

Electrical & Electronics Engineering

POs, PSOs, Cos

Program Outcomes

1. **PO-1: Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **PO-2: Problem analysis:** Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **PO-3: 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.
4. **PO-4: 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.
5. **PO-5: 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.
6. **PO-6: 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.
7. **PO-7: Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.
8. **PO-8: Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **PO-9: Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **PO-10: 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.
11. **PO-11: 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.
12. **PO-12: Life-long learning:** Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

Program Specific Outcomes

1. **PSO1:** An ability to apply the strong fundamentals of Mathematics, Science and Engineering Knowledge to identify, formulate, design and investigate complex Engineering problems of Electrical & Electronics circuits, Control System, Embedded System, Electrical Machines and Power System that is essential to pursue Successful Careers / Higher Studies.
2. **PSO2:** An Ability to apply appropriate techniques and Modern Engineering hardware and Software tools in Power System, Control System and Embedded System, Renewable Energy Sources to engage in life-long learning and to successfully adapt in multidisciplinary environment.
3. **PSO3:** Be Professionals with leadership qualities, effective communication skills, ethical attitude, and competence to excel individually, work efficiently in teams and become an entrepreneur.

Course Outcomes

YEAR: 2 SEM: 3

Course Name: Transform Calculus, Fourier Series and Numerical Techniques

Sub code: 18MAT31

CO	Course Outcomes
1.	Use Laplace transform and inverse Laplace transform in solving differential/ integral equation arising in network analysis, control systems and other fields of engineering.
2.	Demonstrate Fourier series to study the behaviour of periodic functions and their applications in system communications, digital signal processing and field theory.
3.	Make use of Fourier transform and Z-transform to illustrate discrete/continuous function arising in wave and heat propagation, signals and systems.
4.	Solve first and second order ordinary differential equations arising in engineering problems using single step and multistep numerical methods
5.	Determine the external of functional using calculus of variations and solve problems arising in dynamics of rigid bodies and vibrational analysis.

Course Name: **ELECTRIC CIRCUIT ANALYSIS**

Sub code: **18EE32**

CO	Course Outcomes
1.	Understand the basic concepts, basic laws and methods of analysis of DC and AC networks and reduce the complexity of network using source shifting, source transformation and network reduction using Transformations.
2.	Solve complex electric circuits using network theorems.
3.	Discuss resonance in series and parallel circuits and also the importance of initial conditions and their evaluation.
4.	Synthesize typical waveforms using Laplace transformation.
5.	Solve unbalanced three phase systems and also evaluate the performance of two port networks

Course Name: **TRANSFORMERS AND GENERATORS**

Sub code: **18EE33**

CO	Course Outcomes
1.	Understand the construction and operation of 1-phase, 3-Phase transformers and Autotransformer.
2.	Analyze the performance of transformers by polarity test, Sumpner's Test, phase conversion, 3-phase connection, and parallel operation.
3.	Understand the construction and working of AC and DC Generators.
4.	Analyze the performance of the AC Generators on infinite bus and parallel operation.
5.	Determine the regulation of AC Generator by Slip test, EMF, MMF, and ZPF Methods.

Course Name: **ANALOG ELECTRONIC CIRCUITS**

Sub code: **18EE34**

CO	Course Outcomes
1.	Obtain the output characteristics of clipper and clamper circuits.
2.	Design and compare biasing circuits for transistor amplifiers & explain the transistor switching.
3.	Explain the concept of feedback, its types and design of feedback circuits
4.	Design and analyze the power amplifier circuits and oscillators for different frequencies.
5.	Design and analysis of FET and MOSFET amplifiers

Course Name: **DIGITAL SYSTEM DESIGN**

Sub code: **18EE35**

CO	Course Outcomes
1.	Develop simplified switching equation using Karnaugh Maps and QuineMcClusky techniques.
2.	Design Multiplexer, Encoder, Decoder, Adder, Subtractors and Comparator as digital combinational controlcircuits.
3.	Design flip flops, counters, shift registers as sequential control circuits.
4.	Develop Mealy/Moore Models and state diagrams for the given clocked sequential circuits.
5.	Explain the functioning of Read only and Read/Write Memories, Programmable ROM, EPROM and Flashmemory.

Course Name: **ELECTRICAL AND ELECTRONICMEASUREMENTS**

Sub code: **18EE36**

CO	Course Outcomes
1.	Measure resistance, inductance and capacitance using bridges and determine earth resistance.
2.	Explain the working of various meters used for measurement of Power, Energy & understand the adjustments, calibration & errors in energy meters.
3.	Understand methods of extending the range of instruments & instrument transformers.
4.	Explain the working of different electronic instruments.
5.	Explain the working of different display and recording devices

Course Name: ELECTRICALMACHINES LABORATORY

Sub code: 18EEL37

CO	Course Outcomes
1.	Evaluate the performance of transformers from the test data obtained.
2.	Connect and operate two single phase transformers of different KVA rating in parallel. performance of synchronous generator connected to infinite bus
3.	Connect single phase transformers for three phase operation and phase conversion.
4.	Compute the voltage regulation of synchronous generator using the test data obtained in the laboratory.
5.	Evaluate the performance of synchronous generators from the test data and assess the

Course Name: ELECTRONICS LABORATORY

Sub code:18EEL38

CO	Course Outcomes
1.	Design and test rectifier circuits with and without capacitor filters.
2.	Determine h-parameter models of transistor for all modes.
3.	Design and test BJT and FET amplifier and oscillator circuits.
4.	Realize Boolean expressions, adders and subtractors using gates.
5.	Design and test Ring counter/Johnson counter, Sequence generator and 3 bit counters.

