ELECTRICAL & ELECTRONICS ENGINEERING DEPARTMENT

COURSE CODE	15MAT31 ENGINEERING MATHEMATICS
CO1	Know the use of periodic signals and Fourier series to analyze circuits and system communications
CO2	Explain the general linear system theory for continuous-time signals and digital signal processing using the Fourier Transform and z-transform.
CO3	Employ appropriate numerical methods to solve algebraic and transcendental equations.
CO4	Apply Green's Theorem, Divergence Theorem and Stokes' theorem in various applications in the field of electro-magnetic and gravitational fields and fluid flow problems.
CO5	Determine the extremals of functional and solve the simple problems of the calculus of variations.
COURSE CODE	15EE32 ELECTRIC CIRCUIT ANALYSIS
CO1	Apply knowledge of mathematics, science, and engineering to the analysis and design of electrical circuits.
CO2	Identify, formulate, and solve engineering problems in the area circuits and systems.
CO3	Analyze the solution and infer the authenticity of it.
COURSE CODE	15EE33 TRANSFORMERS AND GENERATORS
CO1	Explain the construction and operation and performance of transformers.
CO2	Explain different connections for the three phase operations, their advantages and applications.
CO3	Explain the construction and operation of Synchronous machines and evaluate the regulation of synchronous machines by different methods.
CO4	Analyze the operation of the synchronous machine connected to infinite machine.
COURSE CODE	15EE34 ANALOG ELECTRONIC CIRCUITS
CO1	Utilize the characteristics of transistor for different applications.
CO2	Design and analyze biasing circuits for transistor.
CO3	Design, analyze and test transistor circuitry as amplifiers and oscillators.
COURSE CODE	15EE35 DIGITAL SYSTEM DESIGN
CO1	Design and analyze combinational & sequential circuits
CO2	Design circuits like adder, sub tractor, code converter etc.
CO3	Understand counters and sequence generators.

COURSE CODE	15EE36 ELECTRICAL AND ELECTRONIC MEASUREMENTS
CO1	Explain the importance of units and dimensions.
CO2	Measure resistance, inductance and capacitance by different methods.
CO3	Explain the working of various meters used for measurement of power and energy.
CO4	Explain the working of different electronic instruments and display devices.
COURSE CODE	15EEL37 ELECTRICAL MACHINES LABORATORY - 1
CO1	Conduct different tests on transformers and synchronous generators and evaluate their performance.
CO2	Connect and operate two single phase transformers of different KVA rating in parallel.
CO3	Connect single phase transformers for three phase operation and phase conversion.
CO4	Assess the performance of synchronous generator connected to infinite bus.
COURSE CODE	15EEL38 ELECTRONICS LABORATORY
CO1	Design and test different diode circuits.
CO2	Design and test amplifier and oscillator circuits and analyse their performance.
CO3	Use universal gates and ICs for code conversion and arithmetic operations.
CO4	Design and verify on of different counters.
COURSE CODE	15MAT41 ENGINEERING MATHEMATICS
CO1	Use appropriate single step and multi-step numerical methods to solve first and second order ordinary differential equations arising in flow data design problems.
CO2	Explain the idea of analyticity, potential fields residues and poles of complex potentials in field theory and electromagnetic theory.
CO3	Employ Bessel's functions and Legendre's polynomials for tackling problems arising in continuum mechanics, hydrodynamics and heat conduction.
CO4	Describe random variables and probability distributions using rigorous statistical methods to analyze problems associated with optimization of digital circuits, information, coding theory and stability analysis of systems.
CO5	Apply the knowledge of joint probability distributions and Markov chains in attempting engineering problems for feasible random events.
COURSE CODE	15EE42 POWER GENERATION AND ECONOMICS

