Department of Electrical Engineering

Course Outcomes (CO)

COURSE PATTERN 2019 SE ELECTRICAL ENGINEERING			
SE SEM-III			
Course Code	**Course Name**	**COs**	**Course Outcomes**
207006	**Engineering Mathematics-III**	**1**	Solve higher order linear differential equation using appropriate techniques to model and analyze electrical circuits.
		2	Apply Integral transforms such as Laplace transform, Fourier transform and Z-Transform to solve problems related to signal processing and control systems.
		3	Apply Statistical methods like correlation, regression and Probability theory as applicable to analyze and interpret experimental data related to energy management, power systems, testing and quality control.
		4	Perform Vector differentiation and integration, analyze the vector fields and apply to wave theory and electro-magnetic fields.
		5	Analyze Complex functions, conformal mappings, and perform contour integration in the study of electrostatics, signal and image processing.
203141	**Power Generation Technologies**	**1**	Identify components and elaborate working principle of conventional power plants.
		2	Recognize the importance and opportunities of renewable energies.
		3	Calculate and control power output of wind solar, and hydro power plant.
		4	Describe process of grid interconnection of distributed generation and requirements.
		5	Interpret the environmental and social impact of various generation technologies.
203142	**Material Science**	**1**	Discuss classification, properties and characteristics of different electrical engineering materials.
		2	State various applications measuring methods for parameters of different classes of electrical engineering materials.

		3	Solve simple problems based on dielectric, magnetic and conducting materials.
		4	Apply knowledge of Nano-technology to electrical engineering.
		5	Execute tests on dielectric, insulating, magnetic, conducting, resistive materials as per IS to decide the quality of the materials.
		6	Create learning resource material ethically to demonstrate self learning leading to lifelong learning skills and usage of ICT/ online technology through collaborative/active learning activities.
203143:	**Analog And Digital Electronics**	**1**	Design logical, sequential and combinational digital circuit using K-Map.
		2	Demonstrate different digital memories and programmable logic families.
		3	Apply and analyze applications of OPAMP in open and closed loop condition.
		4	Design uncontrolled rectifier with given specifications
203144	**Electrical Measurements and Instrumentation**	**1**	Define various characteristic and classify measuring instruments along with range extension techniques.
		2	Apply measurement techniques for measurement of resistance, inductance and capacitance.
		3	Demonstrate construction, working principle of electro dynamo type and induction type instruments for measurement of power and energy.
		4	Make use of CRO for measurement of voltage, current and frequency.
		5	Classify transducer and apply it for measurement of physical parameters in real time.
203150	**Applications of Mathematics in Electrical Engineering**	**1**	Apply fundamentals of mathematics in solving electrical engineering problem
		2	Analyze complex electrical engineering problem using mathematical techniques.

		3	Implement program and simulation for problems in electrical engineering.
		4	Demonstrate self-lifelong learning skills with applications of mathematics in electrical engineering through software.
203151	**Soft Skill**	**1**	Do SWOC analysis.
		2	Develop presentation and take part in group discussion.
		3	Understand and implement etiquette in workplace and in society at large
		4	Work in team with team spirit
		5	Utilize the techniques for time management and stress management
203152 (A)	**Audit Course-III Solar Thermal System**	**1**	Differentiate between types of solar Concentrators
		2	Apply software tool for solar concentrators
		3	Design different types of Solar collectors and balance of plant
203152 (B)	**Audit Course-III C Language Programming**	**1**	Elaborate data types, arithmetic, logical and conditional operators
		2	Apply control and looping statements in C programming
		3	Write programming using C language with functions, arrays and pointers.
203152 (C)	**Audit Course-III Japanese Language-I**	**1**	Will have ability of basic communication.
		2	Will have the knowledge of Japanese script.
		3	Will get introduced to reading , writing and listening skills
		4	Will develop interest to pursue professional Japanese Language course.