Course Name: Vyavaharika Kannada

Sub code: 18KVK28/39/49

CO	Course Outcomes
1.	At the end of the course, the student will be able to understand Kannada and communicate in Kannada Language.

Course Name: CONSTITUTION OF INDIA, PROFESSIONAL ETHICS AND CYBER LAW (CPC)

Sub code: 18CPC39/49

CO	Course Outcomes
1.	Have constitutional knowledge and legal literacy.
2.	Understand Engineering and Professional ethics and responsibilities of Engineers.
3.	Understand the the cybercrimes and cyber laws for cyber safety measures.

CO	Course Outcomes
1.	Apply concepts of complex numbers and vector algebra to analyze the problems arising in related area.
2.	Use derivatives and partial derivatives to calculate rate of change of multivariate functions.
3.	Analyze position, velocity and acceleration in two and three dimensions of vector valued functions.
4.	Learn techniques of integration including the evaluation of double and triple integrals.
5.	Identify and solve first order ordinary differential equations.

YEAR: 2 SEM: 4

Course Name: COMPLEX ANALYSIS, PROBABILITY AND STATISTICAL METHODS **Sub code:** 18MAT41

CO	Course Outcomes
1.	Use the concepts of analytic function and complex potentials to solve the problems arising in electromagnetic field theory.
2.	Utilize conformal transformation and complex integral arising in aerofoil theory, fluid flow visualization and image processing.
3.	Apply discrete and continuous probability distributions in analyzing the probability models arising in engineering field.
4.	Make use of the correlation and regression analysis to fit a suitable mathematical model for the statistical data.
5.	Construct joint probability distributions and demonstrate the validity of testing the hypothesis.

Course Name: POWER GENERATION AND ECONOMICS

Sub code: 18EE42

CO	Course Outcomes
1.	Describe the working of hydroelectric, steam, nuclear power plants and state functions of major equipment of the power plants.
2.	Classify various substations and explain the functions of major equipments in substations.
3.	Explain the types of grounding and its importance.
4.	Infer the economic aspects of power system operation and its effects.
5.	Explain the importance of power factor improvement

Course Name: TRANSMISSION AND DISTRIBUTION**Sub code:** 18EE43

CO	Course Outcomes
1.	Explain transmission and distribution scheme, identify the importance of different transmission Systems and types of insulators.
2.	Analyze and compute the parameters of the transmission line for different configurations.
3.	Assess the performance of overhead lines.
4.	Interpret corona, explain the use of underground cables.
5.	Classify different types of distribution systems; examine its quality & reliability.

Course Name: ELECTRIC MOTORS**Sub code:** 18EC44

CO	Course Outcomes
1.	Explain the construction, operation and classification of DC Motor, AC motor and Special purpose motors.
2.	Describe the performance characteristics & applications of Electric motors.
3.	Demonstrate and explain the methods of testing of DC machines and determine losses and efficiency.
4.	Control the speed of DC motor and induction motor.
5.	Explain the starting methods, equivalent circuit and phasor diagrams, torque angle, effect of change in excitation and change in load, hunting and damping of synchronous motors

Course Name: ELECTROMAGNETIC FIELD THEORY**Sub code:** 18EE45

CO	Course Outcomes
1.	Use different coordinate systems, Coulomb's Law and Gauss Law for the evaluation of electric fields produced by different charge configurations.
2.	Calculate the energy and potential due to a system of charges & Explain the behavior of electric field across a boundary conditions.
3.	Explain the Poisson's, Laplace equations and behavior of steady magnetic fields.
4.	Explain the behavior of magnetic fields and magnetic materials.
5.	Asses time varying fields and propagation of waves in different media

Course Name: **OPERATIONAL AMPLIFIERS AND LINEAR ICs**

Sub code: **18EE46**

CO	Course Outcomes
1.	Describe the characteristics of ideal and practical operational amplifier.
2.	Design filters and signal generators using linear ICs.
3.	Demonstrate the application of Linear ICs as comparators and rectifiers.
4.	Analyze voltage regulators for given specification using op-amp and IC voltage regulators.
5.	Summarize the basics of PLL and Timer

Course Name: ELECTRICAL MACHINES LABORATORY – 2

Sub code: 18EEL47

CO	Course Outcomes
1.	Test DC machines to determine their characteristics and also to control the speed of DC motor.
2.	Pre-determine the performance characteristics of DC machines by conducting suitable tests.
3.	Perform load test on single phase and three phase induction motor to assess its performance.
4.	Conduct test on induction motor to pre-determine the performance characteristics.
5.	Conduct test on synchronous motor to draw the performance curves.

