COURSE CODE	ELECTRICAL & ELECTRONICS ENGINEERING
	BEEE103 Elements of Electrical Engineering
CO1	Understand the concepts of DC circuits and Electromagnetism.
CO2	Understand the concepts of single phase and Three phase AC circuits.
CO3	Apply the basic Electrical laws to solve circuits
CO4	Understand the concepts of measurements and measuring Instruments
CO5	Explain the concepts of domestic wiring, electricity billing, circuit protective devices and personal safety measures
AVG	
	BMATE 301 Mathematics-III for EE Engineering
CO1	Understand that physical systems can be described by differential equations and solve such equations
CO2	Make use of correlation and regression analysis to fit a suitable mathematical model for statistical data
CO3	Demonstrate the Fourier series to study the behavior of periodic functions and their applications in system communications, digital signal processing, and field theory.
CO4	To use Fourier transforms to analyze problems involving continuous-time signals and to apply Z-Transform techniques to solve difference equations
CO5	Apply discrete and continuous probability distributions in analyzing the probability models arising in the engineering field. Demonstrate the validity of testing the hypothesis.
	BEE302 Electric Circuit Analysis
CO1	Understand the basic concepts, basic laws and methods of analysis of DC and AC n e t wo r ks and reduce the complexity of network using source shifting, source transformation a n d n e t w o r k redu c ti on u s i n g transformations
CO2	Solve complex electric circuits using network theorems.
CO3	Discuss resonance in series and parallel circuits and also the importance of initial conditions and their evaluation.
CO4	Synthesize typical waveforms using Laplace transformation.
CO5	Solve unbalanced three phase systems and also evaluate the performance of two port networks.
	BEE303 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

	BEE304 Transformers and Generators
CO1	Explain the construction, working and various tests of single phase Transformer.
CO2	Explain the construction, working and parallel operation of three phase Transformer
CO3	Explain the construction, working and analysis of Synchronous Generator
CO4	Explain the construction, working of solar and wind power generators.
	BEEL305 Transformers and Generators Lab
CO1	Conduct various tests on transformers and synchronous machines and evaluate their performance.
CO2	Perform the parallel operation on two single phase transformers
CO3	Verify the performance of synchronous generator.
CO4	Calculate the voltage regulation of an alternator using different methods for comparison.
	BEE306A DIGITAL LOGIC CIRCUIT
CO1	Explain the concept of combinational and sequential logic circuits
CO2	Analyse and design combinational circuits
CO3	Describe and characterize flip flops and its applications
CO4	Design the sequential circuits using SR, JK, D and T flip-flops and Melay and Moore applications
CO5	Design applications of combinational and sequential circuits
CO6	Employ the digital circuits for different applications
	BEE306B Electrical Measurements and Instrumentation
CO1	Explain the significance and methods of Measurements, elements of generalised measurement system and errors in measurements.
CO2	Measure resistance, inductance and capacitance by different methods.
CO3	Explain the construction, working and characteristics of various instrument transformers.
CO4	Explain the working of different electronic instruments and display devices.
	BEE 306C ELECTROMAGNETIC FIELD THEORY
CO1	Explain Scalars, Vectors, Cartesian co-ordinate system, relation between different coordinate systems, Coulomb's law, Electric field intensity and its evaluation for different charge conditions.
CO2	Explain the potential field of a point charge, Potential gradient, Energy density in the electrostatic field and conductor's properties and boundary conditions.
CO3	Explain the Poisson's and Laplace Equations, Biot - Savart's law, Ampere's circuital law and Stokes theorem.
CO4	Explain the Magnetic force, Force between differential current elements. Force and torque on a closed circuit, Nature of magnetic materials and Magnetic boundary conditions.

