Electrical Engineering Department

Flexible Scheme: Course Outcomes (COs)

The course outcomes of the courses from 1st year to 4th year of the undergraduate course of Electrical Engineering Program are given below:

Courses	Course Outcomes	
100104: Basic Electrical & Electronics Engineering	**After the completion of this course, students will be able to:**	
	100104.1	**Solve** DC & AC circuits by applying fundamental laws & theorems
	100104.2	**Analyze** the response of linear electrical and magnetic circuits for given input
	100104.3	**Explain** the working principle, construction, applications of rotating electrical machines
	100104.4	**Explain** the working principle, constructional details, losses & applications of single phase transformer.
	100104.5	**Select** the logic gates for various applications in digital electronic circuits.
	100104.6	**Explain** characteristics of Diode and Transistor.
100104: Basic Electrical & Electronics Engineering Lab	**After the completion of this course, students will be able to:**	
	100104.1	**Verify** circuit theorems.
	100104.2	**Perform** tests on transformer for determination of losses, efficiency & polarity.
	100104.3	**Demonstrate** the constructional features of electrical machines
	100104.4	**Acquire** teamwork skills for working effectively in groups
	100104.5	**Prepare** an organized technical report on experiments conducted in the laboratory.
100202: Energy, Ecology, Environment & Society	**After the completion of this course, students will be able to:**	
	100202.1	**Describe** various energy resources, their conversion to electrical power and role in technological & economic development.
	100202.2	**Update** with national/international power status and renewable power development targets & missions.
	100202.3	**Recognize** the impact of pollution on the ecosystem and control policies adopted at national/international levels.
	100202.4	**Illustrate** the concepts of ecosystems and their conservation.
	100202.5	**Solve** practical problems of society in a sustainable and ethical manner.
	100202.6	**Fulfill** professional duties keeping in mind the environmental safety, health, and welfare of public.

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130301: Electromagnetic Field Theory	**After the completion of this course, students will be able to:**	
	130301.1	**Interpret** Maxwell's equations in differential and integral forms, both in time and frequency domains.
	130301.2	**Define** complex permittivity, permeability, conductivity and perfect electric and perfect magnetic conductors.
	130301.3	**Derive** Poyntings theorem from Maxwells equations and interpret the terms in the theorem physically.
	130301.4	**Apply** vector calculus to understand the behavior of static electric fields in standard configurations
	130301.5	**Formulate** engineering problems of Electromagnetic, Electrostatic and Magnetic to Static circuits using Basic relations
	130301.6	**Solve** engineering problems of Electromagnetic.
130302: Measurement & Instrumentation	**After the completion of this course, students will be able to:**	
	130302.1	**Explain** the basic concepts of electrical and electronic measurement and measuring instruments.
	130302.2	**Determine** errors in a measurement system.
	130302.3	**Describe** the construction and working of AC and DC bridges and their applications
	130302.4	**Select** suitable measuring instrument, signal Generator, frequency counter, CRO and digital IC tester for appropriate measurement
	130302.5	**Select** appropriate passive, active transducers and A/D & D/A converters for measurement of physical quantity.
	130302.6	**Describe** working principle of CT & PT and their applications
130302: Measurement & Instrumentation Lab	**After the completion of this course, students will be able to:**	
	130302.1	**Handle** an instrument and perform basic calibration
	130302.2	**Estimate** the deviations in measurements due to possible errors and measures to minimize them based on their characteristics.
	130302.3	**Measure** unknown resistance, inductance and capacitance
	130302.4	**Acquire** teamwork skills for working effectively in groups
	130302.5	**Prepare** technical report on experiments conducted in the lab.
130303: Network Analysis	**After the completion of this course, students will be able to:**	
	130303.1	**Apply** different AC and DC networks laws & theorems for solving electric network.
	130303.2	**Analyze** the series/parallel resonant and magnetically coupled circuits