Course Name: **OP- AMP AND LINEAR ICS LABORATORY**

Sub code: **18EEL48**

CO	Course Outcomes
1.	To conduct experiment to determine the characteristic parameters of OP-Amp
2.	To design test the OP-Amp as Amplifier, adder, subtractor, differentiator and integrator.
3.	To design test the OP-Amp as oscillators and filters.
4.	Design and study of Linear IC's as multivibrator power supplies.

Course Name: ADDITIONAL MATHEMATICS – II

Sub code: 18MATDIP41

CO	Course Outcomes
1.	Solve systems of linear equations using matrix algebra.
2.	Apply the knowledge of numerical methods in modeling and solving engineering problems.
3.	Make use of analytical methods to solve higher order differential equations.
4.	Classify partial differential equations and solve them by exact methods.
5.	Apply elementary probability theory and solve related problems.

YEAR: 3 SEM: 5

Course Name: MANAGEMENT AND ENTREPRENEURSHIP

Sub code: 18EE51

CO	Course Outcomes
1.	Explain the field of management, task of the manager, planning and steps in decision making.
2.	Discuss the structure of organization, importance of staffing, leadership styles, modes of communication, techniques of coordination and importance of managerial control in business.
3.	Explain the concepts of entrepreneurship and a businessman's social responsibilities towards different groups.
4.	Show an understanding of role of SSI's in the development of country and state/central level institutions/agencies supporting business enterprises.
5.	Discuss the concepts of project management, capital budgeting, project feasibility studies, need for project report and new control techniques

Course Name: MICROCONTROLLER

Sub code: 18EE52

CO	Course Outcomes
1.	Outline the 8051 architecture, registers, internal memory organization, addressing modes.
2.	Discuss 8051 addressing modes, instruction set of 8051, accessing data and I/O port programming.
3.	Develop 8051C programs for time delay, I/O operations, I/O bit manipulation, logic and arithmetic operations, data conversion and timer/counter programming.
4.	Summarize the basics of serial communication and interrupts, also develop 8051 programs for serial data communication and interrupt programming.
5.	Program 8051 to work with external devices for ADC, DAC, Stepper motor control, DC motor control, Elevator control.

Course Name: **POWER ELECTRONICS**

Sub code: **18EE53**

CO	Course Outcomes
1.	To give an overview of applications power electronics, different types of power semiconductor devices, their switching characteristics, power diode characteristics, types, their operation and the effects of power diodes on RL circuits.
2.	To explain the techniques for design and analysis of single phase diode rectifier circuits.
3.	To explain different power transistors, their steady state and switching characteristics and limitations.
4.	To explain different types of Thyristors, their gate characteristics and gate control requirements.
5.	To explain the design, analysis techniques, performance parameters and characteristics of controlled rectifiers, DC- DC, DC -AC converters and Voltage controllers.

Course Name: **SIGNALS AND SYSTEMS**

Sub code: **18EE54**

CO	Course Outcomes
1.	Explain the generation of signals, behavior of system and the basic operations that can be performed on signals and properties of systems.
2.	Apply convolution in both continuous and discrete domain for the analysis of systems given impulse response of a system.
3.	Solve the continuous time and discrete time systems by various methods and their representation by block diagram.
4.	Perform Fourier analysis for continuous and discrete time, linear time invariant systems.
5.	Apply Z-transform and properties of Z transform for the analysis of discrete time systems

Course Name: **ELECTRICAL MACHINE DESIGN (Core Course)**

Sub code: **18EE55**

CO	Course Outcomes
1.	Identify and list, limitations, modern trends in design, manufacturing of electrical machines and properties of materials used in the electrical machines.
2.	Derive the output equation of DC machine, discuss selection of specific loadings and magnetic circuits of DC machines, design the field windings of DC machine, and design stator and rotor circuits of a DC machine.
3.	Derive the output equations of transformer, discuss selection of specific loadings, estimate the number of cooling tubes, no load current and leakage reactance of core type transformer.
4.	Develop the output equation of induction motor, discuss selection of specific loadings and magnetic circuits of induction motor, design stator and rotor circuits of a induction motor.
5.	Formulate the output equation of alternator, design the field windings of Synchronous machine, discuss short circuit ratio and its effects on performance of synchronous machines, design salient pole and non-salient pole alternators for given specifications.

Course Name: **HIGH VOLTAGE ENGINEERING**

Sub code: **18EE56**

CO	Course Outcomes
1.	Explain conduction and breakdown phenomenon in gases, liquid dielectrics and breakdown phenomenon in solid dielectrics.
2.	Summarize generation of high voltages and currents
3.	Outline measurement techniques for high voltages and currents.
4.	Summarize overvoltage phenomenon and insulation coordination in electric power systems.
5.	Explain non-destructive testing of materials and electric apparatus, high-voltage testing of electric apparatus.