COURSE PATTERN 2019 SE ELECTRICAL ENGINEERING

SE SEM-IV

Course Code	Course Name	COs	Course Outcomes
203145	Power System-I	1	Recognize different patterns of load curve and calculate associated different factors with it and tariff.
		2	Draft specifications of electrical equipment in power station.
		3	Design electrical and mechanical aspects in overhead transmission and underground cables.
		4	Evaluate the inductance and capacitance of different transmission line configurations.
		5	Analyze the performance of short and medium transmission lines
203146	Electrical Machines-I	1	Evaluate performance parameters of transformer with experimentation and demonstrate construction along with specifications as per standards.
		2	Distinguish between various types of transformer connections as per vector groups with application and to perform parallel operation of single/three phase transformers.
		3	Select and draft specifications of DC machines and Induction motors for various applications along with speed control methods.
		4	Justify the need of starters in electrical machines with merits and demerits.
		5	Test and evaluate performance of DC machines and Induction motors as per IS standard.
203147	Network Analysis	1	Calculate current/voltage in electrical circuits using simplification techniques, Mesh, Nodal analysis and network theorems.
		2	Analyze the response of RLC circuit with electrical supply in transient and stead state.

		3	Apply Laplace transform to analyze behaviour of an electrical circuit.
		4	Derive formula and solve numerical of two port network and Design of filters
		5	Apply knowledge of network theory to find transfer function, poles and zeroes location to perform stability analysis and parallel resonance
203148	**Numerical Methods and Computer Programming**	**1**	Demonstrate types of errors in computation and their causes of occurrence.
		2	Calculate root of algebraic and transcendental equations using various methods.
		3	Apply numerical methods for various mathematical problems such as interpolation, numerical differentiation, integration and ordinary differential equation
		4	Solve linear simultaneous equation using direct and indirect method.
		5	Develop algorithms and write computer programs for various numerical methods.
203149	**Fundamental of Microcontroller and Applications**	**1**	Describe the architecture and features of various types of the microcontroller.
		2	Illustrate addressing modes and execute programs in assembly language for the microcontroller.
		3	Write programs in C language for microcontroller 8051.
		4	Elaborate interrupt structure of 8051 and program to handle interrupt and ADC809
		5	Define the protocol for serial communication and understand the microcontroller development systems.
		6	Interface input output devices and measure electrical parameters with 8051 in real time.
203152	**Project Based Learning**	**1**	Identify, formulate, and analyze the simple project problem.

		2	Apply knowledge of mathematics, basic sciences, and electrical engineering fundamentals to develop solutions for the project.
		3	Learn to work in teams, and to plan and carry out different tasks that are required during a project.
		4	Understand their own and their team-mate's strengths and skills.
		5	Draw information from a variety of sources and be able to filter and summarize the relevant points.
		6	Communicate to different audiences in oral, visual, and written forms.
203153(A)	**Audit Course-IV 203153(A) Solar Photovoltaic Systems**	**1**	Design of Solar PV system for small and large installations
		2	Handle software tools for Solar PV systems
203153(B)	**Audit Course-IV Installation & Maintenance of Electrical appliances**	**1**	Observing the safety precautions while working,
		2	Test line cord for continuity with test lamp/ multimeter
		3	Dismantle and reassemble an electric iron
		4	Heater, kettle, room heater, toaster, hair dryer, mixer grinder etc.
		5	Install a ceiling fan and the regulator
		6	Check a fluorescent lamp chock, starter and install it
203153 ©	**Audit Course-IV Japanese Language-II**	**1**	Will have ability of basic communication.
		2	Will have the knowledge of Japanese script.
		3	Will get introduced to reading , writing and listening skills
		4	Will develop interest to pursue professional Japanese Language course.

