

## **Yeshwantrao Chavan College of Engineering, Nagpur**

### **PO/PSO and CO's of all courses of the UG Programme**

**Name of the Department:** Electrical Engineering

**Name of the UG Programme:** B.E. in Electrical Engineering

#### **Programme Outcomes (PO)**

**Undergraduate engineering programmes are designed to prepare graduates to attain the following program outcomes:**

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

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

#### **Programme Specific Outcomes (PSO)**

PSO1: Interpret, identify, analyse and evaluate problems in power system operation, control and design.

PSO2: Demonstrate knowledge to develop, control and assess electrical and electronic systems.

#### **Course Outcomes (CO)**

#### **Important Note**

**In case of combine CO's for Theory & Practical Course include:**

**Course Name: Complete Course Name (T/P), Course Code: Code of Theory /Code of Practical**

**In case of Exclusive CO's for Theory Course include:**

**Course Name: Complete Course Name (T), Course Code: Code of Theory Course**

**In case of exclusive CO's for Practical Course (eg. Project etc.) include:**

**Course Name: Complete Course Name (P), Course Code: Code of Practical/Project Course**

**Every Engineering Department should get first year courses related CO data from First Year Coordinator Prof. Thatere and include in their respective department file.**

**Do not change the format.**

**Include complete course name, do not use short forms.**

**Use case sensitive PO/PSO & CO statements, in Times Roman with Font Size 12 only.**

**First Year: Semester I and II:**

<b>Course Name: Engineering Mathematics I (T)   Course Code: GE2101</b>	
<b>CO1</b>	Apply the knowledge of differentiation to develop the Mathematical equations and compute geometrical measures
<b>CO2</b>	Determine the expansion and derivatives of functions of Multiple variables and use it to find extreme values of functions.
<b>CO3</b>	Evaluate the integrals of single, multiple variables and use it to find the dimensions of various geometrical figures.
<b>CO4</b>	Discuss Calculus of Scalar and vector point function and use appropriate theorems to evaluate integrals of functions of single, multiple variables.

<b>Course Name: Engineering Mathematics II (T)</b>		<b>Course Code: GE2102</b>
<b>CO1</b>	Use appropriate Methods to solve first order and higher order differential equations and apply it to find solutions of engineering problems	
<b>CO2</b>	Analyse the functions of complex numbers and variables, prove Mathematical equations and evaluate the complex integrals	
<b>CO3</b>	Use Matrix method to solve linear equations , evaluate eigen values - eigen vectors and its applications.	
<b>CO4</b>	Measure the statistical parameters and derive the equations of best fit curves	

<b>Course Name: Communication Skill (T)</b>		<b>Course Code: GE2107</b>
<b>CO1</b>	Explain the basics of communication process as well as identify the barriers in communication.	
<b>CO2</b>	Classify and describe the different Speech Sounds of English Language.	
<b>CO3</b>	Apply different strategies and techniques of presentations, interviews and group communication.	
<b>CO4</b>	Drafting reports, memos and emails, considering the professional etiquettes and ethics with appropriate content and context.	

<b>Course Name: Social Science (T)</b>		<b>Course Code: GE2108</b>
<b>CO1</b>	Explain the basic concepts of Social Sciences.	
<b>CO2</b>	Describe the development of various Civilizations and their Culture.	
<b>CO3</b>	Analyze the Impact of Industrialization on society and discuss the Fundamental Concepts of Society.	
<b>CO4</b>	Explain Industrial Organization and Management.	

<b>Course Name: Engineering Physics (T/P)</b>		<b>Course Code: GE2105/ GE 2106</b>
<b>CO1</b>	Examine the intensity variation of light due to interference, diffraction and its applications.	
<b>CO2</b>	Explain fundamentals of quantum mechanics and its application to problems dealing with quantum particle.	
<b>CO3</b>	Develop ability to classify and analyze the characteristics of semiconductor materials in terms of crystal structures, charge carriers and energy bands for device applications.	
<b>CO4</b>	Analyze the motion of charged particle in electric and magnetic fields and its applications to electron optic devices.	
<b>CO1</b>	Illustrate working principle of lasers, ultrasonic waves and its properties for useful applications in the field of industry.	

<b>Course Name: Engineering Chemistry (T/P)</b>		<b>Course Code: GE2103/ GE 2104</b>
<b>CO1</b>	Assess qualitative and quantitative aspects of water as a conventional material for industrial and domestic applications.	
<b>CO2</b>	Apply the knowledge of basic electrochemistry to understand battery technology, corrosion process and preventive techniques.	
<b>CO3</b>	Know the basics and assess analytical aspects of industrial materials like fuels and lubricants for efficient utilization.	
<b>CO4</b>	Recognize the significance of cement and advanced engineering materials in technological applications.	
<b>CO5</b>	Analyze and generate analytical and instrumental techniques.	