Course Name: **MICROCONTROLLER LABORATORY**

Sub code: **18EEL57**

CO	Course Outcomes
1.	Write assembly language programs for data transfer, arithmetic, Boolean and logical instructions and code conversions.
2.	Write ALP using subroutines for generation of delays, counters, configuration of SFRs for serial communication and timers.
3.	Perform interfacing of stepper motor and dc motor for controlling the speed, elevator, LCD, external ADC and temperature control.
4.	Generate different waveforms using DAC interface.
5.	Work with a small team to carry out experiments using microcontroller concepts and prepare reports that present lab work.

Course Name: **POWER ELECTRONICS LABORATORY**

Sub code: **18EEL58**

CO	Course Outcomes
1.	Obtain static characteristics of semiconductor devices to discuss their performance.
2.	Trigger the SCR by different methods
3.	Verify the performance of single phase controlled full wave rectifier and AC voltage controller with R and RL loads.
4.	Control the speed of a DC motor, universal motor and stepper motors.
5.	Verify the performance of single phase full bridge inverter connected to resistive load.

Course Name: **ENVIRONMENTAL STUDIES**

Sub code: **18CIV59**

CO	Course Outcomes
1.	Understand the principles of ecology and environmental issues that apply to air, land, and water issues on a global scale,
2.	Develop critical thinking and/or observation skills, and apply them to the analysis of a problem or question related to the environment.
3.	Demonstrate ecology knowledge of a complex relationship between biotic and abiotic components.
4.	Apply their ecological knowledge to illustrate and graph a problem and describe the realities that Managers face when dealing with complex issues.

YEAR: 3 SEM: 6

Course Name: **CONTROL SYSTEMS (Core Subject)**

Sub code: **18EE61**

CO	Course Outcomes
1.	Analyze and model electrical and mechanical system using analogous.
2.	Formulate transfer functions using block diagram and signal flow graphs.
3.	Analyze the stability of control system, ability to determine transient and steady state time response.
4.	Illustrate the performance of a given system in time and frequency domains, stability analysis using Root locus and Bode plots.
5.	Discuss stability analysis using Nyquist plots, Design controller and compensator for a given Specification.

Course Name: **POWER SYSTEM ANALYSIS – 1 (Core Subject)**

Sub code: **18EE62**

CO	Course Outcomes
1.	Model the power system components & construct per unit impedance diagram of power system.
2.	Analyze three phase symmetrical faults on power system.
3.	Compute unbalanced phasors in terms of sequence components and vice versa, also develop sequence networks.
4.	Analyze various unsymmetrical faults on power system.
5.	Examine dynamics of synchronous machine and determine the power system stability

Course Name: **DIGITAL SIGNAL PROCESSING (Core Subject)**

Sub code: **18EE63**

CO	Course Outcomes
1.	Apply DFT and IDFT to perform linear filtering techniques on given sequences to determine the output.
2.	Apply fast and efficient algorithms for computing DFT and inverse DFT of a given sequence
3.	Design and realize infinite impulse response Butterworth and Chebyshev digital filters using impulse invariant and bilinear transformation techniques.
4.	Develop a digital IIR filter by direct, cascade, parallel, ladder and FIR filter by direct, cascade and linear phase methods of realization.
5.	Design and realize FIR filters by use of window function and frequency sampling method.

Course Name: **INTRODUCTION TO NUCLEAR POWER (PROFESSIONAL ELECTIVE)** Sub code: **18EE641**

CO	Course Outcomes
1.	Explain the fission process in nuclear materials, basic components of nuclear reactors, types of nuclear reactors and their working.
2.	List different types of coolants, their features, and cooling of reactors,
3.	Summarize loss of cooling accidents in different reactors.
4.	Discuss postulated severe accidents in reactors and cooling of reactor during removal of spent fuel.
5.	Discuss cooling and disposing the nuclear waste and prospect of fusion energy in the future.

Course Name: **ELECTRICAL ENGINEERING MATERIALS (Professional Elective)** Subcode: **18EE642**

CO	Course Outcomes
1.	Discuss electrical and electronics materials, their importance, classification and operational requirement
2.	Discuss conducting, dielectric, insulating and magnetic materials used in engineering, their properties and classification.
3.	Explain the phenomenon superconductivity, super conducting materials and their application in engineering.
4.	Explain the plastic and its properties and applications

Course Name: **COMPUTER AIDED ELECTRICAL DRAWING (Professional Elective)** Sub code: **18LEEE6T43**

CO	Course Outcomes
1.	Develop armature winding diagram for DC and AC machines
2.	Develop a Single Line Diagram of Generating Stations and substation using the standard symbols.
3.	Construct sectional views of core and shell types transformers using the design data
4.	Construct sectional views of assembled DC and AC machine and their parts using the design data or the sketches.

Course Name: **EMBEDDED SYSTEMS (PROFESSIONAL ELECTIVE)** Sub code: **18EE644**

CO	Course Outcomes
1.	Identify the Embedded system components.
2.	Apply technological aspects to various interfacing with devices.
3.	Elaborate various design tradeoffs.
4.	Apply software aspects and programming concepts to the design of Embedded System.
5.	Explain how to interface subsystems with external systems.