	130303.3	**Solve** three-phase circuits under balanced & unbalanced conditions
	130303.4	**Evaluate** transient response, Steady-state response, network functions
	130303.5	**Analyze** the circuit behavior with initial conditions
	130303.6	**Compute** the two-port parameters
130303: Network Analysis Lab	**After the completion of this course, students will be able to:**	
	130303.1	**Design** simple networks by exploring circuit theorems.
	130303.2	**Analyze** transient behavior of RL, RC & RLC circuit using the appropriate instruments
	130303.3	**Develop** teamwork skills for working effectively in groups
	130303.4	**Prepare** technical report on experiments conducted in the lab.
130304: Analog Electronics	**After the completion of this course, students will be able to:**	
	130304.1	**Explain** working principles of electronic devices e.g. Diode, Zener Diode, LED, Rectifiers, Transistor, Power Amplifier, Oscillator and Op-Amp.
	130304.2	**Categorize** the different types of Diode, Power Amplifier, Oscillators and Op-Amp and transistor Biasing.
	130304.3	**Explain** the different types of characteristic of Diode, Transistor, Power Amplifier and Op-amp.
	130304.4	**Describe** the various mathematical model of transistor e.g. Hybrid model, re model.
	130304.5	**Develop** an ability and skill to design different types of diode rectifier, transistor biasing, oscillators and timer circuit.
	130304.6	**Apply** the various principles of electronics to design different types of Analog Electronics circuits for various applications.
130304: Analog Electronics Lab	**After the completion of this course, students will be able to:**	
	130304.1	**Develop** the understanding of diode biasing conditions.
	130304.2	**Investigate** the operation of half-wave and full wave rectifier and find their performance curves.
	130304.3	**Examine** transistor configurations and investigate common emitter configuration input-output characteristics.
	130304.4	**Develop** teamwork skills for working effectively in groups
	130304.5	**Prepare** technical report on experiments conducted in the lab
130305: Software Lab-I	**After the completion of this course, students will be able to:**	
	130305.1	**Design** Series & Parallel RL, RC, RLC circuit

	130305.2	**Simulate** the performance of second order systems using MATLAB Simulink environment.
	130305.3	**Validate** the theoretical concepts by writing MATLAB codes.
	130305.4	**Design** engineering problem in MATLAB environment
	130305.5	**Develop** teamwork skills for working effectively in groups
130401: Digital Electronics & Microprocessor	**After the completion of this course, students will be able to:**	
	130401.1	**Explain** the concept of different number system, logic Families and Microprocessor**.**
	130401.2	**Design** the logic expressions using logic gates after simplifying the expression using Boolean laws and K-map method.
	130401.3	**Design** different types of logic circuits such as Combinational circuits, sequential circuits**.**
	130401.4	**Describe** the working of logic families such (RTL, DTL, TTL, ECL, HTL, TSL, C-MOS & Schottky logic)
	130401.5	D**escribe** an 8 bit microprocessor architecture & explain the concepts of memory and I/O interfacing with microprocessor
130401: Digital Electronics & Microprocessor Lab	**After the completion of this course, students will be able to:**	
	130401.1	**Develop** skill to build and troubleshoot digital circuits.
	130401.2	**Operate** standard electronic test equipment
	130401.3	**Identify** the importance for verification & testing of digital circuits.
	130401.4	**Develop** the ability to work is team and learns professional ethics.
	130401.5	**Prepare** an organized written engineering report on electronic testing of digital circuits.
130402: Electrical Machines-I	**After the completion of this course, students will be able to:**	
	130402.1	**Explain** the principles and construction of different AC and DC machines.
	130402.2	**Discuss** the fundamental control practices such as starting, reversing, braking, plugging etc associated with AC and DC machines.
	130402.3	**Analyze** the performance of AC and DC machines.
	130402.4	**Develop** the equivalent circuits and compute the induced emf, torque, efficiency, losses etc.
	130402.5	**Describe** various tests conducted for evaluating the performance of AC and DC machines.
	130402.6	**Evaluate** the performance of machines under different operating conditions
130402:	**After the completion of this course, students will be able to:**	

