-engineering-portal.com/

EE405U B INDUSTRIAL AUTOMATION

Teaching Scheme: 03L, Total: 03 **Credits:** 03
Evaluation Scheme: 30 MSE + 10 ISA + 60 ESE **Total marks:** 100
Duration of ESE: 03 Hrs

COURSE DESCRIPTION:

This course contains PLC & SCADA based Industrial Automation systems which will improve the knowledge of the students about industrial processes using automation. The course will cover industrial automation systems in terms of their architecture, their interface to the process hardware, the functionality and the application development facilities

DESIRABLE AWARENESS/SKILLS:

Knowledge of Electrical Machines and Power Electronics

COURSE OBJECTIVES:

The objectives of the course are to:

1. apply the knowledge of automation in machine control.
2. design and conduct practical in realistic constraints on motors such that it is applicable in manufacturing, testing and maintenance field.
3. design the automation system for fast and value added quality product for economic growth through technological development.
4. solve engineering solution for fast growing industrial sector with reliable atomized system using PLC and SCADA system.

COURSE OUTCOMES:

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

1. understand the generic architecture and constituent components of a Programmable Logic Controller.
2. develop the architecture of SCADA explaining each unit in detail.
3. develop a software program using modern engineering tools and techniques for PLC and SCADA.
4. apply knowledge gained about PLCs and SCADA systems to identify few real-life industrial applications.

Course Outcomes (COs) and Program Outcomes (POs) mapping with strength of correlation:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1				2									3		
2					3									2	
3					2									2	
4						2								2	

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Introduction to PLC

Role of automation in Industries, benefits of automation, Necessity of PLC, History and evolution of PLC, Definition, types, selection criterion, Overall PLC system, PLC Input and output modules (along with Interfaces), CPU, programmers and monitors, power supplies, Solid state memory, advantages and disadvantages.

Programming of PLC

Programming equipment, Various techniques of programming, Ladder diagram fundamentals, proper construction of ladder diagram, basic components and their symbols in ladder diagram, MCR (master control relay) and control zones, Boolean logic and relay logic Timer and counter-types along with timing diagrams, shift registers, sequencer function, latch instruction Arithmetic and logical instruction with various examples.

Advance PLC function

Input ON/OFF switching devices, Input analog devices, Output ON/OFF devices, Output analog devices, programming ON/OFF Inputs to produce ON/OFF outputs. Analog PLC operation, PID control of continuous processes, simple closed loop systems, problems with simple closed loop systems, closed loop system using Proportional, Integral & Derivative (PID), PLC interface, and Industrial process example**.**

Applications of PLC

PLC interface to various circuits : Encoders, transducer and advanced sensors (Thermal, Optical, Magnetic, Electromechanical, Flow, Level sensors) Measurement of temperature, flow, pressure, force, displacement, speed, level Developing a ladder logic for Sequencing of motors, Tank level control, ON OFF temperature control, elevator, bottle filling plant, car parking Motors Controls: AC Motor starter, AC motor overload protection, DC motor controller, Variable speed (Variable Frequency) AC motor Drive.

SCADA System and Protocols s:

Introduction, definitions and history of Supervisory Control and Data Acquisition, typical SCADA system Architecture, Communication requirements, Desirable Properties of SCADA system, features, advantages, disadvantages and applications of SCADA. SCADA Architectures (First generation - Monolithic, Second generation - Distributed, Third generation – Networked Architecture), SCADA systems in operation and control of interconnected power system, Power System Automation (Automatic substation control and power distribution), Petroleum Refining Process, Water Purification System, Chemical Plant. Open systems interconnection (OSI) Model, TCP/IP protocol, DNP3 protocol, IEC61850 layered architecture, Control and Information Protocol (CIP), DeviceNet, Control Net, EtherNet/IP, Flexible Function Block process (FFB), Process Field bus (Profibus), Interfacing of SCADA with PLC.

Text Books:

1.Introduction to Programmable Logic Controllers, Gary Dunning, " Thomson, 2nd Edition
2. John R. Hackworth, Frederick D., Hackworth Jr., "Programmable Logic Controllers Programming Methods and Applications", PHI Publishers
3. John W. Webb, Ronald A. Reis, "Programmable Logic Controllers: Principles and Application", PHI Learning, New Delhi, 5th Edition
4. Ronald L. Krutz, "Securing SCADA System", Wiley Publications.

Reference books:

1. Batten G. L., "Programmable Controllers", McGraw Hill Inc., Second Edition
2. Bennett Stuart, "Real Time Computer Control", Prentice Hall, 1988
3. Doebelin E. O., "Measurement Systems", McGraw-Hill International Editions, Fourth Edition, 1990

EE406U – ELECTRIC DRIVES LAB

Teaching Scheme: 02P, Total: 02 **Credits:** 01
Evaluation Scheme: 25 ICA + 25 ESE **Total marks:** 50
Duration of ESE: 02 Hrs

COURSE DESCRIPTION:

This course contains different industrial drives, load characteristics, factors for selection of drives depending upon their electrical and mechanical characteristics. The subject also provides the knowledge of solid state microprocessor based electric drives. The course consists of general factors of electrical drives, material classification, temperature rise and rating of machines.

DESIRABLE AWARENESS/SKILLS:

Knowledge of DC Machines and Transformer, AC Machines and Power Electronics

COURSE OBJECTIVES:

The objectives of the course are to:

1. provide basic knowledge of topology, hardware configuration, working principles and control techniques of DC and AC variable speed drives.
2. impart skills to select suitable drives for particular applications.
3. develops the ability to repair and maintain the drive panels.
4. gives exposure to research avenues in the field of Electrical Drives.

COURSE OUTCOMES:

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

1. explain the various concepts used in AC and DC drives.
2. apply the control techniques for AC and DC drives for speed control.
3. solve the problems of AC and DC drives based on topology.
4. evaluate the control techniques for AC and DC drives.

Course Outcomes (COs) and Program Outcomes (POs) mapping with strength of correlation:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1				2			2			1			3		
2					3									2	
3					2				2		2			2	
4						2		1				3		2	
5						2				2				1	

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

EE406U – ELECTRIC DRIVES LAB

Teaching Scheme: 02P, Total: 02 **Credits:** 01
Evaluation Scheme: 25 ICA + 25 ESE **Total marks:** 50
Duration of ESE: 02 Hrs

The laboratory work should consist of experiments based on theory syllabus of EE401U. Experiments should involve simulation performance/design of practical, result and conclusion based on it. The sample list given below is just a guideline.

1. Speed – torque characteristics of chopper fed D. C. series motor.
2. Closed – loop speed control of chopper fed D. C. drive (simulation).
3. Open loop speed control of single phase full wave, half controlled converter fed D. C. shunt motor.
4. Open loop speed control of single phase full wave, full controlled converter fed D. C. shunt motor.
5. Closed loop speed control of converter fed D. C. drive.
6. Two quadrant single phase converter fed 5 HP DC drive (simulation).
7. Four quadrant single phase converter fed 5 HP DC drive (simulation).
8. Four quadrant chopper fed DC drive (simulation).
9. Speed control of slip-ring induction motor by rotor resistance control.
10. To study VSI fed induction motor drive.
11. Simulation of brushless DC motor drive.
12. Speed control of induction motor drive.
13. Closed loop Speed control of induction motor drive (simulation).

Note:

Guidelines for ICA: Internal Continuous Assessment shall support for regular performance of minimum 10 practical's and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by the student (journal) based on practical performance by the student. The performance shall be assessed experiment wise using internal continuous assessment format (S10).

Guidelines for ESE: The end semester examination(ESE) for the laboratory course of three hrs duration, shall be based on performance in one of the experiments performed by student in the semester followed by sample questions to judge the depth of understanding/knowledge or skill acquired by the student. It shall be evaluated by two examiners out of which one examiner shall be out of institute.

EE407U A – POWER SYSTEM DESIGN LAB

Teaching Scheme: 02P, Total: 02 **Credits:** 01
Evaluation Scheme: 25 ICA + 25 ESE **Total marks:** 50
Duration of ESE: 02 Hrs

COURSE DESCRIPTION:

This course contains different industrial drives, load characteristics, factors for selection of drives depending upon their electrical and mechanical characteristics. The subject also provides the knowledge of solid state microprocessor based electric drives. The course consists of general factors of electrical drives, material classification, temperature rise and rating of machines.

DESIRABLE AWARENESS/SKILLS:

Knowledge of DC Machines and Transformer, AC Machines and Power Electronics

COURSE OBJECTIVES:

The objectives of the course are to:
1. provide basic knowledge of topology, hardware configuration, working principles and control techniques of DC and AC variable speed drives.
2. impart skills to select suitable drives for particular applications.
3. develops the ability to repair and maintain the drive panels.
4. gives exposure to research avenues in the field of Electrical Drives.