COURSE PATTERN 2019 TE ELECTRICAL ENGINEERING

TE SEM-V

Course Code	Course Name	COs	Course Outcomes
303141	Industrial and Technology Management	1	Differentiate between different types of business organizations and discuss the fundamentals of economics and management.
		2	Explain the importance of technology management and quality management.
		3	Explain the importance of technology management and quality management.
		4	Understand the importance of Quality and its significance.
		5	Describe the characteristics of marketing & its types and overview of financial Management.
		6	Discuss the qualities of a good leader and road map to Entrepreneurship.
303142	Power Electronics	1	Develop characteristics of different power electronic switching devices.
		2	Develop characteristics of different power electronic switching devices.
		3	Choose the appropriate converter for different applications.
303143	Electrical Machines-II	1	Learn construction, working principle of three phase Synchronous Machines, Induction Motors, A.C. Series Motor and Special Purpose Motors.
		2	Understand characteristics of three phase Synchronous Machines, Induction Motors, A.C. Series Motor and Special Purpose Motors.
		3	Select the above machines in Power System, industrial, household & Military Engineering applications.
		4	Testing of machines to evaluate the performance through experimentation.

303144	**Electrical Installation, Design and Condition Based Maintenance**	**1**	Classify different types of distribution supply system and determine economics of distribution system. compare and classify various substations, bus-bars and Earthing systems.
		2	Demonstrate the importance and necessity of maintenance.
		3	Analyse and test different condition monitoring methods.
		4	Carry out estimation and costing of internal wiring for residential and commercial installations.
		5	Apply electrical safety procedures.
		6	
303145A	**Elective-I: Advanced Microcontroller and Embedded System**	**1**	Explain architecture of PIC 18F458 microcontroller, its instructions and the addressing modes.
		2	Use Ports and timers for peripheral interfacing and delay generation.
		3	Interface special and generate events using CCP module.
		4	Effectively use interrupt structure in internal and External interrupt mode.
		5	Effectively use ADC for parameter measurement and also understand LCD interfacing.
		6	Use Serial Communication and various serial communication protocols.
303145B	**Elective-I: Digital Signal Processing**	**1**	Analyse discrete time signals and systems.
		2	Construct frequency response of LTI system using Fourier Transform.
		3	Design and realize IIR and FIR filters.

		4	Apply concepts of DSP in applications of electrical engineering.
303146	**Seminar**	**1**	Relate with the current technologies and innovations in Electrical engineering.
		2	Improve presentation and documentation skill
		3	Apply theoretical knowledge to actual industrial applications and research activity.
		4	Communicate effectively.
303147A	**Audit Course V: Energy Storage System**	**1**	Explain and differentiate various types of energy storage for suitable applications
		2	Understand battery recycling techniques
303147B	**Start-up and Disruptive Innovations**	**1**	Describe role of incubation for Startup and recent national policy.
		2	Identify various types of Startups.
		3	Explain impacts of disruptive innovation and Differentiate between disruptive innovation and disruptive technology

COURSE PATTERN 2019 TE ELECTRICAL ENGINEERING

TE SEM-VI

Course Code	Course Name	COs	Course Outcomes
303148	Power System-II	1	Solve problems involving modelling, design and performance evaluation of HVDC and EHVAC power transmission lines.
		2	Calculate per unit values and develop Y bus for solution power flow equations in power transmission networks
		3	Calculate currents and voltages in a faulted power system under both symmetrical and asymmetrical faults, and relate fault currents to circuit breaker ratings.
303149	Computer Aided Design of Electrical Machines	1	Summarize temperature rise, methods of cooling of transformer and consider IS 2026 in transformer design.
		2	Design the overall dimensions of the transformer.
		3	Analyze the performance parameters of transformer.
		4	Design overall dimensions of three phase Induction motor
		5	Analyze the performance parameters of three phase Induction motor.
		6	Implement and develop computer aided design of transformer and induction motor.
303150	Control System Engineering	1	Construct mathematical model of Electrical and Mechanical system using differential equations and transfer function and develop analogy between Electrical and Mechanical systems.
		2	Determine time response of systems for a given input and perform analysis of first and second order systems using time domain specifications.
		3	Investigate closed loop stability of system in s-plane using Routh Hurwitz stability criteria and root locus.