Course Name: **OBJECT ORIENTED PROGRAMMING USING C++ (PROFESSIONAL ELECTIVE)**
 Sub code: **18EE64**

CO	Course Outcomes
1.	Explain the basics of Object Oriented Programming concepts.
2.	Apply the object initialization and destroy concept using constructors and destructors.
3.	Apply the concept of polymorphism to implement compile time polymorphism in programs by using overloading methods and operators.
4.	Utilize the concept of inheritance to reduce the length of code and evaluate the usefulness.
5.	Apply the concept of run time polymorphism by using virtual functions, overriding functions and abstract class in programs.
6.	Utilize I/O operations and file streams in programs.

Course Name: **CONTROL SYSTEM LABORATORY**

Sub code: **18EEL66**

CO	Course Outcomes
1.	Utilize software package and discrete components in assessing the time and frequency domain response of a given second order system.
2.	Design, analyze and simulate Lead, Lag and Lag – Lead compensators for given specifications.
3.	Determine the performance characteristics of ac and DC servomotors and synchro-transmitter receiver pair used in control systems.
4.	Simulate the DC position and feedback control system to study the effect of P, PI, PD and PID controller and Lead compensator on the step response of the system.
5.	Develop a script files to plot Root locus, Bode plot and Nyquist plot to study the stability of

Course Name: **DIGITAL SIGNAL PROCESSING LABORATORY**

Sub code: **18EEL67**

CO	Course Outcomes
1.	Explain physical interpretation of sampling theorem in time and frequency domains.
2.	Evaluate the impulse response of a system.
3.	Perform convolution of given sequences to evaluate the response of a system.
4.	Compute DFT and IDFT of a given sequence using the basic definition and/or fast methods.
5.	Provide a solution for a given difference equation.
6.	Design and implement IIR and FIR filters.

Course Name: **INDUSTRIAL SERVO CONTROL SYSTEMS (Open Elective)**

Sub code: **18EE651**

CO	Course Outcomes
1.	Explain the evolution and classification of servos, with descriptions of servo drive actuators, amplifiers, feedback transducers, performance, and troubleshooting techniques.
2.	Discuss system analogs, vectors and transfer functions of differential equations.
3.	Discuss mathematical equations for electric servo motors, both DC and brushless DC servo motors.
4.	Represent servo drive components by their transfer function, to combine the servo drive building blocks into system block diagrams.
5.	Determine the frequency response techniques for proper servo compensation.
6.	Explain perform indices and performance criteria for servo systems and discuss the mechanical considerations of servo systems

Course Name: **PLC and SCADA (Open Elective)**

Sub code: **18EE652**

CO	Course Outcomes
1.	Discuss history of PLC and describe the hardware components of PLC: I/O modules, CPU, memory devices, other support devices, operating modes and PLC programming.
2.	Describe field devices Relays, Contactors, Motor Starters, Switches, Sensors, Output Control Devices, Seal-In Circuits, and Latching Relays commonly used with I/O module.
3.	Analyze PLC timer and counter ladder logic programs and describe the operation of different program control instructions
4.	Discuss the execution of data transfer instructions, data compare instructions and the basic operation of PLC closed-loop control system.
5.	Describe the operation of mechanical sequencers, bit and word shift registers, processes and structure of control systems and communication between the processes.

Course Name: **RENEWABLE ENERGY RESOURCES (Open Elective)**

Sub code: **18EE653**

CO	Course Outcomes
1.	Discuss causes of energy scarcity and its solution, energy resources and availability of renewable energy.
2.	Outline energy from sun, energy reaching the Earth's surface and solar thermal energy applications.
3.	Discuss types of solar collectors, their configurations, solar cell system, its characteristics and their applications.
4.	Explain generation of energy from hydrogen, wind, geothermal system, solid waste and agriculture refuse.
5.	Discuss production of energy from biomass, biogas.
6.	Summarize tidal energy resources, sea wave energy and ocean thermal energy

Course Name: **TESTING AND COMMISSIONING OF POWER SYSTEM APPARATUS (Open Elective)**

Sub code: **18EE654**

CO	Course Outcomes
1.	Describe the process to plan, control and implement commissioning of electrical equipment's.
2.	Differentiate the performance specifications of transformer and induction motor.
3.	Demonstrate the routine tests for synchronous machine, induction motor, transformer & switchgears.
4.	Describe corrective and preventive maintenance of electrical equipment's.
5.	Explain the operation of an electrical equipment's such as isolators, circuit breakers, induction motor and synchronous machines

YEAR: 4 SEM: 7

Course Name **POWER SYSTEM ANALYSIS – 2(Core Course)**

Sub code: **18EE71**

CO	Course Outcomes
1.	Formulate network matrices and models for solving load flow problems.
2.	Perform steady state power flow analysis of power systems using numerical iterative techniques.
3.	Solve issues of economic load dispatch and unit commitment problems.
4.	Analyze short circuit faults in power system networks using bus impedance matrix.