COURSE OUTCOMES:

On the successful completion of this course, student will be able to:
1. analyze the aspects of designing various electrical systems
2. model the distribution systems with complex technical constraints.
3. identify different abnormal conditions and design protection systems.
4. file the tenders for several power system sectors.
5. classify different Earthing systems and design it.

Course Outcomes (COs) and Program Outcomes (POs) mapping with strength of correlation:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1				2			2			2			3		
2					3			3				1		2	
3											1			2	
4						2			1					2	
5						2						2		1	

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

EE407U A – POWER SYSTEM DESIGN LAB

Teaching Scheme: 02P, Total: 02 **Credits:** 01
Evaluation Scheme: 25 ICA + 25 ESE **Total marks:** 50
Duration of ESE: 02 Hrs

The laboratory work should consist of experiments based on theory syllabus of EE403U. Experiments should involve simulation performance/design of practical, result and conclusion based on it. The sample list given below is just a guideline.

1. Study on (i) on load Time Delay Relay (ii) off load Time Delay Relay
2. Polarity, Ratio and Magnetization Characteristics Test of CT & PT
3. Testing on (i) Under Voltage Relay and (ii) Earth Fault Relay
4. Study on D C Load Flow
5. Study of A C Load Flow Using Gauss – Seidel Method
6. Study of A C Load Flow Using Newton Raphson Method
7. Study on Economic Load Dispatch
8. Study of Transformer Protection by Simulation
9. Study of Generator Protection by Simulation
10. Study of Motor Protection by Micon Relay
11. Study of Different Characteristics of Over Current Relay

Note:

Guidelines for ICA: Internal Continuous Assessment shall support for regular performance of minimum 10 practical's and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by the student (journal) based on practical performance by the student. The performance shall be assessed experiment wise using internal continuous assessment format (S10).

Guidelines for ESE: The end semester examination(ESE) for the laboratory course of three hrs duration, shall be based on performance in one of the experiments performed by student in the semester followed by sample questions to judge the depth of understanding/knowledge or skill acquired by the student. It shall be evaluated by two examiners out of which one examiner shall be out of institute.

EE407U B– ELECTRICAL MACHINE DESIGN LAB

Teaching Scheme: 02P, Total: 02 **Credits:** 01
Evaluation Scheme: 25 ICA + 25 ESE **Total marks:** 50
Duration of ESE: 02 Hrs

COURSE DESCRIPTION:

The course consists of general factors of electrical machine design, material classification, temperature rise and rating of machines. It explores the design concept of transformer core, windings overall dimension, performance and cooling design of transformer. The course also provides sound understanding and basic concepts of rotating machine design.

DESIRABLE AWARENESS/SKILLS:

Knowledge of Electrical Machines -I and Electrical Machines –II

COURSE OBJECTIVES:

The objectives of the course are to:

1. understand concept of specific loading
2. design single phase and three phase transformer
3. design starters of rotating machines
4. design rotating machines
5. aware them about use of latest software in electrical machine design

COURSE OUTCOMES:

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

1. differentiate between power and distribution transformer
2. determine main dimensions of rotating machines
3. design windings of rotating machines
4. differentiate between power and distribution transformer
5. differentiate between the design specifications of asynchronous and synchronous machines

Course Outcomes (COs) and Program Outcomes (POs) mapping with strength of correlation:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1				2									3		
2					3									2	
3					2									2	
4						2								2	
5						2								1	

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

EE407U B– ELECTRICAL MACHINE DESIGN LAB

Teaching Scheme: 02P, Total: 02 **Credits:** 01
Evaluation Scheme: 25 ICA + 25 ESE **Total marks:** 50
Duration of ESE: 02 Hrs

The laboratory work should consist of experiments based on the theory syllabus of EE403B. Experiments should involve simulation performance/design of practical, result and conclusion based on it. The sample list given below is just a guideline.

The term work shall consist of three drawing sheets (Minimum one in AutoCAD).

1. Details and assembly of 3- phase transformer with design report.
2. Details and layout of AC winding with design report.
3. Assembly of 3- phase induction motor.(only sheet)
4. Report based on Industrial visit to a manufacturing unit. (Transformer or Induction motor).

Note:

Guidelines for ICA: Internal Continuous Assessment shall support for regular performance of minimum 10 practical's and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by the student (journal) based on practical performance by the student. The performance shall be assessed experiment wise using internal continuous assessment format (S10).

Guidelines for ESE: The end semester examination(ESE) for the laboratory course of three hrs duration, shall be based on performance in one of the experiments performed by student in the semester followed by sample questions to judge the depth of understanding/knowledge or skill acquired by the student. It shall be evaluated by two examiners out of which one examiner shall be out of institute.

EE407U C– OPTIMIZATION TECHNIQUES LAB

Teaching Scheme: 02P, Total: 02 **Credits:** 01
Evaluation Scheme: 25 ICA + 25 ESE **Total marks:** 50
Duration of ESE: 02 Hrs

COURSE DESCRIPTION:

The course consists of optimization techniques that are essential in the planning of large electrical systems, optimization of power flows, and a wide variety of other electrical engineering problems. The course covers linear programming methods for the optimal allocation of electrical resources, constrained and unconstrained methods applied to the design of optimal power systems, nonlinear programming methods for the optimisation of power flows, genetic and evolutionary algorithms applied to a variety of electrical engineering tasks.

DESIRABLE AWARENESS/SKILLS:

Knowledge of feedback control system, power system

COURSE OBJECTIVES:

The objectives of the course are to:

1. to study different questions related to optimization techniques.
2. program with different method used for optimizations
3. solve a variety of electrical engineering applications problems.
4. translate questions in optimization to the correct mathematical formalization.
5. apply the correct techniques to solve such questions.

COURSE OUTCOMES:

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

1. recognize and formulate problems that arise in engineering in terms of optimization problems.
2. present the basic theory of such problems related to the power system.
3. understand, and solve problems using optimization techniques.
4. implement different techniques to the electrical engineering field.
5. write algorithms for electrical engineering application problem

Course Outcomes (COs) and Program Outcomes (POs) mapping with strength of correlation:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1				2									3		
2					3									2	
3					2									2	
4						2								2	
5						2								1	

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

EE407U C– OPTIMIZATION TECHNIQUES LAB

Teaching Scheme: 02P, Total: 02 **Credits:** 01
Evaluation Scheme: 25 ICA + 25 ESE **Total marks:** 50
Duration of ESE: 02 Hrs

The laboratory work should consist of experiments based on theory syllabus of EE401. Experiments should involve simulation performance/design of practical, result and conclusion based on it. The sample list given below is just a guideline.

Name of Experiment

1. Matrix operations in MATLAB
2. Differentiation of a vector and matrix in MATLAB
3. Integration of a vector and matrix in MATLAB
4. Simplex algorithm in MATLAB
5. Implementation of Newton's method in MATLAB
6. Implementation of Secant method in MATLAB
7. Implementation of Lagrange multiplier method in MATLAB
8. Implementation of KKT theorem in MATLAB
9. Implementation of BFGS method in MATLAB

Note:

Guidelines for ICA: Internal Continuous Assessment shall support for regular performance of minimum 10 practical's and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by the student (journal) based on practical performance by the student. The performance shall be assessed experiment wise using internal continuous assessment format (S10).

Guidelines for ESE: The end semester examination(ESE) for the laboratory course of three hrs duration, shall be based on performance in one of the experiments performed by student in the semester followed by sample questions to judge the depth of understanding/knowledge or skill acquired by the student. It shall be evaluated by two examiners out of which one examiner shall be out of institute.

EE408U – SEMINAR

Teaching Scheme: 02P, Total: 02 **Credits:** 02
Evaluation Scheme: 50 ICA **Total marks:** 50
Duration of ESE: 02 Hrs

The guidelines for seminar are as below:

1. Each Student shall select a topic for seminar which is not covered in the curriculum. Seminar topics should not be repeated and registration of the same shall be done on a first come first serve basis.
2. Topic of Seminar shall be registered within three weeks from commencement of VII Semester and shall be approved by the committee.
3. The three-member committee appointed by Head of the department shall be constituted for finalizing the topics of Seminar-II. Seminar shall be related to the state of the art topic of his/her choice approved by the committee.
4. Each student should deliver a seminar in scheduled period (Specified in time table or time framed by department) and submit the seminar report (paper bound copy/Thermal bound) in following format:

a. Title
b. Abstract
c. Introduction
d. Literature survey
e. Concept
f. Functional and Technical Details
g. Applications
h. Comparison with similar topics / methods
i. Future scope
j. References

ASSESSMENT OF SEMINAR

Guidelines for ICA: ICA shall be based on topic selection, presentation and Seminar report submitted by the student in the form of thermal bound. Assessment of the Seminar for award of ICA marks shall be done jointly by the guide and a departmental committee, as per the guidelines given in Table- B.