CO5	Explain the Faraday's law, Displacement current. Maxwell's equations, Wave propagation in free space and in dielectrics.
BEE306D PHYSICS OF ELECTRONIC DEVICES	
CO1	Understand the principles of semiconductor physics
CO2	Understand the principles and characteristics of different types of semiconductor devices
CO3	Understand the fabrication process of semiconductor devices
CO4	Utilize the mathematical models of MOS transistors for circuits and systems
CO5	Identify the mathematical models of MOS transistors for circuits and systems
BEEL358A Scilab / MATLAB for Transformers & Generators	
CO1	Analyse in an intelligent manner, think better, and perform better.
BEEL358B 555 IC Laboratory	
	Analyse in an intelligent manner, think better, and perform better.
BEEL358C Circuit Laboratory using P-spice	
CO1	Analyse in an intelligent manner, think better, and perform better.
BEEL358D ELECTRICAL HARDWARE LABORATORY	
CO1	Analyse in an intelligent manner, think better, and perform better.
BEE401ELECTRIC MOTORS	
CO1	Understand the construction and operation, characteristics, Testing of DC Motors and determine losses and efficiency.
CO2	Understand the construction and operation, classification and types of Three phase Induction motors.
CO3	Describe the performance characteristics and applications of three phase Induction motors.
CO4	Demonstrate and explain Speed Control methods of three phase induction motor and types of single phase induction motors
CO5	Understand the construction and operation, V and inverted V curves of synchronous motors.
CO6	Construction and operation of Universal motor, AC servomotor, Linear induction motor, PMSM, SRM and BLDC motors.
BEE402 Transmission and Distribution	
CO1	Explain the structure of electrical power system, its components, advantages of high voltage AC and DC transmission, various conductors used for transmission, sag and its calculation.
CO2	Explain various types of insulators and methods to improve string efficiency.
CO3	Explain the various transmission line parameters, their effects on transmission of electricity.

CO4	Evaluate the parameters that influence the performance of transmission line and to calculate performance parameters of various transmission lines.
CO5	Explain carona and its effects, underground cable and its construction, classification, limitations and specifications.
CO6	Evaluate different types of distribution systems.
BEE403 Microcontrollers	
CO1	Outline the 8051 architecture, registers, internal memory organization, addressing modes.
CO2	Discuss 8051 addressing modes, instruction set of 8051, accessing data and I/O port programming
CO3	Develop 8051C programs for time delay, I/O operations, I/O bit manipulation, logic and arithmetic operations, data conversion and timer/counter programming.
CO4	Summarize the basics of serial communication and interrupts, also develop 8051 programs for serial data communication and interrupt programming.
CO5	Program 8051to work with external devices for ADC, DAC, Stepper motor control, DC motor control
AVG.	Develop various 8051 based projects
BEEL404 Electric Motors Lab	
CO1	Perform tests on DC Machines to determine their characteristics.
CO2	Control the DC Motors using different methods.
CO3	Pre-determination the performance characteristics of DC Machines.
CO4	Conduct load test on single-phase and three-phase Induction Motor and draw performance characteristics
CO5	Conduct test on Induction Motor to determine performance characteristics.
CO6	Conduct test on synchronous motor to draw performance curves.
BEE405A Electrical Power Generation and Economics	
CO1	Explain the basics of hydro electric power plant, merits and demerits of hydroelectric power plants, site selection, arrangement and elements of hydro electric plant
CO2	Explain the working, site selection and arrangement of Steam, Diesel and Gas Power Plants
CO3	Explain the working, site selection and arrangement of Nuclear Power Plants.
CO4	Explain the importance of different equipments in substation, Interconnection of power stations and different types of grounding
CO5	Explain the economics of power generation.
BEE405B OPAMPS AND LIC	
CO1	Explain the basics of linear ICs.
CO2	Design circuits using linear ICs.

CO3	Demonstrate the application of Linear ICs.
CO4	Use ICs in the electronic projects
BEE405C Engineering Materials	
CO1	Explain wave particle duality, tunnelling phenomenon, electron theory of metals.
CO2	Explain the free electron theory of conduction in metals.
CO3	Explain the polarization under static fields, behavior of dielectrics in alternating fields, Inorganic materials, organic materials,), resins and varnishes, liquid insulators.
CO4	Explain the mechanism of conduction in semiconductors.
CO5	Explain the magnetic materials, their classification and magneto materials.
BEE405D Object Oriented Programming	
CO1	Discuss the basic Object Oriented concepts.
CO2	Develop applications using Object Oriented Programming Concepts.
CO3	Implement features of object oriented programming to solve real world problems.
BEE456A BASICS OF –VHDL LAB	
CO1	Write the VHDL/Verilog programs to simulate combinational circuits in data flow, behavioral, gate level abstractions.
CO2	Describe sequential circuits like flip-flops, counters, in behavioral descriptions and obtain simulated waveforms.
CO3	Synthesize combinational and sequential circuits on programmable ICs and test the hardware
CO4	Interface the hardware programmable chips and obtain the required output.
BEEL456B Scilab / MATLAB for Electrical and Electronic Measurements	
	Analyse in a systematic way, think better, and perform better.
BEEL456C PCB Design Laboratory	
	Analyse in an intelligent manner, think better, and perform better.
BEEL456D ARDUINO AND RASPBERRY PI	
CO1	Explain the concepts of Internet of Things and its hardware and software components
CO2	Interface I/O devices, sensors & communication modules
CO3	Remotely monitor data and control devices
CO4	Develop real life IoT based projects.
BEE501 Enginerring Management and Enterpreneurship	
CO1	Understand the fundamental concepts of Management and its functions.
CO2	Understand the different functions to be performed by mangers/Enterpreneur