<b>Course Name: Engineering Mechanics (T/P)</b>		<b>Course Code: CV2101/CV2102</b>
<b>CO1</b>	An ability to apply the concept of applied mechanics and can solve problems on planar force system for friction as well as frictionless surfaces.	
<b>CO2</b>	An ability to analyze pin jointed truss frame structure and beam structure analytically and graphic	
<b>CO3</b>	An ability to understand centroid, moment of inertia, product of inertia and mass moment of inertia and can find properties of surfaces.	
<b>CO4</b>	An ability to determine the dynamic variables of moving body, understand working principle of simple lifting machine.	

<b>Course Name: Basic Electronics (T)</b>		<b>Course Code: EE 2101</b>
<b>CO1</b>	Characterize Number systems, semiconductors, diodes, transistors and operational amplifiers.	

<b>CO2</b>	Design simple analog circuits
<b>CO3</b>	Design simple combinational and sequential logic circuits
<b>CO4</b>	Identify functions of digital multimeter, Bridges and transducers in the measurement of physical variables

<b>Course Name: Introduction to Computer Programming (T/P)</b>		<b>Course Code: IT2101/IT2102</b>
<b>CO1</b>	Understand computer system, basics of algorithm & flowchart, and demonstrate straight line program using basic 'C' programming language constructs.	
<b>CO2</b>	Design & Develop programs using different loop control structures, user defined functions, and Pointers.	
<b>CO3</b>	Analyze and apply concepts of different dimensional Arrays as a data structure & development of programs using the same.	
<b>CO4</b>	Design and develop programs using basics of Strings, Structures, union and Files in 'C' language.	

<b>Course Name: Electrical Engineering (T/P)</b>		<b>Course Code: EL 2101/EL2102</b>
<b>CO1</b>	Reproduce fundamentals of dc circuits, single phase, and three phase ac circuits.	
<b>CO2</b>	Analyse dc circuits, single phase and three phase ac circuits for basic electrical quantities such as current, voltage, power etc.	
<b>CO3</b>	Explain construction, working, testing, and applications of various electrical machines.	
<b>CO4</b>	Analyse performance of various electrical machines.	
<b>CO5</b>	Perform laboratory experiments and demonstrate competency in collecting, interpreting, analysing data, communicate and present effectively through laboratory journals.	

<b>Course Name: Engineering Graphics (T/P) Engineering Graphics Lab.</b>		<b>Course Code: ME2101/ME2102</b>
<b>CO1</b>	Transform orthographic projections into isometric projections and vice versa.	
<b>CO2</b>	Evaluate Projections of various One Dimensional, Two dimensional, Three dimensional objects.	
<b>CO3</b>	Built the development of lateral surfaces of various solids and their cut section.	
<b>CO4</b>	Predict the intersections and intersections of various solid objects.	
<b>CO5</b>	Justify the use of software tools used for Two dimensional drawings.	

<b>Course Name: Workshop Practice (P)</b>		<b>Course Code: ME 2103</b>
<b>CO1</b>	Understand the carpentry tools, joints, machineries and its applications	
<b>CO2</b>	Understand the fitting tools, measuring instruments, machineries and its applications	
<b>CO3</b>	Understand the smithy tools furnaces and hand and power forging equipment's	
<b>CO4</b>	Understand Gas and Electric welding processes, utility, tools and its applications	

**Second Year: Semester III:**

<b>Course Name: Engineering Mathematics III (T)</b>		<b>Course Code: GE2201</b>
<b>CO1</b>	Estimate the Calculus of Numerical Function.	
<b>CO2</b>	Determine the transforms and inverse transforms of various functions of variables and use it to solve Mathematical equations.	
<b>CO3</b>	Discuss the nature of periodic function and express it in terms of series.	
<b>CO4</b>	Use appropriate method/s to solve partial differential equations.	

<b>Course Name: Analog Electronics (T)</b>		<b>Course Code: EL2201</b>
<b>CO1</b>	To identify the basic structure, characteristics and various operating modes of BJT	
<b>CO2</b>	To Explain and Describe the various small signal parameters and its applications.	
<b>CO3</b>	To demonstrate the knowledge to develop various power amplifier and oscillator circuit.	
<b>CO4</b>	To analyse and evaluate the basic concept of Op-Amp circuit and its various applications.	

<b>Course Name: Electronics Engineering Workshop (P)</b>		<b>Course Code: EL2202</b>
<b>CO1</b>	Explain the basics of electronic hardware system and to identify the active and passive electronic components.	
<b>CO2</b>	Build hands-on training with familiarization, identification, testing, assembling, and dismantling of various components.	
<b>CO3</b>	Test the electronic components like resistors, capacitors, transistors, UJT, JFET, different IC's, etc. using analog and digital meters.	
<b>CO4</b>	Design various systems and develop PCB fabrication skills making use of the various tools and instruments available in the Electronics Engineering Workshop.	

<b>Course Name: Electrical Machines (T/P)</b>		<b>Course Code: EL2203/EL2204</b>
<b>CO1</b>	Explain and apply the basic fundamentals of Electromagnetism.	