Name of Guide: _____

Table-B

Sr No	Name of Studets	Seminar topic	Topic selection	Literature Survey	Report Writing	Depeth of understanding	presentation	Total
			5	**5**	**5**	**5**	**5**	**25**

EE409U PROJECT-I

Teaching Scheme: 02P, Total: 02 **Credits:** 02
Evaluation Scheme: 25 ICA + 25 ESE **Total marks:** 50
Duration of ESE: 02 Hrs

The guidelines for Project-I are as below:
1. It is expected that the broad area of Project-I shall be finalized by the student in the beginning of the VII semester / extension of the Minor project undertaken may be Project-I.

2. A group of Minimum 3 and Maximum 5 students shall be allotted for Project-I and same project group for Project-II.

3. Fabrication, design or analysis

4. Approximately more than 50% work should be completed by the end of VII semester.

5. Each student group is required to maintain log book for documenting various activities of Project-I and submit group project report in the form of thermal bound at the end of semester – VII. Submit the progress report in following format:
a. Title
b. Abstract
c. Introduction
d. Problem identification and project objectives
e. Literature survey
f. Case study/Analysis/Design Methodology
g. Work to be completed (Progress status)
h. Expected result and conclusion
i. References.

6. Evaluation Committee comprising of the Guide, Project Coordinator and Expert appointed by the Head of the department will award the marks based on the work completed by the end of semester and the presentation based on the project work.

Guidelines for ICA: The Internal Continuous Assessment shall be based on the active participation of the students in the Project work and knowledge / skill acquired. Assessment of the project-I for award of ICA marks shall be done jointly by the guide and departmental committee as per the guidelines given in Table-A.

Guidelines for ESE: The End Semester Examination for Project shall consist of demonstration if any, presentation and oral examinations based on the project report.

Assessment of Project-I

Name of the Project: _____

Name of the Guide: _____

Table-A

Sr. No.	Name Of Student	Problem identification and project objective	Literature survey	Project methodology/ design / pcb/ hardware/simulation programming	Progress status	Presentation	Total
		5	5	5	5	5	25

EE410U Industrial Lecture

Teaching Scheme: 01L, Total: 01 **Credits:** 01
Evaluation Scheme: 50 ICA **Total marks:** 50
Duration of ESE: 03 Hrs

The guidelines for Industrial lectures are as below:
Industrial lectures are to be arranged to share experiences of eminent industrial Managers/ Engineers/ Entrepreneurs/Scientists/Professors. At least 4 lectures could be arranged for EE459 during the semester and tests may be conducted based on lectures.

1. There is a need to create avenues for close academia and industry interaction through all the phases of technology development, starting from conceptualization down to commercialization.

2. List of renowned persons from industry shall be prepared by the committee appointed by the Head of the department. After approval from the Principal, minimum five Industrial lectures in alternate week shall be arranged. This shall be delivered by the experts/Officials from Industries/Govt. organizations/ Private Sectors/Public Sectors / R&D Labs covering the various aspects.

3. Topics of Industrial Lectures shall be Technical in nature and should not be the specific contents from the curriculum.

4. Minimum five Lectures to be delivered by experts from the industry in alternate weeks.

5. Students shall submit the report based on minimum five lectures giving summary of the lecture delivered.

6. The summary should contain a brief resume of the expert, brief information of his organization and brief summary of the lecture in bullet point form.

Guidelines for ICA : Assessment of the Industrial Lecture for award of ICA marks shall be done jointly by departmental committee as per attendance in industrial lecture, report submitted by student and overall performance in the semester as per the guidelines given in Table- D.

Table-D

SN	Name of Student	Attendance (05 Marks per Lecture)	Dept of understanding (03 Marks per Lecture)	Report	Total
		25	15	10	50

EE451U – UTILIZATION OF ELECTRICAL ENERGY

Teaching Scheme: 03L, Total: 03 **Credits:** 03
Evaluation Scheme: 30 MSE + 10 ISA + 60 ESE **Total marks:** 100
Duration of ESE: 03 Hrs

COURSE DESCRIPTION:

The course consists of different industrial drives, load characteristics, factors for selection of drives depending upon their electrical and mechanical characteristics. The subject also provides the knowledge of solid state microprocessor based electric drives. The course consists of general factors of electrical drives, material classification, temperature rise and rating of machines.

DESIRABLE AWARENESS/SKILLS:

Knowledge of Electrical Machines and Power Electronics

COURSE OBJECTIVES:

The objectives of the course are to:

1. introduce various electric drives and their applications
2. discuss different methods of electrical heating and electric welding.
3. explain various techniques for designing indoor & outdoor lighting schemes
4. illustrate the fundamentals on electrolytic and electrometallurgical processes

COURSE OUTCOMES:

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

1. to design a safe and cost-effective electric traction system
2. understand the suitability of different motor drives to be used for a specific purpose
3. analyze the control operation of various electric appliances
4 .develop appropriate techniques for designing indoor & outdoor lighting schemes
5.designing/developing electrolytic and electrometallurgical processes

Course Outcomes (COs) and Program Outcomes (POs) mapping with strength of correlation:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1										2					
2				1			2					2			
3					2				1						
4						2					3			2	
5						2		3						1	

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Electric Heating

Modes of heat transfer, mathematical expressions Electric heating: Introduction to electric heating, Advantages of electrical heating Heating methods: - Resistance heating – Direct resistance heating, indirect resistance heating, electric ovens, different types of heating element materials, temperature control of resistance furnaces, design of heating element(Numerical). Applications of resistance heating Induction heating : Principle, core type and coreless induction furnaces, Numerical on melting furnaces Applications of induction heating Electric arc heating – Direct and indirect arc heating, types of arc furnaces, equivalent circuit of arc furnace, condition for maximum output, power factor at maximum output (Numerical), Heat control in arc furnace, Applications of arc heating Dielectric heating –Principle, choice of voltage and frequency for dielectric heating (Numerical), Applications of dielectric heating Electric Welding Welding methods–Electric arc welding and resistance welding. Modern welding techniques like ultrasonic welding and laser welding

Electrochemical Process

Need of electro-deposition. Applications of Faraday's laws in electro-deposition. Factors governing electro-deposition. Objectives of electroplating. Equipments and accessories for electroplating plant, Electroplating on non-conducting materials, Principle of anodizing and its applications.
Pilot devices and Control devices - construction and working of push button, limit switches, float switches pressure switches, contactors, thermostats, timers, relays Application of above devices in 1) Automatic water level controller 2) Lift Electrical Circuits Used in Refrigeration, Air Conditioning Brief description of vapour compression refrigeration cycle. Description of electrical circuits used in Refrigerator, Air Conditioner

Illumination

Definitions of flux, solid angle, luminous intensity, illumination, luminous efficiency, depreciation factor, coefficient of utilization, space to height ratio, reflection factor; Laws of illumination.
Design of illumination scheme-Factors to be considered for design of illumination scheme,
Calculation of illumination at different points, considerations involved in simple design problems for indoor installation, illumination schemes, standard illumination level. Design of flood lighting, street lighting Natural daylight illumination (brief information)
Different sources of light: Incandescent lamp, fluorescent lamp, comparison between them.
Incandescent and discharge lamps – their construction and characteristics; mercury vapour lamp, sodium lamp, halogen lamp, compact fluorescent lamp, metal halide lamp, neon lamps
Electroluminescent lamp-LEDs, types, LASERs Comparison of all above luminaries.

Electric Traction

History of Indian railways. Traction systems - Steam engine drive, electric drive, diesel electric drive, types of diesel locomotives, Advantages of electric traction, Brief treatment to - Indian railway engine coding terminology, WDM,WDP,WDG series and their capacity . Introduction to metro system, mono rail system. Systems of track electrification: D.C. system, single phase low frequency A.C. system, 3 phase low frequency A.C. systems, composite systems – kando systems,

single phase A.C. to D.C. system Different accessories for track electrification -overhead wires, conductor rail system, current collector-pantograph, catenary Electric locomotive- Block diagram with description of various equipments and accessories.
Supply system constituents-Layout and description of -Traction substation, feeding post(25kV), feeding and sectioning arrangement, sectioning and paralleling post, neutral section.
Details of major equipments in traction substation-transformer, circuit breaker, interrupter

Traction Mechanics
Types of services- Urban, Sub-urban, Main line Speed time curves, trapezoidal and quadrilateral speed-time curves, average and schedule speed(Numerical), Tractive effort. Specific energy consumption. Factors affecting specific energy consumption (Numerical), Mechanics of train movement, coefficient of adhesion (Numerical).