CO1	Describe the working of hydroelectric, steam, nuclear power plants and state functions of major equipment of the power plants.
CO2	Classify various substations and explain the importance of grounding.
CO3	Understand the economic aspects of power system operation and its effects.
CO4	Explain the importance of power factor improvement.
COURSE CODE	**15EE43 TRANSMISSION AND DISTRIBUTION**
CO1	Explain the concepts of various methods of generation of power.
CO2	Explain the importance of HVAC, EHVAC, UHVAC and HVDC transmission.
CO3	Design and analyze overhead transmission system for a given voltage level.
CO4	Calculate the parameters of the transmission line for different configurations and assess the performance of line.
CO5	Explain the use of underground cables and evaluate different types of distribution systems.
COURSE CODE	**15EE44 ELECTRIC MOTORS**
CO1	Explain the constructional features of Motors and select a suitable drive for specific application.
CO2	Analyze and assess the performance characteristics of DC motors by conducting suitable tests and control the speed by suitable method.
CO3	Explain the constructional features of Three Phase and Single phase induction Motors and assess their performance.
CO4	Control the speed of induction motor by a suitable method.
CO5	Explain the operation of Synchronous motor and special motors.
COURSE CODE	**15EE45 ELECTROMAGNETIC FIELD THEORY**
CO1	Use different coordinate systems to explain the concept of gradient, divergence and curl of a vector.
CO2	Use Coulomb's Law and Gauss Law for the evaluation of electric fields produced by different charge configurations.
CO3	Calculate the energy and potential due to a system of charges.
CO4	Explain the behavior of electric field across a boundary between a conductor and dielectric and between two different dielectrics.
CO5	Explain the behavior of magnetic fields and magnetic materials.
CO6	Assess time varying fields and propagation of waves in different media.

COURSE CODE	15EE46 OPERATIONAL AMPLIFIERS AND LINEAR ICs
CO1	At the end of the course the student will be able to:
CO2	Explain the basics of linear ICs.
CO3	Design circuits using linear ICs.
CO4	Demonstrate the application of Linear ICs.
CO5	Use ICs in the electronic projects.
COURSE CODE	15EEL47 ELECTRICAL MACHINES LABORATORY -2
CO1	To perform tests on dc machines to determine their characteristics.
CO2	To control the speed of dc motor.
CO3	To conduct test for pre-determination of the performance characteristics of dc machines
CO4	To conduct load test on single phase and three phase induction motor.
CO5	To conduct test on induction motor to determine the performance characteristics.
CO6	To conduct test on synchronous motor to draw the performance curves.
COURSE CODE	15EEL48 OP- AMP AND LINEAR ICS LABORATORY
CO1	To conduct experiment to determine the characteristic parameters of OP-Amp
CO2	To design test the OP-Amp as Amplifier, adder, subtractor, differentiator and integrator
CO3	To design test the OP-Amp as oscillators and filters
CO4	Design and study of Linear IC's as multivibrator power supplies.
COURSE CODE	15EE51 MANAGEMENT AND ENTREPRENEURSHIP
CO1	Explain the field of management, task of the manager, planning and the need of proper staff, recruitment and selection process.
CO2	Discuss work allocation, the structure of organization, the modes of communication and importance of managerial control in business.
CO3	To explain need of coordination between the manager and staff in exercising the authority and delegating duties.
CO4	To explain the social responsibility of business and leadership
CO5	Explain the concepts of entrepreneurship and the role and importance of the entrepreneur in economic development.
CO6	Show an understanding of the role and importance of Small Scale Industries, business plan and its presentation.