<b>CO2</b>	Develop phasor diagrams, classify 3 phase transformers, analyse and evaluate performance indices theoretically and experimentally and examine the need of parallel operation of transformers.
<b>CO3</b>	Explain and examine principle, construction, types, operation, speed control, characteristic and applications of DC machines and evaluate performance parameters of d.c. machines theoretically and experimentally.
<b>CO4</b>	Explain and examine principle, construction, operation, starting, speed control, applications and evaluate the performance indices of induction motors theoretically and experimentally.

<b>Course Name: Network Analysis (T)</b>		<b>Course Code: EL2205</b>
<b>CO1</b>	Define basic concepts related to the course of network analysis.	
<b>CO2</b>	Select best possible method of circuit analysis for a given situation.	
<b>CO3</b>	Apply a variety of circuit analysis methods including theorems and Laplace transform.	
<b>CO4</b>	Design circuits for a given voltage, power, as well as for critical frequencies and two port parameters.	

<b>Course Name: Computer Programming (P)</b>		<b>Course Code: EL2206</b>
<b>CO1</b>		
<b>CO2</b>		
<b>CO3</b>		
<b>CO4</b>		

<b>Course Name: Electrical Measurement &amp; Instrumentation (T/P)</b>		<b>Course Code: EL2207/EL2208</b>
<b>CO1</b>	Explain the working of Electrical instruments and compute the value of Resistances, inductance and capacitance by using bridges.	
<b>CO2</b>	Evaluate electrical power and energy in single phase and three phase circuits.	
<b>CO3</b>	Explain and illustrate the concept of instrumentation system with different Transducers and Sensors.	
<b>CO4</b>	Explain the construction, working principle and applications of Transducers.	
<b>CO5</b>	Evaluate Power calculations and applications of Transducers.	

**Second Year: Semester IV:**

<b>Course Name: Advance Mathematical Techniques (T)</b>		<b>Course Code: GE2204</b>
<b>CO1</b>	Utilize numerical techniques to obtain approximate solutions of mathematical equations	
<b>CO2</b>	Design and determine the solution of linear programming problems.	
<b>CO3</b>	Measure the Statistical parameters for random variables.	
<b>CO4</b>	Explain the basic concept of fuzzy sets, Relations and fuzzy logic.	

<b>Course Name: Electrical Machines in Power System (T/P)</b>		<b>Course Code: EL2251/EL2252</b>
<b>CO1</b>	Explain constructional features, develop phasor diagram and winding layout, examine steady state performance of synchronous machines theoretically and experimentally.	
<b>CO2</b>	Illustrate the need and method of parallel operation of alternators, analyse and evaluate the behaviour of synchronous machine connected to infinite bus and understand the process of Synchronisation in laboratory.	
<b>CO3</b>	Interpret behaviour & determine time constant and equivalent circuit parameters under transient conditions of synchronous machines and evaluate various transient parameters experimentally.	

<b>Course Name: Electrical Energy Generation System (T)</b>		<b>Course Code: EL2253</b>
<b>CO1</b>	Classify types of renewable energy sources and relate different factors associated with a generating station.	
<b>CO2</b>	Explain various parameters related to selection and application of Solar and Wind Energy.	
<b>CO3</b>	Make use of design parameters and develop a model for various Power generating Systems.	
<b>CO4</b>	Apply the knowledge to understand the applications of various renewable energy sources.	

<b>Course Name: Renewable Energy System (P)</b>		<b>Course Code: EL2254</b>
<b>CO1</b>	Summarize, classify types of renewable energy sources, outline as per Global and Indian context.	
<b>CO2</b>	Utilize ,analyze solar energy for various applications.	
<b>CO3</b>	Classify, analyze wind energy conversion systems and estimate its parameters.	

<b>Course Name: Electric &amp; Magnetic Fields (T)</b>		<b>Course Code: EL2255</b>
<b>CO1</b>	Remember, Understand and analyse the properties of electrostatic field.	
<b>CO2</b>	Apply electrostatics on different mediums and analyse the boundary characteristics.	
<b>CO3</b>	Remember and Understand and apply the properties of electromagnetic field.	
<b>CO4</b>	Understand the electromagnetic waves and analyse them over different medium.	

<b>Course Name: Electrical Engineering Workshop (P)</b>		<b>Course Code: EL2256</b>
<b>CO1</b>	Describe the basic concept of various electrical components.	
<b>CO2</b>	Demonstrate, formulate and solve the basic maintenance and troubleshooting of household equipment, energy saving etc.	
<b>CO3</b>	Outline the fundamentals of major electrical devices and actual operation of devices like induction motor.	



<b>Course Name: Microprocessor (T/P)</b>		<b>Course Code: EL2257/EL2258</b>
<b>CO1</b>	List, select and explain types of memory devices and architecture of 8085 microprocessor.	
<b>CO2</b>	Recall, experiment with and make use of assembly language instructions of 8085.	
<b>CO3</b>	Demonstrate and test microprocessors and its interfacing devices.	
<b>CO4</b>	Illustrate and make use of DMA controller and timer.	
<b>CO5</b>	Experiment with the real time implementation of programs along with interfacing demonstration.	