5.	Apply Point by Point method and RungeKutta Method to solve Swing Equation.
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Course Name: **POWER SYSTEM PROTECTION (Core Subject)**

Sub code: **18EE72**

CO	Course Outcomes
1.	Discuss performance of protective relays, components of protection scheme and relay terminology over current protection.
2.	Explain the working of distance relays and the effects of arc resistance, power swings, line length and source impedance on performance of distance relays.
3.	Discuss pilot protection, construction, operating principles and performance of differential relays and discuss protection of generators, motors, transformer and Bus Zone Protection.
4.	Explain the construction and operation of different types of circuit breakers.
5.	Outline features of fuse, causes of overvoltages and its protection, also modern trends in Power System Protection.

Course Name: **SOLAR AND WIND ENERGY(Professional Elective)**

Sub code:**18EE731**

CO	Course Outcomes
1.	Discuss the importance of the role of renewable energy, the concept of energy storage and the principles of energy storage devices.
2.	Discuss the concept of solar radiation data and solar PV system fabrication, operation of solar cell, sizing and design of PV system.
3.	Describe the process of harnessing solar energy and its applications in heating and cooling.
4.	Explain basic Principles of Wind Energy Conversion, collection of wind data, energy estimation and site selection.
5.	Discuss the performance of Wind-machines, energy storage, applications of Wind Energy and environmental aspects.

Course Name: **SENSORS AND TRANSDUCERS (Professional Elective)**

Sub code: **18EE732**

CO	Course Outcomes
1.	Classify the transducers and explain the need of transducers, their classification, advantages and Disadvantages.
2.	Explain the working of various transducers and sensors.
3.	Outline the recent trends in sensor technology and their selection.
4.	Analyze the signal conditioning and signal conditioning equipment.
5.	Illustrate different configuration of Data Acquisition System and data conversion.
6.	Show knowledge of data transmission and telemetry.
7.	Explain measurement of non-electrical quantities -temperature, flow, speed, force, torque, power and viscosity.

Course Name: **INTEGRATION OF DISTRIBUTED GENERATION(Professional Elective)**Sub code:**18EE733**

CO	Course Outcomes
1.	Explain energy generation by wind power and solar power.
2.	Discuss the variation in production capacity at different time scales,the size of individual units, and the flexibility in choosing locations with respect to wind and solar systems.
3.	Explain the performance of the system when distributed generation is integrated to the system.
4.	Discuss effects of the integration of DG: the increased risk of overload, increased losses, increased risk of over voltages and increased levels of power quality disturbances.
5.	Discuss effects of the integration of DG: incorrect operation of the protection.
6.	Discuss the impact the integration of DG on power system stability and operation

Course Name: **ADVANCED CONTROL SYSTEMS (Professional Elective)**

Sub code: **18EE734**

CO	Course Outcomes
1.	Discuss state variable approach for linear time invariant systems in both the continuous and discrete time systems.

2.	Develop of state models for linear continuous–time and discrete–time systems.
3.	Apply vector and matrix algebra to find the solution of state equations for linearcontinuous–time and discrete–time systems.
4.	Define controllability and observability of a system and test for controllability and observability of a given system.
5.	Design pole assignment and state observer using state feedback.
6.	Develop the describing function for the nonlinearity present to assess the stability of the system.
7.	Develop Lyapunov function for the stability analysis of nonlinear systems.

Course Name: **REACTIVE POWER CONTROL IN ELECTRIC POWER SYSTEMS (Professional Elective)**
 Sub code: **18EE735**

CO	Course Outcomes
1.	Distinguish the importance of load compensation in symmetrical as well as unsymmetrical loads.
2.	Observe various compensation methods in transmission lines.
3.	Distinguish demand side reactive power management & user side reactive power management.
4.	Construct model for reactive power coordination and effects of harmonics on electrical equipments.
5.	Discuss the Reactive Power Planning for the electricity boards.

Course Name: **INDUSTRIAL DRIVES AND APPLICATIONS (Professional Elective)** Sub code: **18EE741**

CO	Course Outcomes
1.	Explain the advantages, choice and control of electric drive
2.	Explain the dynamics, generating and motoring modes of operation of electric drives
3.	Explain the selection of motor power rating to suit industry requirements
4.	Analyze the performance & control of DC motor drives using controlled rectifiers
5.	Analyze the performance & control of converter fed Induction motor, synchronous motor & stepper motor drives.

Course Name: **UTILIZATION OF ELECTRICAL POWER (Professional Elective)** Sub code: **18EE742**

CO	Course Outcomes
1.	Discuss different methods of electric heating & welding.
2.	Discuss the laws of electrolysis, extraction, refining of metals and electro deposition process.
3.	Discuss the laws of illumination, different types of lamps, lighting schemes and design of lighting systems.
4.	Analyze systems of electric traction, speed time curves and mechanics of train movement.
5.	Explain the motors used for electric traction, their control & braking and power supply system used for electric traction.