		4	Analyze the systems in frequency domain and investigate stability using Nyquist plot and Bode plot
		5	Design PID controller for a given plant to meet desired time domain specifications.
303151A	**Elective II: IoT and Its Applications in Electrical Engineering**	**1**	Build circuits for signal acquisition and conditioning
		2	Experiment with sensors and actuators and choose the right sensor for application
		3	Determine the performance of IoT based automated process
		4	Design and develop IoT based applications
303151B	**Elective-II: Electric Mobility**	**1**	Analyze the concepts of Hybrid and Electric vehicles.
		2	Describe the different types of energy storage systems
		3	Comprehend the knowledge of the battery charging and management systems.
		4	Classify the different mode of operation for hybrid vehicle.
		5	Apply the different Charging standards used for electric vehicles.
		6	Differentiate between Vehicle to home & Vehicle to grid concepts.
303151C	**Elective-II: Cybernetics Engineering**	**1**	Define cybernetics in terms of control and how is it used in controlling technical, biological, and other processes.
		2	Understand various matrix operations.
		3	Describe different types of control system configurations and their applications.
		4	Carry out mathematical modeling and simulation of simple processes.

		5	Appreciate the essential requirements for computers and computer equipment that are intended to operate in dedicated applications and industrial environments.
		6	Know intelligent optimization techniques.
303151D	**Elective-II Energy Management**	**1**	Describe BEE Energy policies, Energy ACT.
		2	List and apply demand side management measures for managing utility systems.
		3	Explore and use simple data analytic tools.
		4	Use various energy measurement and audit instruments.
		5	Evaluate economic feasibility of energy conservation projects.
		6	Identify appropriate energy conservations methods for electric and thermal utilities.
303152	**Internship**	**1**	Understand the working culture and environment of the Industry and get familiar with various departments and practices in the industry.
		2	Operate various meters, measuring instruments, tools used in industry efficiently and develop technical competence.
		3	Apply internship learning in other course completions and final year project management, i.e. topic finalization, project planning, hardware development, result interpretations, report writing, etc.
		4	Create a professional network and learn about ethical, safety measures, and legal practices.
		5	Appreciate the responsibility of a professional towards society and the environment.
		6	Identify career goals and personal aspirations.
303153A	**Audit Course IV: Ethical**	**1**	Understand for their professional responsibilities as Engineers.

	Practices for Engineers	**2**	Recognize and think through ethically significant problem situations that are common in Engineering.
		3	Evaluate the existing ethical standards for Engineering Practice.
303153B	**Audit Course VI: Project Management**	**1**	Elaborate importance of project management and its process.
		2	Learn about the role of high performance teams and leadership in project management.

COURSE PATTERN 2019 BE ELECTRICAL ENGINEERING

BE SEM-VII

Course Code	Course Name	COs	Course Outcomes
403141	Power System Operation and Control	1	Summarize angle, voltage and frequency stability in the power system control (UN).
		2	Illustrate various ways of interchange of power between interconnected utilities (AP).
		3	Analyze stability and optimal load dispatch using different techniques (AN).
		4	Select appropriate FACTS devices for stable operation of the system (EV).
		5	Evaluate the stability of the system and suggest the methods to improve it (EV).
403142	Advanced Control System	1	Explain compensation networks, common nonlinearities, the concept of state, sampling and reconstruction, and concepts of advanced controls (Understanding)
		2	Determine transfer function from state model (Applying)
		3	Test controllability and observability properties of the system (Evaluating)
		4	Design compensators, state feedback controls, and observers for the system (Creating)
403143A	PLC and SCADA	1	Develop and explain the working of a PLC with the help of a block diagram.
		2	Classify input and output interfacing devices with PLC.
		3	Design PLC based application by proper selection criteria, developing GUI and ladder program.
		4	Execute, debug, and test the programs developed for digital and analog operations.