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Electrical Machines-I Lab	130402.1	**Draw** characteristics of electric machine for a specific purpose, requirement.
	130402.2	**Determine** the efficiency of any transformer, regulation of any transformer.
	130402.3	**Conduct** Load sharing by two or more machines
	130402.4	**Develop** the ability to work is team and learns professional ethics
	130402.5	**Prepare** an organized written engineering report on electronic testing of digital circuits.
130403: Control System	**After the completion of this course, students will be able to:**	
	130403.1	**Develop** mathematical models of mechanical system, electrical system and electromechanical system.
	130403.2	**Represent** the complex system into standard canonical form by signal flow graph and block diagrams reduction rules.
	130403.3	**Compute** the time and frequency-domain responses of first and second-order systems to standard inputs.
	130403.4	**Formulate** control engineering problems in state-variable form.
	130403.5	**Evaluate** the stability of a closed-loop control system in time-domain as well as in frequency-domain**.**
	130403.6	**Predict** the nature of response for the given input
130404: Power System-I	**After the completion of this course, students will be able to:**	
	130404.1	**Describe** the general structure of power systems
	130404.2	**Develop** the knowledge of generation of electricity based on conventional and nonconventional energy sources
	130404.3	**Determine** the transmission line parameters
	130404.4	**Analyze** the performance of overhead transmission line
	130404.5	**Describe** the concept of power plant economics
	130404.6	**Explain** different types of tariffs and power factor improvement techniques
130405: Software Lab-II	**After the completion of this course, students will be able to:**	
	130405.1	**Simulate** the performance of DC motor using MATLAB Simulink environment.
	130405.2	**Validate** the concepts of Induction motor by writing MATLAB codes.
	130405.3	**Analyze** the waveforms on parameter variation of PV Array module using MATLAB Environment.
	130405.4	**Compare** the performance of renewable energy sources using MATLAB environment.
	130405.5	**Design** engineering problem and validate the results using MATLAB environment.
130501: Signals & Systems	**After the completion of this course, students will be able to:**	

	130501.1	**Explain** the process of sampling and the effects of under sampling.
	130501.2	**Classify** systems based on their properties and determine the response of LSI system using convolution.
	130501.3	**Apply** the concepts of linear algebra to signals.
	130501.4	**Analyze** the spectral characteristics of continuous-time periodic and a periodic signal using Fourier analysis.
	130501.5	**Analyze** system properties based on impulse response and Fourier analysis.
	130501.6	**Apply** the Laplace transform and Z- transform for analysis of continuous-time and discrete-time signals and systems
130502: Power System II	**After the completion of this course, students will be able to:**	
	130502.1	**Explain** the concepts of single line diagram and per unit system
	130502.2	**Apply** different load flow techniques to solve load flow problem
	130502.3	**Perform** fault calculations for symmetrical and unsymmetrical faults
	130502.4	**Explain** the theoretical and practical aspects of Power System Stability, and its enhancement
	130502.5	**Elucidate** the automatic generation control reactive power, voltage control, series and shunt compensation
	130502.6	**Discuss** the insulation resistance, capacitance of various types of cables and the need of HVDC transmission.
130502: Power System II (Lab)	**After the completion of this course, students will be able to:**	
	130502.1	**Demonstrate** the performance EHV-AC transmission on simulation panel.
	130502.2	**Determine** transmission line parameters.
	130502.3	**Simulate** the different types of faults in transmission line using MATLAB.
	130502.4	**Prepare** report for presentation.
	130502.5	**Display** team work.
130503: Electrical Machine-II	**After the completion of this course, students will be able to:**	
	130503.1	**Analyze** the performance of 3-phase induction and synchronous machines using equivalent circuits & phasor diagrams under different loading conditions.
	130503.2	**Explain** the constructional details and working principle of three phase transformer and synchronous machine**.**