<b>Course Name: Signals and Systems (T)</b>		<b>Course Code: EL2259</b>
<b>CO1</b>	Determine and Classify signals and systems in continuous and discrete time domain.	
<b>CO2</b>	Solve and determine signals in time and frequency domain using Fourier series and Fourier transform.	
<b>CO3</b>	Apply sampling and show the characteristics of system in time and frequency domain	
<b>CO4</b>	Solve and Determine Laplace and Z-transform for analysis of signals and system.	

### Third Year: Semester V:

<b>Course Name: Fundamentals of Economics (T)</b>		<b>Course Code: GE2312</b>
<b>CO1</b>	Recognize consumer's behaviour and analyse Market price	
<b>CO2</b>	Extrapolate operations in market with production constraints	
<b>CO3</b>	Describe the national income accounting and public finance.	
<b>CO4</b>	Analyse international trade and institutions.	

<b>Course Name: Power Electronics (T/P)</b>		<b>Course Code: EL2301/EL2302</b>
<b>CO1</b>	Demonstrate the learnings of various power semiconductor devices with their protection and apply them for various applications.	
<b>CO2</b>	Analyse different Power Electronics Converter circuits and choose them for suitable applications.	
<b>CO3</b>	Demonstrate the knowledge of chopper circuits, analyse and utilise them for different applications.	
<b>CO4</b>	Analyse inverter circuits with different modulation techniques and identify their applications.	

<b>Course Name: Fundamentals of Power System (T)</b>		<b>Course Code: EL2303</b>
<b>CO1</b>	Define and explain basic components of power system and representation of its elements in terms of per unit.	
<b>CO2</b>	Analyze and evaluate the transmission line parameters which limits the transmission capacity of a line.	
<b>CO3</b>	Classify, evaluate and determine the performance of distribution and transmission system.	

<b>CO4</b>	Choose, Compare and select the type of insulators and underground cables and improve the performance of system.
<b>Course Name: Electrical Drives (T/P)</b>	
<b>Course Code: EL2304/EL2305</b>	
<b>CO1</b>	CO1: Classify and compare characteristics of AC and DC motors to interpret application of motors in electrical drives.
<b>CO2</b>	CO2: Apply Selection criteria for electrical drives by adapting electrical and mechanical characteristics of motor.
<b>CO3</b>	CO3: Categorize and compare contactors and relays for application of control circuit.
<b>CO4</b>	CO4: Explain the applications of PLCs in electrical drives and compare and assess control of electrical drive.
<b>CO5</b>	CO5: Estimate and adapt different motors for traction work.

<b>Course Name: OEI: Renewable Energy Generation System (T)</b>	
<b>Course Code: EL2311</b>	
<b>CO1</b>	Summarize, classify and compare types of renewable energy sources, outline as per Global and Indian context.
<b>CO2</b>	Utilize solar energy for various applications, estimate solar radiation geometry and classify types of wind turbine generator.
<b>CO3</b>	Demonstrate, Classify and utilize geothermal and biomass energy.
<b>CO4</b>	Compare, classify and apply energy from ocean, tide, wave and hydro for power generation, explain storage methods for renewable energy sources.

<b>Course Name: OEI: Electrical Machines and their Applications (T)</b>	
<b>Course Code: EL2312</b>	
<b>CO1</b>	Explain speed-torque characteristics, need for starters, starting and braking of AC and DC motors.
<b>CO2</b>	Apply criterion for selection of drives.
<b>CO3</b>	Illustrate and develop the principle, operation and construction of transformers.
<b>CO4</b>	Classify and identify special machines used in industry.

<b>Course Name: OEI: Testing and Maintenance of Electrical Machines (T)</b>	
<b>Course Code: EL2313</b>	
<b>CO1</b>	Classify, the causes of hazards, accidents, shock and the remedial action taken against the electrical shock.
<b>CO2</b>	Demonstrate, apply and evaluate different types of tests and the various maintenance techniques to be employed on various electrical machines and its installation.
<b>CO3</b>	Demonstrate, apply and estimate the factors affecting the life of insulation, its testing and maintenance.
<b>CO4</b>	Explain, develop and determine the various tests to be conducted on distribution transformer, I.S. Standards.

<b>Course Name: OEII: Electrical Energy Audit and Safety (T)</b>	
<b>Course Code: EL2321</b>	

<b>CO1</b>	Classify, the consumption pattern, conservation of electrical energy and Electricity Act 2001.
<b>CO2</b>	Demonstrate, apply and evaluate different forms of energy to optimize the use for maximizing the efficiency of system.
<b>CO3</b>	Demonstrate, apply and estimate the use energy and its impact on the Environment.
<b>CO4</b>	Explain, develop and determine the hazards, risk associated with unsafe action and the safety.