		5	Develop the architecture of SCADA and explain the importance of SCADA in critical infrastructure.
		6	Describe the SCADA protocols and digital control systems, along with their architecture for automation.
403143B	**Power Quality Management**	**1**	Understand power quality and attribute of power quality
		2	Describe voltage flicker and mitigation of it
		3	Analyze the effect of power system events on voltage sag and its characteristics.
		4	Identify the sources of harmonics and harmonics produced
		5	Select proper method for harmonic mitigation along with methods of power quality monitoring.
		6	Carry out power quality monitoring using power quality analyzers.
403143C	**High Voltage Engineering**	**1**	Identify, describe and analyze the breakdown theories of gaseous, solid and liquid materials.
		2	Analyze the occurrence of over voltage and to provide remedial solutions
		3	Describe and use of various methods of generation of high AC, DC, impulse voltage and current.
		4	Demonstrate the methods of measurement of high AC, DC, impulse voltage and current, tests on high voltage equipment and devices
		5	Study design of high voltage laboratory with all safety measures.
403143D	**Robotics and Automation**	**1**	Differentiate between types of robots based on configuration, method of control, types of drives, sensors used, etc
		2	Apply mathematical modeling of a robot for a specific application with given specifications
		3	Analyze the robot arm dynamics for calculation of torques and forces required for different joints of robots for control of the robot arm.

		4	Apply knowledge of Robot for their various applications
403144A	**Alternate Energy System**	**1**	Analyze the performance of solar thermal and photovoltaic systems.
		2	Determine wind turbine performance.
		3	Explain and evaluate biomass resources in an Indian context.
		4	Illustrate the importance of storage systems.
		5	Analyze the economics of renewable energy sources.
403144B	**Electric and Hybrid Vehicle**	**1**	Analyze the Life Cycle Assessment of Li-ion battery.
		2	Describe the different types of Li-ion charging methods
		3	Comprehend the knowledge of drivetrain hybridization.
		4	Evaluate EV motor sizing
		5	Classify Battery Recycling methods.
403144C	**Special-Purpose Machines**	**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 above motors.
		4	Demonstrate various control strategies.
403144D	**HVDC and FACTs**	**1**	Choose a proper FACTS controller for the specific application based on system requirements.

		2	Analyze shunt, series, and combined controllers to explore different benefits
		3	Compare EHVAC and HVDC systems and to describe various types of DC links.
		4	Describe various methods for the control of HVDC systems and to perform power flow analysis in AC/DC systems.
403145	**Project Stage I**	**1**	Define the project problem statement and identify the scope of the project.
		2	Search the appropriate research papers, standards and e-resources and write a literature survey
		3	Identify tools, techniques, methods, concepts, measuring devices, and instruments required for the project to define the methodology of the project.
		4	Justify the selection of electrical, electronic and mechanical components for the project prototyping
		5	Simulate or develop a system for software or hardware verification.
		6	Write a project report with proper interpretation of results.
403146	**MOOCs**	**1**	Enables the students to directly engage and learn from the best faculty in the country in order tostrengthen the fundamentals.
		2	Explore new areas of interest in a relevant field.
		3	Enable self learning initiative in learners..
		4	Develop critical thinking to solve complex problems in engineering, science and humanities.
		5	Improve communication skills by interacting with peers and course teachers.
403147A	**German Language-I**	**1**	Will have the ability of basic communication.
		2	Will have the knowledge of German script.

		3	Will get introduced to reading ,writing and listening skills
		4	Will develop interest to pursue profession in Indo-German Industry.
403147B	**Engineering Economics-I**	**1**	Discuss concepts related to business and its impact on enterprise.
		2	Illustrate time value of money in economic analysis.
403147C	**Sustainability**	**1**	Understand different types of environmental pollution problem.
		2	Suggest solutions for sustainable development.
		3	Develop a broader perspective in thinking for sustainable practices by utilizing engineering principle and knowledge

COURSE PATTERN 2019 BE ELECTRICAL ENGINEERING

BE SEM-VIII

Course Code	Course Name	COs	Course Outcomes
403148	Switchgear and Protection	1	Understand the fundamentals of protective relaying.
		2	Demonstrate the arc interruption and analyze the RRRV in circuit breakers
		3	Demonstrate the construction and working principle of air brake circuit breakers, SF6 circuit breakers, and a vacuum circuit breaker.
		4	Explain the characteristics of static and digital relays and their applications in power systems.
		5	Apply the differential protection scheme to large transformers, alternators, and induction motors.
		6	Apply distance protection, three stepped protection for transmission line.
403149	Advanced Electrical Drives and Control	1	Explain motor load dynamics and multi quadrant operation of drives.
		2	Analyze operation of converter fed and chopper fed DC drives.
		3	Apply different braking methods of D.C. and induction motor drive.
		4	Elaborate vector control for induction motor and BLDC drives.
		5	Elaborate synchronous motor, reluctance motor drive.
		6	Differentiate between classes and duty cycles of motors and select suitable drives in various industrial applications.
403150A	Digital Control	1	Analyze digital control system and its stability.