CO7	Discuss the concepts of project management, capitol building process, project feasibility study, project appraisal and project financing.
CO8	Discuss the state /central level institutions / agencies supporting business enterprises.
COURSE CODE	**15EE52 MICROCONTROLLER**
CO1	Discuss the history of the 8051 and features of other 8051 family members and the internal architecture of the 8051.
CO2	Explains the use of an 8051 assembler, the stack and the flag register, loop, jump, and call instructions.
CO3	Discuss 8051 addressing modes, accessing data and I/O port programming, arithmetic, logic instructions, and programs.
CO4	Develop 8051C programs for time delay, I/O operations, I/O bit manipulation, logic and arithmetic operations, data conversion and data serialization
CO5	Discuss the hardware connection of the 8051 chip, its timers, serial data communication and its interfacing of 8051to the RS232.
CO6	Discuss in detail 8051 interrupts and writing interrupt handler programs.
CO7	Interface 8051 with real-world devices such as LCDs and keyboards, ADC, DAC chips and sensors.
CO8	Interface 8031/51 with external memories, 8255 chip to add ports and relays, opt isolators and motors
COURSE CODE	**15EE53 POWER ELECTRONICS**
CO1	Explain application area of power electronics, types of power electronic circuits and switches their characteristics and specifications.
CO2	Explain types of power diodes, their characteristics, and the effects of power diodes on RL circuits.
CO3	Explain the techniques for design, operation and analysis of single phase diode rectifier circuits.
CO4	Explain steady state, switching characteristics and gate control requirements of different power transistors and their limitations.
CO5	Discuss different types of Thyristors, their operation, gate characteristics and gate control requirements.
CO6	Explain designing, analysis techniques and characteristics of thyristor controlled rectifiers.
CO7	Discuss the principle of operation of single phase and three phase DC - DC, DC –AC converters and AC voltage controllers.
COURSE CODE	**15EE54 SIGNALS AND SYSTEMS**
CO1	Classify the signals and systems.
CO2	Explain basic operations on signals and properties of systems.

CO3	Use convolution in both continuous and discrete domain for the analysis of systems given the impulse response of a system.
CO4	Evaluate response of a given linear time invariant system.
CO5	Provide block diagram representation of a linear time invariant system.
CO6	Apply continuous time Fourier transform representation to study signals and linear time invariant systems.
CO7	Apply discrete time Fourier transform representation to study signals and linear time invariant systems.
CO8	Use Z-transform and properties of Z transform for the analysis of discrete time systems.
COURSE CODE	**15EE553 ELECTRICAL ESTMATION AND COSTING**
CO1	Explain the purpose of estimation and costing.
CO2	Discuss market survey, estimates, purchase enquiries, preparation of tenders, comparative statements and payment of bills.
CO3	Discuss Indian Electricity act and Indian Electricity rules.
CO4	Discuss distribution of energy in a building, wiring and methods of wiring, cables used in internal wiring, wiring accessories and fittings, fuses and types of fuses.
CO5	Discuss design of lighting points and its number, total load, sub-circuits, size of conductor.
CO6	Discuss types of service mainsand estimation of service mains and power circuits.
CO7	Discuss estimation of overhead transmission and distribution system and its components.
CO8	Discuss main components of a substation, preparation of single line diagram of a substation and earthing of a substation.
COURSE CODE	**15EE563 RENEWABLE ENERGY RESOURCES**
CO1	Discuss causes of energy scarcity and its solution, energy resources and availability of renewable energy.
CO2	Discuss energy from sun, energy reaching the Earth's surface and solar thermal energy applications.
CO3	Discuss types of solar collectors, their configurations, solar cell system, its characteristics and their applications.
CO4	Discus generation of energy from hydrogen, wind, geothermal system, solid waste and agriculture refuse.
CO5	Discuss production of energy from biomass, biogas.
CO6	Discuss tidal energy resources, energy availability and power generation.
C07	Discuss power generation sea wave energy and ocean thermal energy.
COURSE CODE	**15EEL57 MICROCONTROLLER LABORATORY - 1**
CO1	Write assembly language programs for data transfer, arithmetic, Boolean and logical instructions.
CO2	Write ALP for code conversions.