	130503.3	**Develop** phasor diagram and determine voltage regulation of an alternator and its steady state performance.
	130503.4	**Determine** time constant, various sequence reactance and equivalent circuit parameters under transient conditions for synchronous machines.
	130503.5	**Analyze** the behavior of synchronous machine connected to infinite bus and parallel operation of alternators.
	130503.6	**Analyze** the performance of 3-phase induction and synchronous machines using equivalent circuits & phasor diagrams under different loading conditions.
130503: Electrical Machine-II (Lab)	**After the completion of this course, students will be able to:**	
	130503.1	**Demonstrate** an understanding of the fundamental control practices associated with AC machines (starting, reversing, braking, plugging, etc.).
	130503.2	**Use** accepted national and international standards (such as NEMA, IE Code) to select appropriate electrical machines to meet specified performance requirements.
	130503.3	**Conduct** testing and experimental procedures on different types of electrical machines.
	130503.4	**Develop** the ability to work is team and learns professional ethics
	130503.5	**Prepare** an organized written report
130504: Power Electronics	**After the completion of this course, students will be able to:**	
	130504.1	**Explain** static & dynamic characteristics of power electronics devices like Diode SCR, BJT, MOSFET and IGBT, etc
	130504.2	**Explain** the configuration of different commutation methods.
	130504.3	**Describe** the configuration of AC to DC converter, Dual converter, chopper, cyclo-converter.
	130504.4	**Classify** converters and identify their applications.
	130504.5	**Develop** different model of different converters to calculate their performance parameter
	130504.6	**Identify** the problems/limitations of power electronics devices, converters and suggest solution
130504: Power Electronics Lab	**After the completion of this course, students will be able to:**	
	130504.1	**Demonstrate** VI characteristics of Semiconductor Devices and Various Firing scheme of SCR.
	130504.2	**Demonstrate** the performance of various converters AC to DC and DC to AC converter
	130504.3	**Compare** the performance of single and three phases VSI Inverter**.**

	130504.4	**Demonstrate** the performance of converters in its different modes of operation.
	130504.5	**Prepare** an organized written report.
	130504.6	**Develop** the ability to work is team and learns professional ethics.
130505: Minor Project-I	**After the completion of this course, students will be able to:**	
	130505.1	**Formulate** the real-world problems.
	130505.2	**Express** the technical ideas, strategies and methodologies.
	130505.3	**Utilize** the new tools, algorithms, techniques to obtain solution of the project.
	130505.4	**Prepare** oral demonstrations.
130506: Summer Internship Project-II (Evaluation)	**After the completion of this course, students will be able to:**	
	130506.1	**Exhibit** the characteristics of industrial environment.
	130506.2	**Apply** the technical knowledge in real industrial situations.
	130506.3	**Write** the report in technical work/project.
	130506.4	**Show** engineer's responsibilities & ethics.
130507: Self-learning/Presentation (SWAYAM/NPTEL/ MOOC)	**After the completion of this course, students will be able to:**	
	130507.1	**Refer** various technical recourses available from multiple field.
	130507.2	**Adhere** to deadlines and commitment to complete the assignment.
	130507.3	**Improve** his/her performance in self-learning domain.
	130507.4	**Acquire** additional knowledge helpful for competitive examinations.
130601: Switchgear and Protection	**After the completion of this course, students will be able to:**	
	130601.1	**Explain** the concepts, theories and features associated with protective devices and circuit breakers.
	130601.2	**Classify** relays and circuit breakers based on criterion such as construction, type of supply, working principle, actuating quantities.
	130601.3	**Select** relays and circuit breakers for specific equipment and applications.
	130601.4	**Design** protection schemes for generators, motors, transformers and transmission lines.
	130601.5	**Analyze** the behavior and performance of relays under different loading levels and faults.
	130601.6	**Select** the protective devices and their locations for protecting power systems against over voltages.
130601: Switchgear and Protection(LAB)	**After the completion of this course, students will be able to:**	
	130601.1	**Operate** the Over/Under voltage & over current relays and observe the performance for different settings