<b>Course Name: OEII: Utilization of Electrical Energy (T)</b>		<b>Course Code: EL2322</b>
<b>CO1</b>	Demonstrate and utilize electrical energy for various purposes including heating and traction system. Students will also be able to classify illumination, its types and purpose.	
<b>CO2</b>	Demonstrate and apply electric energy to different types of welding	
<b>CO3</b>	Explain how refrigeration system and air condition system works.	
<b>CO4</b>	Analyse, determine and estimate proper economic generation.	

<b>Course Name: OEII: Power System Engineering (T)</b>		<b>Course Code: EL2323</b>
<b>CO1</b>	Articulate types of load and power system concepts required to engineering problems.	
<b>CO2</b>	Develop the ability to implement the appropriate safety equipment for design of electrical power system with enhancing the efficiency of the transmission and distribution system with environment friendly technology.	
<b>CO3</b>	Formulate A.C and D.C distribution networks for necessary variable calculation.	
<b>CO4</b>	Ability to design and analyze switchgear protection system with respect to various electrical parameters which is required in substation.	

### Third Year: Semester VI:

<b>Course Name: Fundamentals of Management (T)</b>		<b>Course Code: GE2311</b>
<b>CO1</b>	Explain the Legal provision and Functions of Management.	
<b>CO2</b>	Analyze the role of Human Resource and Financial Management in the organization.	
<b>CO3</b>	Analyze the project life cycles.	
<b>CO4</b>	Identify tools and techniques for the marketing of goods and services.	

<b>Course Name: Control System (T/P)</b>		<b>Course Code: EL2351/EL2352</b>
<b>CO1</b>	Classify, select types of control systems, interpret transfer function of the system and compare and evaluate electrical and mechanical systems.	
<b>CO2</b>	Illustrate the time response, develop and evaluate the controller.	

<b>CO3</b>	Demonstrate, apply and evaluate stability using transfer function and state variable approach.
<b>CO4</b>	Demonstrate, construct and select design parameters using root locus and frequency domain methods.
<b>CO5</b>	Experiment, demonstrate and simulate time domain and frequency domain methods using control system components.

<b>Course Name: Power System Analysis (T)</b>		<b>Course Code: EL2353</b>
<b>CO1</b>	Classify, analyze and evaluate different types of faults in power system.	
<b>CO2</b>	Explain, apply and evaluate different types of system stability	
<b>CO3</b>	Illustrate, examine and estimate economic operation of power system	
<b>CO4</b>	Classify and interpret types of neutral grounding and compensation circuits	

<b>Course Name: Simulation of Power Electronics &amp; Power System (P)</b>		<b>Course Code: EL2354</b>
<b>CO1</b>	To provide a detailed understanding of the basic concepts involved in the simulation and analysis of single phase & three phase circuit.	
<b>CO2</b>	Develop SIMULATION circuit in MATLAB to assess the performance of short, medium and long transmission lines.	

<b>Course Name: Substation Design (P)</b>		<b>Course Code: EL2355</b>
<b>CO1</b>	Illustrate and Explain, single line diagram of substation with rating of different equipment's, types of relays required and their settings.	
<b>CO2</b>	Construct plan of equipment's and panels mounted in a substation.	
<b>CO3</b>	Design earthing system of a substation.	

<b>Course Name: PEI: Advanced Power Electronics (T)</b>		<b>Course Code: EL2361</b>
<b>CO1</b>	Identify and recall various power semiconductor devices and their effects produced in electrical system	
<b>CO2</b>	Explain and compare various power electronic converters and inverters used for various applications	
<b>CO3</b>	Apply knowledge of modulation techniques to various converters	
<b>CO4</b>	Demonstrate knowledge related to effects of harmonics, their measurement and elimination from the system	

<b>Course Name: PEI: Electrical Distribution in Power System (T)</b>		<b>Course Code: EL2362</b>
<b>CO1</b>	Define, explain and illustrate various components in distribution System network.	
<b>CO2</b>	Experiment with distribution network for voltage drop, reactive power compensation, power loss, fault analysis for better supply to consumers.	

<b>CO3</b>	Classify and inspect the substation and plan metering for consumers.
<b>CO4</b>	Compare and develop distribution systems for distribution automation and SCADA.

<b>Course Name: PEI: Illumination Engineering (MOOC) (T)</b>		<b>Course Code: EL2363</b>
<b>CO1</b>	Identify the criteria for the selection of lamps and lighting systems for an indoor or outdoor space	
<b>CO2</b>	Explain the different parameters in designing an illumination system for a particular application.	
<b>CO3</b>	Apply different illumination systems for different applications.	
<b>CO4</b>	Design proper illumination model for a specific application.	