CO3	Write ALP using subroutines for generation of delays, counters, configuration of SFRs for serial communication and timers.
CO4	Perform interfacing of stepper motor and dc motor for controlling the speed.
CO5	Generate different waveforms using DAC interface.
CO6	Work with a small team to carryout experiments using microcontroller concepts and prepare reports that present lab work.
COURSE CODE	**15EEL58 POWER ELECTRONICS LABORATORY**
CO1	Obtain static characteristics of semiconductor devices to discuss their performance.
CO2	Trigger the SCR by different methods
CO3	Verify the performance of single phase controlled full wave rectifier and AC voltage controller with R and RL loads.
CO4	Control the speed of a dc motor, universal motor and stepper motors.
CO5	Verify the performance of single phase full bridge inverter connected to resistive load.
CO6	Perform commutation of SCR by different methods.
COURSE CODE	**15EE61 CONTROL SYSTEMS**
CO1	Discuss the effects of feedback and types of feedback control systems.
CO2	Evaluate the transfer function of a linear time invariant system.
CO3	Evaluate the stability of linear time invariant systems.
CO4	Apply block diagram manipulation and signal flow graph methods to obtain transfer function of systems.
CO5	Demonstrate the knowledge of mathematical modeling of control systems and components
CO6	Determine transient and steady state time response of a simple control system.
CO7	Investigate the performance of a given system in time and frequency domains.
CO8	Discuss stability analysis using Root locus, Bode plots and Nyquist plots.
CO9	Determine the controller or compensator configuration and parameter values relative to how it is connec ted to the controlled process given the design specifications.
COURSE CODE	**15EE62 POWER SYSTEM ANALYSIS – 1**
CO1	Show understanding of per unit system, its advantages and computation.
CO2	Show the concept of one line diagram and its implementation in problems
CO3	Perform short circuit analysis on a synchronous machine and simple power system to select a circuit breaker for the system.
CO4	Evaluate symmetrical components of voltages and currents in un-balanced three phase circuits.

CO5	Explain the concept of sequence impedance and sequence networks of power system components and power system.
CO6	Analyze three phase synchronous machine and simple power systems for different unsymmetrical faults using symmetrical components.
CO7	Discuss the dynamics of synchronous machine, stability and types of stability.
CO8	Discuss equal area criterion for the evaluation of stability of a simple system under different fault conditions.
COURSE CODE	**15EE63 DIGITAL SIGNAL PROCESSING**
CO1	Compute the DFT of various signals using its properties and linear filtering of two sequences.
CO2	Apply fast and efficient algorithms for computing DFT and inverse DFT of a given sequence
CO3	Design infinite impulse response Butterworth digital filters using impulse invariant / bilinear transformation technique.
CO4	Design infinite impulse response Chebyshev digital filters using impulse invariant or bilinear transformation technique.
CO5	Realize a digital IIR filter by direct, cascade, parallel and ladder methods of realization.
CO6	Discuss different window functions and frequency sampling method used for design of FIR filters.
CO7	Design FIR filters by use of window function or by frequency sampling method.
CO8	Realize a digital FIR filter by direct, cascade, and linear phase form.
COURSE CODE	**15EE64 ELECTRICAL MACHINE DESIGN**
CO1	Discuss design factors, limitations, modern trends in design, manufacturing of electrical machines and properties of materials used in the electrical machines.
CO2	Derive the output equations of transformer, DC machines and AC machines.
CO3	Discuss selection of specific loadings and magnetic circuits of different electrical machines
CO4	Design the field windings of DC machine and Synchronous machine.
CO5	Design stator and rotor circuits of a DC and AC machines.
CO6	Estimate the number of cooling tubes, no load current and leakage reactance of core type transformer.
CO7	Discuss short circuit ratio and its effects on performance of synchronous machines.
CO8	Design salient pole and non-salient pole alternators for given specifications.
COURSE CODE	**15EE653 ENERGY AUDIT AND DEMAND SIDE MANAGEMENT**
CO1	Understand the need of energy audit and energy audit methodology.
CO2	Explain audit parameters and working principles of measuring instruments used to measure the parameters.