	130601.2	**Analyze** the effect of time and current settings on the operating characteristics of an Inverse Definite Minimum Time (IDMT) relay
	130601.3	**Validate** the characteristics of percentage biased differential relay for different bias settings
	130601.4	**Prepare** an organized written report.
	130601.5	**Develop** the ability to work is team and learns professional ethics.
130602: Electrical Engineering Materials	**After the completion of this course, students will be able to:**	
	130602.1	**Describe** properties and applications of conducting materials
	130602.2	**Explain** behavior of semiconductor materials, their classification and applications.
	130603.3	**Explain** application of magnetic materials, different terms, classification, hysteresis and eddy current losses.
	130604.4	**Explain** dielectric materials, their behavior in different fields, polarization and dielectric losses
	130605.5	**Select** appropriate material depending upon specific requirement
DE-1A (130611) Computer Aided Power System Analysis	**After the completion of this course, students will be able to:**	
	130611.1	**Explain** unit commitment and different methods for Solving UC problem
	130611.2	**Apply** direct method and lamda iteration method for solving economic dispatch problem
	130611.3	**Discuss** the concept of reactive power, control of active power and reactive power and SVC
	130611.4	**Solve** the AGC problem in isolated and interconnected power systems
	130611.5	**Describe** Operations Control Centre functions, System monitoring and Contingency Analysis.
DE-1B (130612) Industrial Automation	**After the completion of this course, students will be able to:**	
	130612.1	**Analyse** architecture of industrial automation system
	130612.2	**Select** appropriate sensors
	130612.3	**Acquire** PLC knowledge
	130612.4	**Acquire** the knowledge of PID control technique
	130612.5	**Develop** small application using PLC & transducer,
	130612.6	**Compare** AC and DC drives for particular applications
DE-1C (130613) Transducers & Sensors	**After the completion of this course, students will be able to:**	
	130613.1	**Describe** the converting principle of a physical parameter into an electrical quantity.
	130613.2	**Classify** transducers for measurement of temperature, strain, motion, position and light

	130613.3	**Choose** proper sensor to make sensitive measurements of physical parameters like displacement, force, pressure, temperature, acceleration, etc.
	130613.4	**Predict** correctly the expected performance of various sensors
	130613.5	**Identify** different type of sensors used in real life applications and paraphrase their importance
	130613.6	**Describe** the converting principle of a physical parameter into an electrical quantity
100007: Disaster Management	**After the completion of this course, students will be able to:**	
	100007.1	**Propose** disaster prevention and mitigation approaches.
	100007.2	**Classify** global and national disasters, their trends and profiles.
	100007.3	**Appreciate** the impacts of various disasters.
	100007.4	**Apply** Disaster Risk Reduction in management.
	100007.5	**Find** the linkage between disasters, environment and development
DE 2 : Courses SWAYAM/NPTEL/MOOC	130651	Non-Conventional Energy Resources (IITM)
	130652	DC Power Transmission Systems (IITM)
OC-A Energy Conservation & Management / 900103	**After the completion of this course, students will be able to:**	
	900103.1	**Explain** the basic concepts of Energy Audit & its various terminologies, rules and regulations, policy and how to write reports.
	900103.2	**Acquire** fundamental knowledge on the science of energy and on both the conventional and non-conventional energy technologies
	900103.3	**Describe** different energy auditing methods and the implementation procedures
	900103.4	**Identify** present scenario of energy utilization, management and corresponding ACT of regulatory commission
	900103.5	**Recognize** process billing, energy tariff and power factor improvements to achieve energy efficient systems.
130711: Electrical Drives (DE-3)	**After the completion of this course, students will be able to:**	
	130711.1	**Describe** various components of a drive system along with modes of operation, control needs and identify stable/unstable regions
	130711.2	**Explain** various drives & loads, their characteristics and control methods under various operating
	130711.3	**Explain** performance analysis & control of dc drives
	130711.4	**Explain** performance analysis & control of ac drives
	130711.5	**Employ** the various static converters for speed control of different types of drives