Course Name: **PLC and SCADA (Professional Elective)** Sub code: **18EE743**

CO	Course Outcomes
1.	Discuss history of PLC, its sequence of operation, advantages and disadvantages, main parts and their functions.
2.	Describe the hardware components of PLC: I/O modules, CPU, memory devices, other support devices, operating modes and PLC programming.
3.	Describe field devices Relays, Contactors, Motor Starters, Switches, Sensors, Output Control Devices, Seal-In Circuits, and Latching Relays commonly used with I/O module.
4.	Convert relay schematics and narrative descriptions into PLC ladder logic programs.
5.	Analyse PLC timer and counter ladder logic programs. Understand about SCADA systems and its subsystems.

Course Name: **SMART GRID (Professional Elective)**

Sub code: **18EE744**

CO	Course Outcomes
1.	Explain the concept of Smart grid enables the Electric Net and need of smart grid.
2.	Outline the benefits and drivers of DC Power delivery system.
3.	Summarize the Intelligrid Architecture for the smart grid.
4.	Explain the Efficient Electric End-use Technology Alternatives.
5.	Discuss Demand side planning and Evaluation.

Course Name: **ARTIFICIAL NEURAL NETWORK WITH APPLICATIONS TO POWER SYSTEMS (Professional Elective)**

Sub code: **18EE745**

CO	Course Outcomes
1.	Develop Neural Network and apply elementary information processing tasks that neural network can solve.
2.	Develop Neural Network and apply powerful, useful learning techniques.
3.	Develop and Analyze multilayer feed forward network for mapping provided through the first network layer and error back propagation algorithm.
4.	Analyze and apply algorithmic type problems to tackle problems for which algorithms are not available.
5.	Develop and Analyze supervised/unsupervised, learning modes of Neural Network for different Applications.

Course Name: **POWER SYSTEM SIMULATION LABORATORY**

Sub code: **18EEL76**

CO	Course Outcomes
1.	Develop a program in suitable package to assess the performance of medium and long transmission lines.
2.	Develop a program in suitable package to obtain the power angle characteristics of salient and non-salient pole alternator.
3.	Develop a program in suitable package to assess the transient stability under three phase fault at different locations in a of radial power systems.
4.	Develop programs in suitable package to formulate bus admittance and bus impedance matrices of interconnected power systems.
5.	Use suitable package to solve power flow problem for simple power systems.
6.	Use suitable package to study unsymmetrical faults at different locations in radial power systems
7.	Use of suitable package to study optimal generation scheduling problems for thermal power Plants

Course Name: **RELAY AND HIGH VOLTAGE LABORATORY**

Sub code: **18EEL77**

CO	Course Outcomes
1.	Verify the characteristics of over current, over voltage, under voltage and negative sequence relay both electromagnetic and static type.
2.	Verify the characteristics of microprocessor based over current, over voltage, under voltage relays and distance relay.
3.	Show knowledge of protecting generator, motor and feeders.

4.	Analyze the spark over characteristics for both uniform and non-uniform configurations using High A and DC voltages.
5.	Measure high AC and DC voltages and breakdown strength of transformer oil.
6.	Draw electric field and measure the capacitance of different electrode configuration models.
7.	Show knowledge of generating standard lightning impulse voltage to determine efficiency, energy of impulse generator and 50% probability flashover voltage for air insulation

Course Name: **PROJECT PHASE – I**

Sub code: **18EEP78**

CO	Course Outcomes
1.	Demonstrate a sound technical knowledge of their selected project topic.
2.	Undertake problem identification, formulation and solution.
3.	Design engineering solutions to complex problems utilizing a systems approach.
4.	Communicate with engineers and the community at large in written and oral forms.

Course Name: **INDUSTRIAL MOTORS & CONTROL (Open Elective)**

Sub code:**18EE751**

CO	Course Outcomes
1.	Basic principles of electric motors explain the procedure of selecting rating of the motor for any application.
2.	Classify DC motors, explain the torque speed characteristics and select a motor for an application.
3.	Classify Induction Motors, explain the torque speed characteristics and select a motor for an application.
4.	Explain the types of Starting and Breaking of Motors
5.	Explain the different types of Speed Control of Motors
6.	Selection of Motors for Industrial Drives & Economic Selection of Electric Motors.
7.	Discuss Electrical Drawings, Installation, Maintenance & Safety

Course Name: **SENSORS AND TRANSDUCERS (Open Elective)**

Sub code: **18EE752**

CO	Course Outcomes
1.	Classify the transducers and explain the need of transducers, their classification, advantages and disadvantages.
2.	Explain the working of various transducers and sensors.
3.	Outline the recent trends in sensor technology and their selection.
4.	Analyze the signal conditioning and signal conditioning equipment.
5.	Illustrate different configuration of Data Acquisition System and data conversion.
6.	Show knowledge of data transmission and telemetry.
7.	Explain measurement of non-electrical quantities -temperature, flow, speed, force, torque, power and viscosity.