CO3	Conduct energy audit of boilers, furnaces, power plant, steam distribution system and compressed air systems.
CO4	Conduct energy audit HVAC systems, motors, pumps, blowers and cooling towers.
CO5	Explain load management techniques, effects of harmonics, electricity tariff, improvement of power factor and losses in transmission.
CO6	Conduct energy audit of lighting systems and buildings.
CO7	Show an understanding of demand side management and energy conservation.
COURSE CODE	**15EE662SENSORS AND TRANSDUCERS**
CO1	Discuss need of transducers, their classification, advantages and disadvantages.
CO2	Show an understanding of working of various transducers and sensors.
CO3	Discuss recent trends in sensor technology and their selection.
CO4	Discuss basics of signal conditioning and signal conditioning equipment.
CO5	Discuss configuration of Data Acquisition System and data conversion.
CO6	Show knowledge of data transmission and telemetry.
CO7	Explain measurement of non-electrical quantities -temperature, flow, speed, force, torque, power and viscosity.
COURSE CODE	**15EEL67 CONTROL SYSTEM LABORATORY**
CO1	Use software package or discrete components in assessing the time and frequency domain reposes of a
CO2	given second order system.
CO3	Design and analyze Lead, Lag and Lag – Lead compensators for given specifications.
CO4	Determine the performance characteristics of ac and dc servomotors and synchro-transmitter receiver pair used in control systems .
CO5	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.
CO6	Write a script files to plot root locus, Bode plot, Nyquist plots to study the stability of the system using a software package.
CO7	Work with a small team to carryout experiments and prepare reports that present lab work.
COURSE CODE	**15EEL68 DIGITAL SIGNAL PROCESSING LABORATORY**
CO1	Give physical interpretation of sampling theorem in time and frequency domains.
CO2	Evaluate the impulse response of a system.
CO3	Perform convolution of given sequences to evaluate the response of a system.

CO4	Compute DFT and IDFT of a given sequence using the basic definition and/or fast methods.
CO5	Provide a solution for a given difference equation.
CO6	Design and implement IIR and FIR filters
CO7	Conduct experiments using software and prepare reports that present lab work
COURSE CODE	**15EE71 POWER SYSTEM ANALYSIS – 2**
CO1	Formulate network matrices and models for solving load flow problems.
CO2	Perform steady state power flow analysis of power systems using numerical iterative techniques.
CO3	Suggest a method to control voltage profile.
CO4	Show knowledge of optimal operation of generators on a bus bar, optimal unit commitment,
CO5	Discuss optimal scheduling for hydro-thermal system, power system security and reliability.
CO6	Analyze short circuit faults in power system networks using bus impedance matrix.
CO7	Perform numerical solution of swing equation for multi-machine stability■
COURSE CODE	**15EE72 POWER SYSTEM PROTECTION**
CO1	Discuss performance of protective relays, components of protection scheme and relay terminology overcurrent protection.
CO2	Explain the working of distance relays and the effects ofarc resistance, power swings, line length and source impedance on performance of distance relays.
CO3	Discuss pilot protection; wire pilot relaying and carrier pilot relaying.
CO4	Discuss construction, operating principles and performance of differential relays for differential protection.
CO5	Discuss protection of generators, motors, Transformer and Bus Zone Protection.
CO6	Explain the principle of circuit interruption in different types of circuit breakers.
CO7	Describe the construction and operating principle of different types of fuses and to give the definitions of different terminologies related to a fuse.
CO8	Discuss protection against Overvoltages and Gas Insulated Substation (GIS).
COURSE CODE	**15EE73 HIGH VOLTAGE ENGINEERING**
CO1	Explain conduction and breakdown phenomenon in gases, liquid dielectrics.
CO2	Explain breakdown phenomenon in solid dielectrics.
CO3	Explain generation of high voltages and currents
CO4	Discuss measurement techniques for high voltages and currents.
CO5	Discuss overvoltage phenomenon and insulation coordination in electric power systems.