<b>Course Name: PEI: Electric Vehicles (T)</b>		<b>Course Code: EL2364</b>
<b>CO1</b>	Understand the history, vehicle mechanics, laws of motion, dynamics and propulsion power of electric vehicles.	
<b>CO2</b>	Analyse energy storage methodologies used in electric vehicles.	
<b>CO3</b>	Analyse the topologies of power electronics and drive-train used in electric vehicles.	
<b>CO4</b>	Understand the types, design, size, capacity of hybrid electric vehicle.	

<b>Course Name: PEI: Electric Power Utilization (T)</b>		<b>Course Code: EL2365</b>
<b>CO1</b>	Classify, Types of electric heating technique, electric welding technique, their Field of application, relative advantage and limitation.	
<b>CO2</b>	Illustrate the Basic concept of illumination, various types of lamps along their characteristics and application. They will be able to design illumination system for various criterion.	
<b>CO3</b>	Illustrate basic refrigeration cycle, Vapour compression and Vapour absorption refrigeration system. Various types of air conditioning system and its use as per requirement.	
<b>CO4</b>	Classify, difference between fans and blowers, various energy saving methods to be used, they can classify pumps, compressors and DG sets, application of compressor as per requirement of compressed air, selection and installation factors of DG system. Energy saving methods for DG sets.	

<b>Course Name: OEIII: Renewable Energy Generation System (T)</b>		<b>Course Code: EL2371</b>
<b>CO1</b>	Summarize, classify and compare types of renewable energy sources, outline as per Global and Indian context.	
<b>CO2</b>	Utilize solar energy for various applications, estimate solar radiation geometry and classify types of wind turbine generator.	
<b>CO3</b>	Demonstrate, Classify and utilize geothermal and biomass energy.	

<b>CO4</b>	Compare, classify and apply energy from ocean, tide, wave and hydro for power generation, explain storage methods for renewable energy sources.
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<b>Course Name: OEIII: Electrical Machines and their Applications (T)</b>		<b>Course Code: EL2372</b>
<b>CO1</b>	Explain speed-torque characteristics, need for starters, starting and braking of AC and DC motors.	
<b>CO2</b>	Apply criterion for selection of drives.	
<b>CO3</b>	Illustrate and develop the principle, operation and construction of transformers.	
<b>CO4</b>	Classify and identify special machines used in industry.	

<b>Course Name: OEIII: Testing and Maintenance of Electrical Machines (T)</b>		<b>Course Code: EL2373</b>
<b>CO1</b>	Classify, the causes of hazards, accidents, shock and the remedial action taken against the electrical shock.	
<b>CO2</b>	Demonstrate, apply and evaluate different types of tests and the various maintenance techniques to be employed on various electrical machines and its installation.	
<b>CO3</b>	Demonstrate, apply and estimate the factors affecting the life of insulation, its testing and maintenance.	
<b>CO4</b>	Explain, develop and determine the various tests to be conducted on distribution transformer, I.S. Standards.	

<b>Course Name: OEIV: Electrical Energy Audit and Safety (T)</b>		<b>Course Code: EL2381</b>
<b>CO1</b>	Classify, the consumption pattern, conservation of electrical energy and Electricity Act 2001.	
<b>CO2</b>	Demonstrate, apply and evaluate different forms of energy to optimize the use for maximizing the efficiency of system.	
<b>CO3</b>	Demonstrate, apply and estimate the use energy and its impact on the Environment.	
<b>CO4</b>	Explain, develop and determine the hazards, risk associated with unsafe action and the safety.	

<b>Course Name: OEIV: Utilization of Electrical Energy (T)</b>		<b>Course Code: EL2382</b>
<b>CO1</b>	Demonstrate and utilize electrical energy for various purposes including heating and traction system. Students will also be able to classify illumination, its types and purpose.	
<b>CO2</b>	Demonstrate and apply electric energy to different types of welding	
<b>CO3</b>	Explain how refrigeration system and air condition system works.	
<b>CO4</b>	Analyse, determine and estimate proper economic generation.	

<b>Course Name: OEIV: Power System Engineering (T)</b>		<b>Course Code: EL2383</b>
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<b>CO1</b>	Articulate types of load and power system concepts required to engineering problems.
<b>CO2</b>	Develop the ability to implement the appropriate safety equipment for design of electrical power system with enhancing the efficiency of the transmission and distribution system with environment friendly technology.
<b>CO3</b>	Formulate A.C and D.C distribution networks for necessary variable calculation.
<b>CO4</b>	Ability to design and analyze switchgear protection system with respect to various electrical parameters which is required in substation.

#### **Fourth Year: Semester VII:**

<b>Course Name: High Voltage Engineering (T/P)</b>		<b>Course Code: EL1401/EL1402</b>
<b>CO1</b>	Understand Breakdown of various dielectrics and calculate their breakdown voltage.	
<b>CO2</b>	Analyze causes of overvoltages due to lightning and switching overvoltages due to protective devices used for the same.	
<b>CO3</b>	Implement propagation of travelling waves along with insulation coordination.	
<b>CO4</b>	Evaluate generation and measurement of high voltage and current.	
<b>CO5</b>	Demonstrate various experimental result of high voltage engineering lab & classify Non-destructive and high voltage testing of electrical apparatus.	