Course Name: **ELECTRIC VEHICLES (Open Elective)**

Sub code: **18EE753**

CO	Course Outcomes
1.	Explain the roadway fundamentals, laws of motion, vehicle mechanics and propulsion system design.
2.	Explain the working of electric vehicles and hybrid electric vehicles in recent trends.
3.	Model batteries, Fuel cells, PEMFC and super capacitors.
4.	Analyze DC and AC drive topologies used for electric vehicle application.
5.	Develop the electric propulsion unit and its control for application of electric vehicles

Course Name: **ELECTRICAL ENERGY CONSERVATION AND AUDITING (Open Elective)** Sub code:**18EE754**

CO	Course Outcomes
1.	Analyze about energy scenario nationwide and worldwide , also outline Energy Conservation Act and its features.
2.	Discuss load management techniques and energy efficiency.
3.	Understand the need of energy audit and energy audit methodology.
4.	Understand various pillars of electricity market design.
5.	Conduct energy audit of electrical systems and buildings.
6.	Show an understanding of demand side management and energy conservation.

YEAR: 4 SEM: 8

Course Name: **POWER SYSTEM OPERATION AND CONTROL (Core Course)** Sub code: **18EE81**

CO	Course Outcomes
1.	Describe various levels of controls in power systems, architecture and configuration of SCADA.
2.	Develop and analyze mathematical models of Automatic Load Frequency Control.
3.	Develop mathematical model of Automatic Generation Control in Interconnected Power system
4.	Discuss the Control of Voltage, Reactive Power and Voltage collapse.
5.	Explain security, contingency analysis, state estimation of power systems

Course Name: **FACTS AND HVDC TRANSMISSION (Professional Elective)** Sub code: **18EE821**

CO	Course Outcomes
1.	Discuss transmission interconnections, flow of Power in an AC System, limits of the loading capability, dynamic stability considerations of a transmission interconnection and controllable parameters.
2.	Explain the basic concepts, definitions of flexible ac transmission systems and benefits from FACTS technology.
3.	Describe shunt controllers, Static Var Compensator and Static Compensator for injecting reactive power in the transmission system in enhancing the controllability and power transfer capability.
4.	Describe series Controllers Thyristor-Controlled Series Capacitor (TCSC) and the Static Synchronous Series Compensator (SSSC) for control of the transmission line current.
5.	Explain advantages of HVDC power transmission, overview and organization of HVDC system.
6.	Describe the basic components of a converter, the methods for compensating the reactive power demanded by the converter.
7.	Explain converter control for HVDC systems, commutation failure, control

Course Name: **ELECTRICAL ESTIMATION AND COSTING (Professional Elective)** Sub code: **18EE822**

CO	Course Outcomes
1.	Explain general principles of estimation and major applicable I.E. rules.
2.	Discuss wiring methods, cables used, design of lighting points and sub-circuits, internal wiring, wiring accessories and fittings, fuses and types.
3.	Discuss estimation of service mains and power circuits.
4.	Discuss estimation of overhead transmission and distribution system its components.
5.	Discuss types of substation, main components and estimation of substation

Course Name: **ELECTRIC VEHICLE TECHNOLOGIES (Professional Elective)** Sub code: **18EE823**

CO	Course Outcomes
1.	Explain the working of electric vehicles and recent trends.
2.	Analyze different power converter topology used for electric vehicle application.

3.	Develop the electric propulsion unit and its control for application of electric vehicles.
4.	Design converters for battery charging and explain transformer less topology

Course Name: **POWER SYSTEMMEMPELSATNENRIN-VGII (professional Elective)** Sub code:**18EE824**

CO	Course Outcomes
1.	Discuss primary components of power system planning, planning methodology for optimum power system expansion and load forecasting.
2.	Understand economic appraisal to allocate the resources efficiently and appreciate the investment decisions.
3.	Discuss expansion of power generation and planning for system energy in the country, evaluation of operating states of transmission system, their associated contingencies and the stability of the system.
4.	Discuss principles of distribution planning, supply rules, network development and the system studies.
5.	Discuss reliability criteria for generation, transmission, distribution and reliability evaluation and analysis, grid reliability, voltage disturbances and their remedies
6.	Discuss planning and implementation of electric –utility activities, market principles and the norms framed.

Course Name: **ELECTRICAL POWER QUALITY (Professional Elective)** Sub code: **18EE825**

CO	Course Outcomes
1.	Define Power quality; evaluate power quality procedures and standards.
2.	Estimate voltage sag performance; explain principles of protection and Sources of transient over voltages.
3.	Identify various sources of harmonics, explain effects of harmonic distortion.
4.	Evaluate harmonic distortion, control harmonic distortion.
5.	Estimate power quality in distribution planning. Identify power quality issues in utility system.

Course Name: **INTERNSHIP** Sub code: **18EEI85**

CO	Course Outcomes
1.	Gain practical experience within industry in which the internship is done.
2.	Acquire knowledge of the industry in which the internship is done.
3.	Apply knowledge and skills learned to classroom work.
4.	Develop a greater understanding about career options while more clearly defining personal career goals.
5.	Experience the activities and functions of professionals.
6.	Develop and refine oral and written communication skills