CO6	Discuss non-destructive testing of materials and electric apparatus andhigh-voltage testing of electric apparatus
COURSE CODE	**15EE742 UTILIZATION OF ELECTRICAL POWER**
CO1	Discuss electric heating, air-conditioning and electric welding.
CO2	Explain laws of electrolysis, extraction and refining of metals and electro deposition.
CO3	Explain the terminology of illumination, laws of illumination, construction and working of electric lamps.
CO4	Design interior and exterior lighting systems- illumination levels for factory lighting- flood lighting-street lighting.
CO5	Discuss systems of electric traction, speed time curves and mechanics of train movement.
CO6	Explain the motors used for electric traction and their control.
CO7	Discuss braking of electric motors, traction systems and power supply and other traction systems.
CO8	Explain the working of electric and hybrid electric vehicles.
COURSE CODE	**15EE752 TESTING AND COMMISSIONING OF POWER SYSTEM APPARATUS**
CO1	Describe the process to plan, control and implement commissioning of electrical equipment's.
CO2	Differentiate the performance specifications of transformer and induction motor.
CO3	Demonstrate the routine tests for synchronous machine, induction motor, transformer & switchgears.
CO4	Describe corrective and preventive maintenance of electrical equipment's.
CO5	Explain the operation of an electrical equipment's such as isolators, circuit breakers, induction motor and synchronous machines
COURSE CODE	**15EEL76 POWER SYSTEM SIMULATION LABORATORY**
CO1	Develop a program in MATLAB to assess the performance of medium and long transmission lines.
CO2	Develop a program in MATLAB to obtain the power angle characteristics of salient and non-salient pole alternator.
CO3	Develop a program in MATLAB to assess the transient stability under three phase fault at different locations in a of radial power systems.
CO4	Develop programs in MATLAB to formulate bus admittance and bus impedance matrices of interconnected power systems.
CO5	Use Mi-Power package to solve power flow problem for simple power systems.
CO6	Use Mi-Power package to study unsymmetrical faults at different locations in radial power systems
CO7	Use of Mi-Power package to study optimal generation scheduling problems for thermal power plants.
COURSE CODE	**15EEL77 RELY AND HIGH VOLTAGE LABORATORY**

CO1	Experimentally verify the characteristics of over current, over voltage, under voltage and negative sequence relays both electromagnetic and static type.
CO2	Experimentally verify the characteristics of microprocessor based over current, over voltage, under voltage relays and distance relay.
CO3	Show knowledge of protecting generator, motor and feeders.
CO4	Analyze the spark over characteristics for both uniform and non-uniform configurations using High AC and DC voltages.
CO5	Measure high AC and DC voltages and breakdown strength of transformer oil.
CO6	Draw electric field and measure the capacitance of different electrode configuration models.
CO7	Show knowledge of generating standard lightning impulse voltage to determine efficiency, energy of impulse generator and 50% probability flashover voltage for air insulation.
COURSE CODE	**15EE81 POWER SYSTEM OPERATION AND CONTROL**
CO1	Describe various levels of controls in power systems, the vulnerability of the system,components, architecture and configuration of SCADA.
CO2	Solve unit commitment problems
CO3	Explain issues of hydrothermal scheduling and solutions to hydro thermal problems
CO4	Explain basic generator control loops, functions of Automatic generation control, speed governors
CO5	Develop and analyze mathematical models of Automatic Load Frequency Control
CO6	Explain automatic generation control, voltage and reactive power control in an interconnected power System
CO7	Explain reliability, security, contingency analysis, state estimation and related issues of power systems
COURSE CODE	**15EE82 INDUSTRIAL DRIVES AND APPLICATIONS**
CO1	Explain the advantages and choice of electric drive.
CO2	Explain dynamics and different modes of operation of electric drives.
CO3	Suggest a motor for a drive and control of dc motor using controlled rectifiers.
CO4	Analyze the performance of induction motor drives under different conditions.
CO5	Control induction motor, synchronous motor and stepper motor drives.
CO6	Suggest a suitable electrical drive for specific application in the industry
COURSE CODE	**15EE833 INTEGRATION OF DISTRIBUTED GENERATION**
CO1	Explain energy generation by wind power and solar power
CO2	Discuss the variation in production capacity at different timescales, the size of individual units
CO3	Explain the performance of the system when distributed generation is integrated to the system.

CO4	Discuss effects of the integration of DG: the increased risk of overload and increased losses.
CO5	Discuss effects of the integration of DG: increased risk of overvoltages, increased levels of power quality disturbances
CO6	Discuss effects of the integration of DG: incorrect operation of the protection
CO7	Discuss the impact the integration of DG on power system stability and operation.