Traction Motors, Control of Traction Motors, Train Lighting
Desirable characteristic of traction motors. Suitability of D.C. series motor, A.C. series motor, 3 phase induction motor and linear induction motor for traction. Control of traction motors - Seriesparallel control, Shunt and bridge transition (Numerical), Electrical breaking, Regenerative breaking in traction, Suitability of different motors for braking. Train lighting system.
Railway signalling:- History, necessity, block system route relay interlock and necessity. Metro signalling, Electromechanical system for route relay interlocking. Introduction to train tracking system.

Text Books:

1. Utilization of electrical energy, by E.O.Taylor.
2. Electrical Drives: Concept and applications by VedamSubrahmanyam, THM.

Reference Books:

1. Art and Science of Utilisation of Electrical Energy, by H.Pratab, DhanpatRai

EE452UA– COMPUTER AIDED POWER SYSTEM ANALYSIS

Teaching Scheme: 03L, Total: 03 **Credits:** 03
Evaluation Scheme: 30 MSE + 10 ISA + 60 ESE **Total marks:** 100
Duration of ESE: 03 Hrs

COURSE DESCRIPTION:

This course will cover the modelling issues and analysis methods for the power flow, short circuit, contingency and stability analyses, required to be carried out for the power systems. Simulation and analysis of such a large system is possible only with the help of digital computers. Load flow or power flow study is the most frequently carried out for steady state analysis, which determines system voltage profile and line flows/losses. A fault in the power system network results in excessive current flowing through its various components.

DESIRABLE AWARENESS/SKILLS:

Knowledge of power system analysis, generation and transmission and distribution

COURSE OBJECTIVES:

The objectives of the course are to:
1. know modern tools for power system analysis.
2. understand complexities in the electrical power system.
3. analyze power systems with less computational time and more accuracy.
4. analyze methods for the power flow, short circuit, contingency and stability analyses.

COURSE OUTCOMES:

On the successful completion of this course, student will be able to:
1. understand the role of computer aided power system analysis in power flow, short circuit, contingency and stability analyses.
2. understand network topology for representation of power system components.
3. analyze the bus impedance and admittance matrices by algorithms.
4. perform the short circuit studies for proper selection of protection schemes.

Course Outcomes (COs) and Program Outcomes (POs) mapping with strength of correlation:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1				2								1	3		
2					3					2				2	
3					2						2			2	
4						2		2				2		2	

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

General Introduction and AC Power Flow Analysis: Modern Power Systems Operation and Control, Different types of Power System Analysis. Modeling of Power System Components,Power Flow Equations, Formation of Ybus Matrix, Power Flow Solution Algorithms, Newton Raphson Load Flow Method, Fast Decoupled Load Flow Method And DC Load Flow Method,AC-DC System Power Flow Analysis- Sequential and Simultaneous Solution Algorithms

Sparse Matrices: Sparsity directed Optimal Ordering Schemes,Solution Algorithms - LU Factorization,Factorization and Iterative Methods.

Analysis of Faulted Power System: Symmetrical and Asymmetrical Faults, Zbus Formulation,Short CircuitAnalysis of Large Power Systems using Zbus ,Analysis of Open Circuit faults.

Security Analysis: Basic Concepts,Static Security Analysis at Control Centers, Contingency Analysis, Contingency Selection.

Stability Analysis: Classification of Power System Stability, Classical Model of Synchronous Machines and Excitation System, Transient Stability Analysis of Multi-Machine Systems,Eigen Analysis of Dynamical Systems,Small Signal Stability Analysis using Classical Model,Basic Concepts of Voltage Stability Analysis.

Text Books:

1. Power System Analysis, J. J. Gringer, W. D. Stevenson, McGraw Hill.2017
2. Modern Power System Analysis, I. J. Nagrath and D. P. Kothari, Tata McGraw Hill,2011

Reference Book :

1. Computer aided power system analysis,'' G. L. Kusic, Prentice Hall, 1986
2. Power system analysis, Hadi Sadat, Tata McGraw Hill,2010
3. Computer method in power system analysis, G. W. Stagg and AL Ebiad, McGraw Hill

EE452U B–ILLUMINATION ENGINEERING

Teaching Scheme: 03L, Total: 03 **Credits:** 03
Evaluation Scheme: 30 MSE + 10 ISA + 60 ESE **Total marks:** 100
Duration of ESE: 03 Hrs

COURSE DESCRIPTION:

The course consists of general factors of electrical drives, material classification, temperature rise and rating of machines.

DESIRABLE AWARENESS/SKILLS:

Knowledge of Electrical Machines and Power Electronics

COURSE OBJECTIVES:

The objectives of the course are to:
1. select proper light source for the given lighting application
2. design a lighting scheme for interior and exterior lighting
3. propose and design energy efficient lighting scheme with suitable stand by source
4. understand how to use data sheets of illumination levels of various light sources
5. solve based on indoor/exterior lighting

COURSE OUTCOMES:

On the successful completion of this course, student will be able to:
1. select proper light source for the given lighting application
2. design a lighting scheme for interior and exterior lighting
3 propose and design energy efficient lighting scheme with suitable stand by source
4 compare light sources based on illumination levels

Course Outcomes (COs) and Program Outcomes (POs) mapping with strength of correlation:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1				2									3		
2					3									2	
3					2									2	
4						2								2	
5						2								1	

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Importance of Lighting in Human Life:
Optical systems of human eye ,Dependence of human activities on light, performance characteristics of human visual system, External factors of vision-visual acuity, contrast, sensitivity, time illuminance, colour, visual perception, optical radiation hazards, Good and bad effects of lighting & perfect level of illumination, Artificial lighting as substitute to natural light, Ability to control natural light, Production of light, physics of generation of light, Properties of light, Quantification & Measurement of Light.

Light Sources:
Lamp materials: Filament, glass, ceramics, gases, phosphors and other metals and non-metals. Discharge Lamps: Theory of gas Discharge phenomena, lamp design considerations, characteristics of low and high mercury and Sodium vapour lamps, Low Vapour Pressure discharge lamps – Mercury Vapour lamp, Fluorescent Lamp, Compact Fluorescent Lamp (CFL) High Vapour Pressure discharge lamps - Mercury Vapour lamp, Sodium Vapour lamp, Metal halide Lamps, Solid Sodium Argon Neon lamps, SOX lamps, Electro luminescent lamps, Induction lamps.

Electrical Control of Light Sources:
Ballast, ignitors and dimmers for different types of lamps, Photometric Control of Light Sources and their Quantification: Types of Luminaries, factors to be considered for designing luminaries Types of lighting fixtures. Optical control schemes, design procedure of reflecting and refracting type of luminaries. Lighting Fixture types, use of reflectors and refractors, physical protection of lighting fixtures, types of lighting fixtures according to installation type, types of lighting fixtures according to photometric usages, luminaries standard (IEC-598-Part I).

Text Books :
1. Illumination Engineering- from Edison's Lamp to the Laser, Joseph B. MurdochMacmillan Publishing company, New York, 1985.
2. Introduction to light emitting diode technology and applications, Gilbert Held, CRC Press, 2009.
3.Light emitting diodes, E. Fred Schubart, Cambridge University Press, 2006

Reference Books:
1.BIS, IEC Standards for Lamps, Lighting Fixtures and Lighting, ManakBhavan, New Delhi.
2. Handbook of Industrial Lighting, Butterworths and Stanley L. Lyons Butterworth and Co. Publishers Ltd., 1981.

EE452U C–HIGH VOLTAGE ENGINEERING

Teaching Scheme: 03L, Total: 03 **Credits:** 03
Evaluation Scheme: 30 MSE + 10 ISA + 60 ESE **Total marks:** 100
Duration of ESE: 03 Hrs

COURSE DESCRIPTION:

The demand for generation and transmission of large amount of electric power today necessitates in transmission at extra- high voltages. Electrical engineering students are expected to possess knowledge of high voltage techniques. The subject is not in-depth but explores the knowledge of insulating material, properties, breakdown phenomena in solid, liquid and gases. It also provides the platform to understand the generation and measurement of high voltage.

DESIRABLE AWARENESS/SKILLS:

Knowledge of electrical measurement and instrumentation

COURSE OBJECTIVES:

The objectives of the course are to:

1. understand breakdown phenomenon in case of solid, liquid and gaseous insulating medium
2. familiarize with various methods of generation of high voltages
3. familiarize with various methods of measurement of high voltages
4. understand over voltage phenomenon & concepts of insulation coordination
5. understand importance of testing of power apparatus

COURSE OUTCOMES:

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

1. understand the breakdown phenomenon in case of various insulating materials
2. understand the concepts of generation of high voltages & currents
3. understand the causes and protection from overvoltages and the concept of insulation coordination
4. analyze the direct and indirect testing methods
5. perform the safe working practices in laboratories

Course Outcomes (COs) and Program Outcomes (POs) mapping with strength of correlation:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1				2									3		
2					3									2	
3					2									2	
4						2								2	
5						2								1	

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Breakdown in Gases:
Ionization process in gas, Townsend's Theory, current growth equation in presence of primary and secondary ionization processes, Townsend Breakdown criterion, primary and secondary ionization coefficients, limitations of Townsend's theory, Streamer mechanism of breakdown, Paschen's Law and its limitations, Corona discharges for point plane electrode combination with positive and negative pulse application, time lag for and factors on which timelag depends. (Numerical on Townsend's theory and Paschen's law).