	130711.6	**Summarize** the functioning of solar, battery powered and traction drives and explain energy conservation methods
130751: Introduction to Smart Grid DE4) (NPTEL)	**After the completion of this course, students will be able to:**	
	130711.1	**Apply** advanced knowledge of electrical power system operations and control to analyze the challenges and opportunities due to increased penetration of renewable energy sources
	130711.2	**Conceptualize** the design of smart grid by selecting appropriate communication
	130711.3	**Describe** the principles and requirements of the next generation future power network
	130711.4	**Describe** the latest trends in IoT for power systems
900201: Applications of Electrical Motor & Equipment	**After the completion of this course, students will be able to:**	
	900201.1	**Discuss** the various types of electrical equipment's and their suitable applications.
	900201.2	**Describe** the various schemes of AC, DC drives, traction schemes and different braking systems.
	900201.3	**Explain** the basics of lighting and illumination and its parameters and able to design Illumination systems for various applications
	900201.4	**Apply** the concepts of power electronics technology in efficient utilization of electrical power.
	900201.5	**Identify** the area for research in field of electric traction & utilization of Electric energy
130701: Control System Lab	**After the completion of this course, students will be able to:**	
	130701.1	**Prepare** professionals in laboratory to compute or to predict the characteristics of a system by visualizing experimental data and its graphical representation
	130701.2	**Evaluate** possible causes of discrepancy in practical experimental observations in comparison to theoretical concepts
	130701.3	**Demonstrate** the ability to interact via teamwork effectively on a social and interpersonal level with fellow students
	130701.4	**Develop** the ability to divide up and share task responsibilities to complete assignments
130702: Summer Internship Project	**After the completion of this course, students will be able to:**	
	130702.1	**Formulate** real-world problems.
	130702.2	**Express** the technical ideas, strategies & methodologies.
	130702.3	**Utilize** the new tools, algorithms, and techniques to obtain solutions for the project.
	130702.4	**Test** & validate the developed prototype/results.
	130702.5	**Write** a project report.
	130702.6	**Prepare** oral demonstrations

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130703: Creative Problem Solving	**After the completion of this course, students will be able to:**	
	130703.1	**Identify** real-time problems
	130703.2	**Produce** solutions to various problems
	130703.3	**Demonstrate** various problems solving skills
100008: Intellectual Property Rights(IPR)	**After the completion of this course, students will be able to:**	
	100008.1	**Imbibe** the knowledge of Intellectual Property and its protection through various laws
	100008.2	**Apply** the knowledge of IPR for professional development
	100008.3	**Develop** a platform for the protection and compliance of Intellectual Property Rights & knowledge
	100008.4	**Create** awareness amidst academia and industry of IPR and Copyright compliance
	100008.5	**Deliver** the purpose and function of IPR and patenting.
130801: Internship/ Project	**After the completion of this course, students will be able to:**	
	130801.1	**Formulate** real-world problems.
	130801.2	**Express** the technical ideas, strategies & methodologies.
	130801.3	**Utilize** the new tools, algorithms, and techniques to obtain the solution of the project.
	130801.4	**Test** the developed prototype/results.
	130801.5	**Write** a project report.
	130801.6	**Prepare** oral demonstrations.
130802 : Professional Development	**After the completion of this course, students will be able to:**	
	130802.1	**Develop** intellectual curiosity, competency and skills
	130802.2	**Develop** critical thinking, creativity and effective communication
	130802.3	**Display** professionalism and ownership of professional growth and learning