<b>Course Name: Computer Applications in Electrical Engineering (T/P)</b>		<b>Course Code: EL1403/EL1404</b>
<b>CO1</b>	Explain and define the basics of Graph theory, find and Illustrate the different types of Matrices.	
<b>CO2</b>	Apply different method, Build & Develop the Bus Impedance Matrix.	
<b>CO3</b>	Classify, Compare, Make use of different methods and analyze Load Flow studies .	
<b>CO4</b>	Analyze and inspect the system for different types of faults.	
<b>CO5</b>	Analyze and make use of different methods for transient stability studies.	

<b>Course Name: PE II: FACTS Devices (T)</b>		<b>Course Code: EL1410</b>
<b>CO1</b>	Define FACTS Concept, various FACTS Controllers, its classification and explain its applications in Transmission system.	
<b>CO2</b>	Explain, show, implement and design different shunt and series compensators and its control schemes	
<b>CO3</b>	Demonstrate, examine and apply voltage and phase angle regulators in power system	

<b>CO4</b>	Extend, apply and analyze the FACTS concept using combine series-shunt and series-series controllers to evaluate the improved transmission system performance
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<b>Course Name: PE II: Artificial Intelligence based Systems (T)</b>		<b>Course Code: EL1427</b>
<b>CO1</b>	Recall, explain, solve and analyse the principles of fuzzy logic and control.	
<b>CO2</b>	Explain and discuss adaptive fuzzy control.	
<b>CO3</b>	Explain, analyse and solve problems in basic neural networks and associative memories	
<b>CO4</b>	Explain, analyse and solve problems on recurrent networks and neural control.	

<b>Course Name: PE II: Advanced Control System (T)</b>		<b>Course Code: EL1431</b>
<b>CO1</b>	Explain concept of lag and lead compensator design in time and frequency domain, theory of PI, PD and PID control in time domain and frequency domain.	
<b>CO2</b>	Illustrate and apply state variable approach with solution of state models and concepts of controllability, observability and state variable feedback.	
<b>CO3</b>	Classify and analyse non-Linear Control System, types of non-linearities, its characteristics. Students will also be able to demonstrate and apply different methods of evaluating non-linear control like describing function method and phase plane method for stability analysis.	
<b>CO4</b>	Explain sample data control system, Stability analysis with Z-transforms and solution of discrete time systems.	

<b>Course Name: Electrical Distribution Power System (T)</b>		<b>Course Code: EL1432</b>
<b>CO1</b>	Define, explain and illustrate various components in distribution System network.	
<b>CO2</b>	Experiment with distribution network for voltage drop, reactive power compensation, power loss, fault analysis for better supply to consumers.	
<b>CO3</b>	Classify and inspect the substation and plan metering for consumers.	
<b>CO4</b>	Compare and develop distribution systems for distribution automation and SCADA.	

<b>Course Name: Simulations in Power System (P)</b>		<b>Course Code: EL1405</b>
<b>CO1</b>	To provide a detailed understanding of the basic concepts involved in the simulation and analysis of single phase & three phase circuit.	
<b>CO2</b>	Develop SIMULATION circuit in MATLAB to assess the performance of short, medium and long transmission lines.	



<b>Course Name: Industrial Training / CRT (T)</b>		<b>Course Code: EL1406</b>
<b>CO1</b>	Analytical skill improvement of logical reasoning for professional responsibilities.	
<b>CO2</b>	Develop communication, overall personality.	

<b>Course Name: Project Phase I (T)</b>		<b>Course Code: EL1407</b>
<b>CO1</b>	Identify the research area of project work in Electrical Engineering.	
<b>CO2</b>	Summarize the literature review in the area identified, propose the objectives of project work.	
<b>CO3</b>	Organize requisite components with specifications for the project software/hardware prototype and apply suitable software/hardware tool in project work	
<b>CO4</b>	Compile, discuss and conclude the results in project report and give presentation by effective communication	

**Fourth Year: Semester VIII:**

<b>Course Name: Switchgear and Protection (T/P)</b>		<b>Course Code: EL1416/EL1417</b>
<b>CO1</b>	Explain and define the various basic principles of protection system	
<b>CO2</b>	Compare & apply overcurrent protection Principle	
<b>CO3</b>	Develop , Compare & Solve the problems of distance protection.	
<b>CO4</b>	Explain , Justify and Compare the types of circuit breaker	
<b>CO5</b>	Explain, Determine and decide the Equipment Protection	

<b>Course Name: Substation Design (P)</b>		<b>Course Code: EL1418</b>
<b>CO1</b>	Illustrate and Explain, single line diagram of substation with rating of different equipment's, types of relays required and their settings.	
<b>CO2</b>	Construct plan of equipment's and panels mounted in a substation.	
<b>CO3</b>	Design earthing system of a substation.	