Breakdown in Liquid and solid Dielectrics: Pure and commercial liquids, Different breakdown theories: Breakdown in Pure liquid and breakdown in commercial liquids: Suspended Particle theory, Cavitations and bubble theory, Thermal mechanism of breakdown and Stressed Oil volume theory.Intrinsic breakdown: electronic breakdown,avalanche or streamer breakdown, electromechanical breakdown, thermal breakdown, treeing and tracking phenomenon, Chemical and
electrochemical breakdown, Partial discharge(Internal discharge),Composite Dielectric material, Properties of composite dielectrics, breakdown in composite dielectrics. (Numerical on theories of liquid and solid dielectric materials)

Lightning and Switching Over Voltages:
Causes of over voltages, lightning phenomenon, Different types of lightning strokes and mechanisms of lightning strokes, Charge separation theories, Wilson theory, Simpson theory, Reynolds and Mason theory, Over voltage due to switching surges and methods to minimize switching surges. Statistical approach of insulation coordination

Generation of High Voltages and Current:
a) Generation of high ac voltages-Cascading of transformers, series and parallel resonance system, Tesla coil b) Generation of impulse voltages and current-Impulse voltage definition, wave front and wave tail time, Multistage impulse generator, Modified Marx circuit, Tripping and control of impulse generators, Generation of high impulse current.

Measurement of High Voltage and High Currents:
Sphere gap voltmeter, electrostatic voltmeter, generating voltmeter, peak reading voltmeter, resistive, capacitive and mixed potential divider , capacitance voltage transformer, cathode ray oscilloscope for impulse voltage and current measurement, measurement of dielectric constant and loss factor, partial discharge measurements. Measurement of high power frequency a.c using current transformer with electro-optical signal converter, Radio interference measurements.

High Voltage Testing of Electrical Apparatus and H V Laboratories:
A) Testing of insulators and bushings, Power capacitors and cables testing, testing of surge arresters.
B) Design, planning and layout of High Voltage laboratory:-Classification and layouts, earthing and shielding of H.V. laboratories.

Text Books:

1. High Voltage Engineering,6th Edition, M. S. Naidu, V. Kamaraju, Tata McGraw –Hill Publications,2020
2. High Voltage Engineering fundamentals, E. Kuffel, W.S. Zaengl, J. Kuffel, Butterworth – Heinemann publishers,2000

Reference Books:

1. High Voltage Test Techniques, D. kind, K. Feser, Vieweg, SBA publications.
2. High Voltage Engineering- Theory & Practices, M. Khalifa, Dekker publications

EE453U A HVDC AND FACTS

Teaching Scheme: 03L, Total: 03 **Credits:** 03
Evaluation Scheme: 30 MSE + 10 ISA + 60 ESE **Total marks:** 100
Duration of ESE: 03 Hrs

COURSE DESCRIPTION:

Flexible AC Transmission System (FACTS) is one aspect of the power electronics revolution that is taking place in all areas of electric energy. In the transmission area, application of power electronics consists of HVDC and FACTS. New technology based on power electronics devices offers an opportunity to enhance controllability, stability of power transfer capability of AC transmission systems. The subject also explores the principles, operation of HVDC associated with FACT controllers.

DESIRABLE AWARENESS/SKILLS:

Knowledge of Electrical Machines, Generation, Transmission, Planning ,Load forecasting

COURSE OBJECTIVES:

The objectives of the course are to:
1. analyze the different control strategies for power flow using HVDC and FACTS devices.
2. understand the working of different FACTS controllers.
3. familiar with the latest advances in Power Electronics
4. study power transmission by EHV AC and FACTS.
5. study different FACTS component and power quality issues

COURSE OUTCOMES:

On the successful completion of this course, student will be able to:
1. analyze the different control strategies for power flow using HVDC and FACTS devices.
2. understand the working of different FACTS controllers.
3. model power system problems using software
4. know the latest advances in Power Electronics
5. understand issues related to enhancement of controllability, stability and power transfer capability of AC transmission system at high voltage

Course Outcomes (COs) and Program Outcomes (POs) mapping with strength of correlation:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1				2									3		
2					3									2	
3					2									2	
4						2								2	
5						2								1	

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

General background

EHVAC versus HVDC transmission, power flow through HVDC link, Graetz circuit, equation for HVDC power flow bridge connection, control of DC voltage and power flow, effects of angle of delay and angle of advance commutation, CIA, CC and CEA control, twelve pulse converter operation Harmonics in HVDC systems.

Multi terminal HVDC system

HVDC system layout and placement of components, HVDC protection, grounding, multi terminal HVDC systems, configurations and types.

HVDC Light

Introduction to VSC transmission, power transfer characteristics, structure of VSC link, VSC DC system control, HVDC light technology.

Power Electronic Controllers

Basics, Challenges and needs, Review of rectifiers and inverters, back to back converter, dc link converter, static Power converter structures, AC controller based structures, DC link converter topologies, converter output and harmonic control, power converter control.

Shunt, series compensation and Unified Power Flow Controller

Operation and control of SVC, STATCOM configuration and control, applications of SVC and STATCOM. TCSC operation, layout and operation, static Synchronous series compensator (SSSC). UPFC configuration, steady state operation control and characteristics, operational constraints of UPFC, Power flow studies in UPFC embedded systems.

Text Books:

1. HVDC Power Transmission System, K. R. Padiyar, Wiley Eastern Limited, New Delhi, First Edition

2. Understanding FACTS: Concepts and Technology of FACTS Systems , N. G. Hingorani, IEEE Press, 2000

3. FACTS Controllers in Power Transmission and Distribution, K. R. Padiyar New Age International (P) Ltd. 2007

Reference Books:

1.Power System Stability and Control,Prabha kundur,MCGraw Hill Education, 2006

2.Flexible AC Transmission System: Modelling and Control,Xiao-Ping Zhang, Christian Rehtan Bikash Pal,Springer 2012

3. Concepts for design of FACTS Controllers to damp power swings , Einar V. Larsen, Juan J. Sanchez-Gasca, Joe H.Chow, IEEE Trans On Power Systems, Vol.10, No.2, May 1995

EE453U B SPECIAL MACHINES

Teaching Scheme: 03L, Total: 03 **Credits:** 03
Evaluation Scheme: 30 MSE + 10 ISA + 60 ESE **Total marks:** 100
Duration of ESE: 03 Hrs

COURSE DESCRIPTION:

This course contains industrial drives, load characteristics, factors for selection of drives depending upon their electrical and mechanical characteristics. The subject also provides the knowledge of solid state microprocessor based electric drives. The course consists of general factors of electrical drives, material classification, temperature rise and rating of machines.

DESIRABLE AWARENESS/SKILLS:

Knowledge of Electrical Machines and Power Electronics

COURSE OBJECTIVES:

The objectives of the course are to:

1. gain knowledge of operation and performance of synchronous reluctance motors.
2. learn operation and performance of stepping motors.
3. understand operation and performance of switched reluctance motors.
4. familiarize with operation and performance of permanent magnet brushless D.C. motors.
5. illustrate operation and performance of permanent magnet synchronous motors.

COURSE OUTCOMES:

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

1.reproduce principal of operation of PMSM, Stepper motor, SRM, Switch reluctance and linear motors.

2. develop torque speed and performance characteristics of above motors
3. enlist application of these motors
4. demonstrate various control strategies.

Course Outcomes (COs) and Program Outcomes (POs) mapping with strength of correlation:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1				2									3		
2					3									2	
3					2									2	
4						2								2	

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Generalised Machine Theory:

Energy in singly excited magnetic field systems, determination of magnetic force and torque from energy. Determination of magnetic force and torque from co-energy, Forces and torques in systems with permanent magnets. MMF of distributed winding, Magnetic fields production of EMFs in rotating machines.

Permanent Magnet Synchronous and brushless D.C. Motor Drives:

Synchronous machines with PMs, machine configurations. Types of PM synchronous machines Sinusoidal and Trapezoidal. EMF and torque equations Torque speed characteristics Concept of electronic commutation, Comparative analysis of sinusoidal and trapezoidal motor operations. Applications

Control of PMSM:

abc-αβ and αβ-dq transformations, significance in machine modelling, Mathematical Model of PMSM (Sinusoidal), Basics of Field Oriented Control (FOC), Control Strategies: constant torque angle, unity power factor.