	System	**2**	Differentiate between various control systems
		3	Present system in state space format.
		4	Design observer for system.
		5	Understand digital controllers
		6	Elaborate applications such as digital temperature control and position control
403150B	**Restructuring and Deregulation**	**1**	Identify the various institutions in the Indian power sector and explain their role in the Indian power sector.
		2	Explain the various fundamentals of power sector economics
		3	Describe the regulatory process in India and list the steps involved in tariff determination and explain the phases of tariff determination
		4	Describe and explain different power sector restructuring models and explain the concept of energy trading
		5	Explain the types of electricity markets and compare the types of electricity markets .
		6	State different transmission pricing methods and describe and compare various congestion management methods.
403150C	**Smart Grid**	**1**	Apply the knowledge to differentiate between Conventional and Smart Grid
		2	Describe importance of Supercapacitors.
		3	Identify the need of Smart metering.
		4	Apply the communication technology in smart grid.
		5	Comprehend the issues of micro grid.

403150D	**Sensor Technology (Open Elective)**	**1**	Understand the characteristics of sensors used for system monitoring and protection.
		2	Interface the various position sensors to microcontrollers.
		3	Demonstrate the characteristics of sensors used for light and image sensing.
403151A	**EHV AC Transmission**	**1**	Highlight need for EHV ac transmission.
		2	Calculate line and ground parameters.
		3	Enlist problems encountered in EHV transmission.
		4	Describe the effect of electric and magnetic fields on human beings.
403151B	**Illumination Engineering**	**1**	Define and reproduce various terms in illumination.
		2	Identify various parameters for illumination system design.
		3	Design indoor and outdoor lighting systems.
		4	Enlist state of the art illumination systems.
403151C	**Electromagnetic Fields**	**1**	Describe time varying Maxwell's equations and their applications in electromagnetic problems
		2	Interpret electric and magnetic field with the help of associated laws
		3	Solve simple electrostatic and magnetic boundary conditions
		4	Determine the relationship between time varying electric and magnetic fields and electromotive force
		5	Solve electromagnetic problems with the help of mathematical tools.

403151D	**Artificial Intelligence and Machine Learning**	**1**	Evaluate Artificial Intelligence (AI) and Machine Learning(ML) methods and describe their foundations.
		2	Demonstrate knowledge of reasoning and knowledge representation for solving real world problems.
		3	Illustrate the construction of learning and expert system Discuss current scope and limitations of AI and societal implications
		4	Distinguish between different types of learning types.
		5	Apply the different supervised, unsupervised and reinforcement learning methods.
403152	**Project Stage II**	**1**	Identify tools, techniques, methods, concepts, measuring devices, and instruments required for the project to define the methodology of the project.
		2	Justify the selection of electrical, electronic and mechanical components for the project prototyping
		3	Select the appropriate testing method for system performance evaluation
		4	Interpret results obtained by simulation, and hardware implementation and decide on further action or write a conclusion
		5	Write a project report and research paper on the project work
403153A	**German Language-II**	**1**	Will have the ability of advanced communication
		2	Will develop reading, writing and listening skills.
		3	Will understand tenses in German Language.
		4	Will develop interest to pursue a German language course.
403153B	**Engineering Economics-II**	**1**	Apply various techniques for evaluation of engineering projects.
		2	Assess cash flow under risk with varying parameters.

403153C	**GREEN BUILDING**	**1**	Design green and sustainable techniques for both commercial and residential buildings.
		2	Design water, lighting, energy efficiency plan using renewable energy sources.
		3	Explain the principles of building planning, its bylaws and provide facilities for rainwater harvesting
		4	Understand the concepts of green buildings