<b>Course Name: Renewable Energy Sources (T/P)</b>		<b>Course Code: EL1433/EL1434</b>
<b>CO1</b>	Summarize, classify types of renewable energy sources, outline as per Global and Indian context.	
<b>CO2</b>	Estimate solar radiation geometry, and categorize types of solar energy collectors.	
<b>CO3</b>	Utilize solar energy for various applications, function of dc-dc converters and Grid converters.	
<b>CO4</b>	Classify, analyze wind energy conversion systems and estimate its parameters.	
<b>CO5</b>	Demonstrate various experimental result of renewable energy sources lab & Compare, formulate and estimate energy from ocean, tide, wave and hydro for power generation.	

<b>Course Name: PE III: Advanced Electrical Drives (T)</b>		<b>Course Code: EL1411</b>
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<b>CO1</b>	Analyse and determine the converter parameters of bridge and chopper controlled DC drives.
<b>CO2</b>	Analyse the various schemes for Induction motor control and estimate the parameters of converters for Induction motor drives.
<b>CO3</b>	Explain synchronous motor, stepper motor and switched reluctance motor drives.
<b>CO4</b>	explain and compare the various drives used in electrical traction and explain solar and battery powered drives.

<b>Course Name: PE III: Power System Operation and Control (T)</b>		<b>Course Code: EL1422</b>
<b>CO1</b>	Explain, analyse reserve requirement & load forecasting methods.	
<b>CO2</b>	Analyse optimal scheduling of generating units, determine with the help of flowcharts.	
<b>CO3</b>	Expounds and develop optimal unit commitment problem & its solution methods.	
<b>CO4</b>	Explain & discuss various methods of voltage control, reactive power compensation equipment used for transmission line & Load Frequency Control.	

<b>Course Name: PE III : Fundamentals of Power Quality (T)</b>		<b>Course Code: EL1435</b>
<b>CO1</b>	Illustrate power quality disturbances and typical problems associated with it.	
<b>CO2</b>	Analyse and evaluate the voltage sag.	
<b>CO3</b>	Appraise the fundamentals of harmonics and develop solutions through filters to minimise the harmonic distortion.	
<b>CO4</b>	Plan of mitigating the power quality events through custom power and network configuring devices with applying suitable control strategies	

<b>Course Name: PE IV: EHVAC-HVDC Transmission (T)</b>		<b>Course Code: EL1424</b>
<b>CO1</b>	Design and analyse Power handling capacity of EHVAC Transmission systems.	
<b>CO2</b>	Explain and analyse Corona, the concept of Electrostatic and electromagnetics, Electrical safety.	
<b>CO3</b>	Demonstrate , Classify HVDC Transmission system , Analyse the methods of HVDC Control.	
<b>CO4</b>	Design of Harmonic filters and reactive power configuration, HVDC Circuit breaker and Types and applications.	

<b>Course Name: PE IV: Electrical Power Utilization (T)</b>		<b>Course Code: EL1425</b>
<b>CO1</b>	Classify, Types of electric heating technique, electric welding technique, their Field of application, relative advantage and limitation.	

<b>CO2</b>	Illustrate the Basic concept of illumination, various types of lamps along their characteristics and application. They will be able to design illumination system for various criterion.
<b>CO3</b>	Illustrate basic refrigeration cycle, Vapour compression and Vapour absorption refrigeration system. Various types of air conditioning system and its use as per requirement.
<b>CO4</b>	Classify, difference between fans and blowers, various energy saving methods to be used, they can classify pumps, compressors and DG sets, application of compressor as per requirement of compressed air, selection and installation factors of DG system. Energy saving methods for DG sets.

<b>Course Name: PE IV: Fundamentals of Smart Grid (T)</b>		<b>Course Code: EL1436</b>
<b>CO1</b>	To compare existing & smart grid and illustrate the various aspects of the smart grid.	
<b>CO2</b>	To explain the various functions in the smart grid and identify components for functioning of smart grid.	
<b>CO3</b>	To assess the performance of smart grid based on congestion, security and contingency studies for optimal solutions.	
<b>CO4</b>	To evaluate sustainable energy options for smart grid.	

<b>Course Name: PE IV: Electric Vehicles (T)</b>		<b>Course Code: EL1437</b>
<b>CO1</b>	Understand the history, vehicle mechanics, laws of motion, dynamics and propulsion power of electric vehicles.	
<b>CO2</b>	Analyse energy storage methodologies used in electric vehicles.	
<b>CO3</b>	Analyse the topologies of power electronics and drive-train used in electric vehicles.	
<b>CO4</b>	Understand the types, design, size, capacity of hybrid electric vehicle.	

<b>Course Name: Project Phase II (P)</b>		<b>Course Code: EL1420</b>
<b>CO1</b>	Develop and inspect the prototype of the project work	
<b>CO2</b>	Analyze and conclude the results on proposed work on project	
<b>CO3</b>	Compile project work to prepare a thesis report and present a research paper on project	