Reluctance Motor :

Principle of operation and construction of Switched Reluctance motor, Selection of poles and pole arcs , Static and dynamics Torque production, Power flow, effects of saturation, Performance, Torque speed characteristics, Synchronous Reluctance, Constructional features; axial and radial air gap motors; operating principle; reluctance torque; phasor diagram; motor characteristics Introduction to control of Reluctance Drive. Applications.

Stepper Motor and Linear Electrical Machines:

Construction and operation of stepper motor, hybrid, Variable Reluctance and Permanent magnet, characteristics of stepper motor, ; Static and dynamics characteristics, theory of torque production, figures of merit; Concepts of lead angles , micro stepping , Applications selection of motor.Introduction to linear electric machines. Types of linear induction motors,Constructional details of linear induction motor, Operation of linear induction motor.Performance specifications and characteristics Applications.

Text Books :

1. Special Electrical Machines K. Venkatratnam, University Press,2021
2. Electric Machinery A.E. Fitzgerald Charles Kingsley, Stephen Umans, Tata McGraw Hill Publication
3. Brushless Permanent magnet and Reluctance Motor Drives, T.J.E. Miller, Clarendon Press, Oxford
4. V. V. Athani, ‘Stepper Motors: Fundamentals, Applications and Design’, New age International

Reference Books :

1. R Krishnan, ‘Permanent Magnet Synchronous and Brushless D.C. Motor Drives’ CRC Press.
2. Ion Boldea, ‘Linear Electric Machines, Drives and maglevs’ CRC press
3. Ion Boldea S. Nasar, ‘Linear Electrical Actuators and Generators’, Cambridge University Press

EE453U C ELECTRICAL & HYBRID VEHICLE

Teaching Scheme: 03L, Total: 03 **Credits:** 03

Evaluation Scheme: 30 MSE + 10 ISA + 60 ESE **Total marks:** 100

Duration of ESE: 03 Hrs

COURSE DESCRIPTION:

This course introduces the fundamental concepts, principles, analysis and design of hybrid, electric and fuel cell vehicles.

DESIRABLE AWARENESS/SKILLS:

Knowledge of Electrical Machines and Power Electronics

COURSE OBJECTIVES:

The objectives of the course are to:

1. understand upcoming technology of electric and hybrid electric vehicles
2. analyze different aspects of drive train topologies
3. learn different energy management strategies
4. understand different communication systems used in electric and Hybrid electric vehicles
5. explain the concept of vehicle to grid configurations

COURSE OUTCOMES:

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

1 understand the different types of drive train topologies
2. analyze the load modelling based on the road profile and braking concepts
3. different types of motors used in electric and hybrid electric vehicles
4. different types of energy storage systems
5. understanding the concept vehicle to grid (V2G) and grid to vehicle (G2V).

Course Outcomes (COs) and Program Outcomes (POs) mapping with strength of correlation:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1				2									3		
2					3									2	
3					2									2	
4						2								2	
5						2								1	

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Introduction to Hybrid Electric Vehicles and Conventional Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. Basics of vehicle performance, vehicle power source characterization, transmission characteristics, mathematical models to describe vehicle performance.

Hybrid Electric Drive-trains and Electric Drive-trains : Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis. Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis.

Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switched Reluctance Motor drives, drive system efficiency.

Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization
of different energy storage devices.

Sizing the drive system and Energy Management Strategies : Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems. Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies. Case Studies: Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV).

Text Books

1. Modern Electric, Hybrid Electric, and Fuel Cell,Vehicles: Fundamentals ,Mehrdad Ehsani, Yimin Gao, Ali Emadi ,CRC Press, 2010.
2. Electric Vehicle Technology Explained, James Larminie, John Wiley & Sons, 2012
3. Electric & Hybrid Vehicles – Design Fundamentals Iqbal Hussain, Second Edition, CRC Press, 2011

Reference Books

1. Hybrid Vehicles and the future of personal transportation, Allen Fuhs, CRC Press, 2011.
2. Vehicle Power Management: Modeling, Control and Optimization, Xi Zhang, Chris Mi.

EE454U UTILIZATION OF ELECTRICAL ENERGY LAB

Teaching Scheme: 02P , Total: 02 **Credits:** 01
Evaluation Scheme: 25ICA + 25 ESE **Total marks:** 50
Duration of ESE: 02 Hrs

COURSE DESCRIPTION:

The subject explores the knowledge of different industrial drives, load characteristics, factors for selection of drives depending upon their electrical and mechanical characteristics. The the subject also provides the knowledge of solid state microprocessor based electric drives. The course consists of general factors of electrical drives, material classification, temperature rise and rating of machines.

DESIRABLE AWARENESS/SKILLS:

Knowledge of Electrical Machines and Power Electronics

COURSE OBJECTIVES:

The objectives of the course are to:

1. introduce various electric drives and their applications
2. discuss different methods of electrical heating and electric welding.
3. understand various techniques for designing indoor & outdoor lighting schemes
4. illustrate the fundamentals on electrolytic and electrometallurgical processes

COURSE OUTCOMES:

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

1.investigate on the various essential requirements and acquire the ability to design a safe and cost-effective electric traction system

2 .judge the suitability of different motor drives to be used for a specific purpose

3. review, analyse, and control the operation of various electric appliances used

4 .develop, select, and apply appropriate techniques for designing indoor & outdoor lighting schemes

5.understand designing/developing electrolytic and electrometallurgical processes

Course Outcomes (COs) and Program Outcomes (POs) mapping with strength of correlation:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1				2									3		
2					3									2	
3					2									2	
4						2								2	
5						2								1	

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

EE454U UTILIZATION OF ELECTRICAL ENERGY LAB

Teaching Scheme: 02P , Total: 02 **Credits:** 01
Evaluation Scheme: 25ICA + 25 ESE **Total marks:** 50
Duration of ESE: 02 Hrs

The laboratory work should consist of experiments based on theory syllabus of **EE451U** Experiments should involve simulation performance/design of practical, result and conclusion based on it. The sample list given below is just a guideline.

1. Study of different types of sources of light and make connections, and to measure intensity of light with lux-meter:
   1.1 Fluorescent lamp
   1.2 HP mercury vapour lamp
   1.3 HP sodium vapour lamp
   1.4 Compact Fluorescent lamp (CFL)
2. Study of induction furnace by visiting a factory and to prepare a report
3. Study of welding equipment along with its accessories
4. Study on the electroplating plant by visiting an industry and preparing a report
5. Study of refrigerator/air conditioner and to prepare a report of its electrical circuit
6. Power factor improvement of a single-phase load using capacitor bank
7. Study of an electric locomotive by visiting any railway repair shop at a nearby station

Note:
Guidelines for ICA: Internal Continuous Assessment shall support for regular performance of minimum 10 practical's and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by student (journal) based on practical performed by students. The performance shall be assessed experiment wise using internal continuous assessment format (S10).

Guidelines for ESE: The end semester examination(ESE) for the laboratory course of three hrs duration, shall be based on performance in one of the experiments performed by student in the semester followed by sample questions to judge the depth of understanding/knowledge or skill acquired by the student. It shall be evaluated by two examiners out of which one examiner shall be out of institute.

EE455 A COMPUTER AIDED POWER SYSTEM ANALYSIS LAB

Teaching Scheme: 02P , Total: 02 **Credits:** 01
Evaluation Scheme: 25ICA + 25 ESE **Total marks:** 50
Duration of ESE: 02 Hrs

COURSE DESCRIPTION:

This course will cover the modelling issues and analysis methods for the power flow, short circuit, contingency and stability analyses, required to be carried out for the power systems.Load flow or power flow study is the most frequently carried out for steady state analysis, which determines system voltage profile and line flows/losses. A fault in the power system network results in excessive current flowing through its various components.

DESIRABLE AWARENESS/SKILLS:

Knowledge of power system analysis, generation and transmission and distribution**.**

COURSE OBJECTIVES:

The objectives of the course are to:

1. know modern tools for power system analysis.
2. understand complexities in the electrical power system.
3. analyse power systems with less computational time and more accuracy.
4. analyze methods for the power flow, short circuit, contingency and stability analyses.
5. to learn the role of Computer aided power system analysis in utility-related applications which are becoming extremely important

COURSE OUTCOMES:

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

1. describe the role of computer aided power system analysis in power flow, short circuit, contingency and stability analyses.
2. understand network topology for representation of power system components.
3. form the bus impedance and admittance matrices by algorithms.
4. perform the short circuit studies for proper selection of protection schemes.
5. evaluate simultaneous faults by matrix transformations

Course Outcomes (COs) and Program Outcomes (POs) mapping with strength of correlation:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1				2									3		
2					3									2	
3					2									2	
4						2								2	
5						2								1	

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

EE455 A COMPUTER AIDED POWER SYSTEM ANALYSIS LAB

Teaching Scheme: 00L + 00T + 02P , Total: 02 **Credits:** 01
Evaluation Scheme: 25ICA + 00 ISA + 25 ESE **Total marks:** 50
Duration of ESE: 02 Hrs

The laboratory work should consist of experiments based on theory syllabus of EE401. Experiments should involve simulation performance/design of practical, result and conclusion based on it. The sample list given below is just a guideline.

1. Introduction about MATLAB/SIMULINK used in Computer Based Power System Designing.
2(a). Design a simulink model of three phase power system and analyze the behavior of voltage and current in case of Line to Ground fault (L-G) on phase "A".
2(b). Design a Simulink model of three phase power system and analyze the behavior of voltage and current in case of Line to Ground fault (L-G) on phase "B".
2(c). Design a simulink model of three phase power system and analyze the behavior of voltage and current in case of Line to Ground fault (L-G) on phase "C".
3(a). Design a simulink model of three phase power system and analyze the behavior of voltage and current in case of Line to Line fault (L-G) on phase "B-C".
3(b). Design a simulink model of three phase power system and analyze the behavior of voltage and current in case of Line to Line fault (L-G) on phase "C-A".
3(c). Design a simulink model of three phase power system and analyze the behavior of voltage and current in case of Line to Line fault (L-G) on phase "A-B".
4(a). Design a simulink model of three phase power system and analyze the behavior of voltage and current in case of Line to Line to Ground fault (L-L-G) on phase "B-C with Ground".
4(b). Design a stimulant model of three phase power system and analyze the behavior of voltage and current in case of Line to Line to Ground fault (L-L-G) on phase "C-A with Ground".
4(c). Design a simulink model of three phase power system and analyze the behavior of voltage and current in case of Line to Line to Ground fault (L-L-G) on phase "A-B with Ground".
`5. Design a simulink model of three phase power system and analyze the behavior of voltage and current in case of Three Phase Short Circuit fault.
6. Design a SIMULINK model to analyze the behavior of Steady state & Transient analysis for linear circuits.
7. To carry out load flow analysis of the given power system by gauss ideal method.
8. To perform load flow analysis by Newton Raphson method.
9. To perform load flow analysis by using Fast Decoupled Method.
10. To understand the fundamentals of economic dispatch and solve the problem using classical method with and without line losses.
11. To develop a program for formation of Z-Bus by the method of inspection
12. To develop a program for formation of Y-Bus by the method of inspection.

Note:

Guide lines for ICA: Internal Continuous Assessment shall support for regular performance of minimum 10 practical's and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by student (journal) based on practical performed by student. The performance shall be assessed experiment wise using internal continuous assessment format (S10).

Guide lines for ESE: The end semester examination(ESE) for the laboratory course of three hrs duration, shall be based on performance in one of the experiments performed by student in the semester followed by sample questions to judge the depth of understanding/knowledge or skill acquired by the student. It shall be evaluated by two examiners out of which one examiner shall be out of institute.

EE455U B ILLUMINATION ENGINEERING LAB

Teaching Scheme: 02P , Total: 02 **Credits:** 01
Evaluation Scheme: 25ICA + 25 ESE **Total marks:** 50
Duration of ESE: 02 Hrs

COURSE DESCRIPTION:

The subject explores the knowledge of different industrial drives, load characteristics, factors for selection of drives depending upon their electrical and mechanical characteristics. The subject also provides the knowledge of solid state microprocessor based electric drives. The course consists of general factors of electrical drives, material classification, temperature rise and rating of machines.

DESIRABLE AWARENESS/SKILLS:

Knowledge of Electrical Machines and Power Electronics

COURSE OBJECTIVES:

The objectives of the course are to:
1. select proper light source for the given lighting application
2. design a lighting scheme for interior and exterior lighting
3. propose and design energy efficient lighting scheme with suitable stand by source
4. understand how to use data sheets of illumination levels of various light sources
5. solve based on indoor/exterior lighting

COURSE OUTCOMES:

On the successful completion of this course, student will be able to:
1. select proper light source for the given lighting application
2. design a lighting scheme for interior and exterior lighting
3 propose and design energy efficient lighting scheme with suitable stand by source
4 compare light sources based on illumination levels

Course Outcomes (COs) and Program Outcomes (POs) mapping with strength of correlation:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1				2									3		
2					3									2	
3					2									2	
4						2								2	
5						2								1	

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

EE455U B ILLUMINATION ENGINEERING LAB

Teaching Scheme: 02P , Total: 02 **Credits:** 01
Evaluation Scheme: 25ICA + 25 ESE **Total marks:** 50
Duration of ESE: 02 Hrs

The laboratory work should consist of experiments based on theory syllabus of EE401. Experiments should involve simulation performance/design of practical, result and conclusion based on it. The sample list given below is just a guide line.

1. Study of Construction and function of each component of road/flood light etc. luminaries.
2. To plot the candlepower, power consumed, current drawn v/s voltage characteristic curve of an incandescent lamp and compare with the theoretical curves.
3. To study the effect of reflectors on luminaire intensity distribution.
4. To determine luminous efficiency of a luminaire.
5. To plot the candlepower, power consumed, current drawn v/s voltage characteristic curve of a road lighting luminaire and compare with the theoretical curves.
6. To determine utilization factor of a luminaire.
7. To study Goniometer for A-α, B-β, C-γ, co-ordinate system of measurement.
8. To plot the candlepower, power consumed, current drawn v/s voltage characteristic curve of a flood lighting luminaire and compare with the theoretical curves.
9. To obtain polar curve of the light distribution of a flood lighting luminaire.□ Study the following:

i) The effect of the cover glass upon the beam spread and
ii) The effect of lamp focus on beam spread

10. To calculate Glare index of a luminaire.
11. To control light of a luminaire by various method.

Note:

Guide lines for ICA: Internal Continuous Assessment shall support for regular performance of minimum 10 practical's and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by student (journal) based on practical performed by student. The performance shall be assessed experiment wise using internal continuous assessment format (S10).

Guide lines for ESE: The end semester examination(ESE) for the laboratory course of three hrs duration, shall be based on performance in one of the experiments performed by student in the semester followed by sample questions to judge the depth of understanding/knowledge or skill acquired by the student. It shall be evaluated by two examiners out of which one examiner shall be out of institute.

EE455 C HIGH VOLTAGE ENGINEERING LAB

Teaching Scheme: 02P , Total: 02 **Credits:** 01
Evaluation Scheme: 25ICA + 25 ESE **Total marks:** 50
Duration of ESE: 02 Hrs

COURSE DESCRIPTION:

The demand for generation and transmission of large amount of electric power today necessitates in transmission at extra- high voltages. Electrical engineering students are expected to possess knowledge of high voltage techniques. The subject is not in-depth but explores the knowledge of insulating material, properties, breakdown phenomena in solid, liquid and gases. It also provides the platform to understand the generation and measurement of high voltage.

DESIRABLE AWARENESS/SKILLS:

Knowledge of electrical measurement and instrumentation

COURSE OBJECTIVES:

The objectives of the course are to:

1. understand breakdown phenomenon in case of solid, liquid and gaseous insulating medium
2. familiarize with various methods of generation of high voltages
3. familiarize with various methods of measurement of high voltages
4. understand over voltage phenomenon & concepts of insulation co-ordination
5. understand importance of testing of power apparatus

COURSE OUTCOMES:

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

1. understand the breakdown phenomenon in case of various insulating materials
2. understand the concepts of generation of high voltages & currents
3. understand the causes and protection from over-voltages and the concept of insulation co-ordination
4. understand the direct and indirect testing methods
5. perform the safe working practices in laboratories

Course Outcomes (COs) and Program Outcomes (POs) mapping with strength of correlation:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1				2									3		
2					3									2	
3					2									2	
4						2								2	
5						2								1	

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

EE455 C HIGH VOLTAGE ENGINEERING LAB

Teaching Scheme: 00L + 00T + 02P , Total: 02 **Credits:** 01
Evaluation Scheme: 25ICA + 00 ISA + 25 ESE **Total marks:** 50
Duration of ESE: 02 Hrs

The laboratory work should consist of experiments based on theory syllabus of EE401. Experiments should involve simulation performance/design of practical, result and conclusion based on it. The sample list given below is just a guide line.

1. Measurement of breakdown strength of solid insulating materials.
2. Breakdown of air under uniform and non-uniform field.
3. Measurement of breakdown strength of liquid insulating materials.
4. Effect of gap length on liquid insulating material.
5. Breakdown of composite dielectric material.
6. Study of impulse generator.
7. High voltage withstand test on cables/safety gloves/shoes as per IS.
8. Surface flashover on the surface of polymer insulator materials.
9. Horn gap arrangement as surge diverter.
10. Measurement audible and visible corona inception and extinction voltage.
11. Surface flashover on corrugated porcelain insulator materials.
12. Sphere gap voltmeter.
13. Development of tracks and trees on polymeric insulation.
14. Measurement of breakdown strength of gaseous dielectrics.
15. Study of output voltage waveform of multistage voltage doubler circuit on CRO.

Note:
Guide lines for ICA: Internal Continuous Assessment shall support for regular performance of minimum 10 practical's and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by student (journal) based on practical performed by student. The performance shall be assessed experiment wise using internal continuous assessment format (S10).

Guide lines for ESE: The end semester examination(ESE) for the laboratory course of three hrs duration, shall be based on performance in one of the experiments performed by student in the semester followed by sample questions to judge the depth of understanding/knowledge or skill acquired by the student. It shall be evaluated by two examiners out of which one examiner shall be out of institute.

EE456U ELECTRICAL TESTING AND MAINTENANCE LAB

Teaching Scheme: 01L + 02P , Total: 03 **Credits:** 02
Evaluation Scheme: 25ICA + 25 ESE **Total marks:** 50
Duration of ESE: 02 Hrs

COURSE DESCRIPTION:

The subject explores the knowledge of different industrial drives, load characteristics, factors for selection of drives depending upon their electrical and mechanical characteristics. The subject also provides the knowledge of solid state microprocessor based electric drives. The course consists of general factors of electrical drives, material classification, temperature rise and rating of machines.

DESIRABLE AWARENESS/SKILLS:

Knowledge of Electrical Machines and Power Electronics

COURSE OBJECTIVES:

The objectives of the course are to:
1.understand the basic concepts, design and estimation of distribution systems, substation
2.enable candidate to design earthing system for residential and commercial
3.understand practical aspects of condition monitoring and maintenance of various electrical equipments
4.to learn the testing of various electrical equipments

COURSE OUTCOMES:

On the successful completion of this course, student will be able to:
1.condition monitoring and testing of various electrical equipments
2.understand the distribution systems, its types and substations
3.design of different earthing systems
4. estimation and costing of residential and commercial buildings

Course Outcomes (COs) and Program Outcomes (POs) mapping with strength of correlation:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1				2									3		
2					3									2	
3					2									2	
4						2								2	
5						2								1	

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

EE456U ELECTRICAL TESTING AND MAINTENANCE LAB

Teaching Scheme: 01L + 00T + 02P , Total: 03 **Credits:** 02
Evaluation Scheme: 25ICA + 00 ISA + 25 ESE **Total marks:** 50
Duration of ESE: 02 Hrs

The laboratory work should consist of experiments based on theory syllabus of EE401. Experiments should involve simulation performance/design of practical, result and conclusion based on it. The sample list given below is just a guide line.

List of Experiments:

Compulsory experiments: (Drawing sheets for 1 and 2 using AutoCAD or other CAD software)

1. Single line diagram of 132 or 220 or 400 KV substation (based on actual field Visit) Symbols, Plate or Pipe earthling
2. Estimation for 11 kV feeders and substation.
3. Project report on area electrification.
4. Measurement of Dielectric Absorption Ratio and Polarization Index of insulation.
5. Study of troubleshooting of electrical equipment based on actual visit to repair workshop (Any One).i) Three phase induction motor ii) Transformer iii) Power Cable
6. Study of thermograph images and analysis based on these images.
7. Study of Construction, working and troubleshooting of any two household Electrical equipments (Fan, Mixer, Electric Iron, Washing machines, Electric Oven, Microwave - Limited to electrical faults)
8. Study the various types of earthing for electrical appliances/systems, Practice of earthing and Measurement of Earth resistance of Campus premises.
9. Design, Estimation and costing of Earthing pit and earthing connection for computer lab, Electrical Machines Lab ,HT Substation.

Note:

Guide lines for ICA: Internal Continuous Assessment shall support for regular performance of minimum 10 practical's and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by student (journal) based on practical performed by student. The performance shall be assessed experiment wise using internal continuous assessment format (S10).

Guide lines for ESE: The end semester examination(ESE) for the laboratory course of three hrs duration, shall be based on performance in one of the experiments performed by student in the semester followed by sample questions to judge the depth of understanding/knowledge or skill acquired by the student. It shall be evaluated by two examiners out of which one examiner shall be out of institute.

EE457U PROJECT II

Teaching Scheme: 04P, Total: 04 **Credits:** 04
Evaluation Scheme: 50ICA + 50 ESE **Total marks:** 100
Duration of ESE: 02 Hrs

The guidelines for students are below:

1. Project-I work decided in VII semester shall be continued as Project-II
2. Students should complete implementation of ideas given in synopsis/Abstract, so that project work should be completed before end of semester.
3. Project-II may involve fabrication, design , experimentation , data analysis within realistic constraints such as economic, environmental, social, ethical, health and safety, manufacturability, and sustainability. The stage also includes testing , possible results and report writing
4. Each students project group is required to maintain log book for documenting various activities of Project-II and submit group project report at the end of Semester-VIII in the form of Hard bound.

a. Title
b. Abstract
c. Introduction
d. Problem identification and project objectives
e. Literature survey
f. Case study/Analysis/Design Methodology
g. Project design and implementation details
h. Result and conclusion
i. Future scope
j. references.

Guide lines for ICA: ICA shall be based on continuous evaluation of students performance throughout semester in project-II and report submitted by the students project group in the form Hard bound. Assessment of the project-II for award of ICA marks shall be done jointly by the guide and departmental committee as per the guidelines given in Table-D.

Guide lines for ESE:-In ESE the student may be asked for demonstration and questions on Project. Evaluation will be based on answers given by students in oral examination.

EE458U PROFESSIONAL INTERNSHIP

Teaching Scheme: 04P, Total: 04 **Credits:** 04
Evaluation Scheme: 50ICA + 50 ESE **Total marks:** 100
Duration of ESE: 02 Hrs

COURSE DESCRIPTION:

This course gives opportunity to students to explore the knowledge of industry organization, new trends in manufacturing, maintenance and safety and also gives actual work experience with exposure to industrial environment or boosts entrepreneurial aspirations or analytical skills to solve real life problem as per student interest.

COURSE OBJECTIVES:

The objective of course are as follows

1. Introduce the basic industries and the process/product development cycle.
2. be familiar with the industrial environment and work culture
3. Learn the importance of entrepreneurial skills.
4. emphasizes intuitive understanding and practical implementations of the theoretical concepts .

DESIRABLE AWARENESS/SKILLS:

Listening, understanding and analyzing ability along with the knowledge of concepts, principles and techniques studied earlier.

Course Outcomes (COs) and Program Outcomes (POs) mapping with strength of correlation:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1				2									3		
2					3									2	
3					2									2	
4						2								2	
5						2								1	

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Course Content-cum-instructions:

This course shall be completed preferably during the summer vacation after sixth semester but in exceptional cases can be completed during the winter vacation after seventh semester or during the weekends of seventh semester. Under any circumstances; this course shall be completed before the commencement of eighth semester. Industrial visit Industry visits for minimum four industries local or outstation shall be carried out by each student. Department shall arrange the industrial visits during the summer/winter vacations after sixth/seventh semester or in exceptional cases weekends during the seventh semester. Industries shall be related to solar energy/ power electronics/ telecom sector/ computer hardware-software/ manufacturing/ automobile automation/ bio-tech-agriculture sector/power station, Tv-radio station/ sugar-chemical factory/ any other relevant industry approved by course coordinator.

For this course, the instructions andr guidelines of AICTE shall be followed. The guidelines, instructions and various format Can be obtained using following link:

https://www.aicte-india.org/sites/default/files/AICTE%20Internship%20Policy.pdf

In addition to above Industrial Training:

Individual or group of students shall undergo industrial training in any industry of own interest and convenience related to any interdisciplinary topic/field/ nature for minimum one week fulltime or two weeks part time so that total training period should be more than 40 hours

Course Deliverable

Every student shall submit the appropriate (visit/training/attendance/visit for special study) certificate along with a report in the format provided by department/course coordinator duly signed by course coordinator and HoD. Evaluation system It includes Internal Continuous Assessment (ICA) and Guidelines for ICA are given bellow.

Internal Continuous Assessment (ICA)

The ICA shall be evaluated by course coordinator appointed by the HoD. Course coordinator shall judge the student on the basis of presentation, deliverables of the course described earlier. The guidelines and format prescribed by AICTE may be used for ICA

https://www.aicte-india.org/sites/default/files/AICTE%20Internship%20Policy.pdf