CO3	Understand the social responsibilities of a business.
CO4	Understand the concepts of Enterpreneurship and to identify business oppurtunities
CO5	Understand the components in developing a business plan and awareness about various sources of funding and institutions supporting Enterpreneur
BEE 502 SIGNALS AND DSP	
CO1	Discuss classification and basic operations that can be performed on both continuous and discrete time signals and to understand sampling theorem.
CO2	Evaluate Discrete Fourier Transform of a sequence , to understand the various properties of DFT and signal segmentation using overlap and overlap add method.
CO3	Evaluate Discrete Fourier Transform of a sequence using decimation in time and decimation in frequency methods.
CO4	To design Butterworth and Chebyshev IIR digital filters and to represent the filters using different methods and to represent IIR filter using different methods.
CO5	To design FIR filters using windows method and frequency sampling method and to represent FIR filters using direct method and lattice method.
BEE503 Power Electronics	
CO1	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.
CO2	To explain the techniques for design and analysis of single phase diode rectifier circuits.
CO3	To explain different power transistors, their steady state and switching characteristics and limitations.
CO4	To explain different types of Thyristors, their gate characteristics and gate control requirements.
CO5	5 To explain the design, analysis techniques, performance parameters and characteristics of controlled rectifiers, DC- DC, DC -AC converters and Voltage controllers.
BEEL504 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.
BEE515A High Voltage Engineering	
CO1	Have detailed knowledge of conduction and breakdown phenomenon in gases, liquids and solid dielectrics
CO2	Ability to design and simulate the generation of high voltages and currents
CO3	Ability to design and analyze the measurement techniques for high voltages and currents

CO4	Summarize overvoltage phenomenon and protection of electric power systems.
CO5	Explain non-destructive testing of materials and high-voltage testing of electric apparatus
BEE515B Power Electronics for Renewable Energy Systems	
CO1	Describe WES and PV systems
CO2	Develop MPPT algorithms for PV systems and WES.
CO3	Design converters for PVS and SES
CO4	Describe biomass, fuel cells and oceanic energy sources
CO5	Discuss grid connection issues of renewable energy sources.
BEE515C ELECTRIC VEHIVLE FUNDAMENTALS	
CO1	Describe about working principle of electric vehicles.
CO2	Explain the construction and working principle of various motors used in electric vehicles.
CO3	Understand about working principle of electronics and sensor less control in electric vehicles.
CO4	Describe the different types and working principle of hybrid vehicles.
CO5	Illustrate the various types and working principle of fuel cells.
BEE515D FUNDAMENTALS OF VLSI DESIGN	
CO1	Identify the CMOS layout levels, and the design layers used in the process sequence.
CO2	Describe the general steps required for processing of CMOS integrated circuits.
CO3	Design static CMOS combinational and sequential logic at the transistor level.
CO4	Demonstrate different logic styles such as complementary CMOS logic, pass-transistor Logic, dynamic logic, etc.
CO5	Interpret the need for testability and testing methods in VLSI
BEE601 POWER SYSTEM ANALYSIS I	
CO1	Model the power system components &construct per unit impedance diagram of power system.
CO2	Analyse three phase symmetrical faults on power system.
CO3	Compute unbalanced phasors in terms of sequence components and vice versa, also develop sequence networks.
CO4	Analyse various unsymmetrical faults on power system.
CO5	Examine dynamics of synchronous machine and determine the power system stability.
BEE602 CONTROLSYSTEMS	
CO1	Analyze and model electrical and mechanical system using analogous.
CO2	Formulate transfer functions using block diagram and signal flow graphs.
CO3	Analyze the stability of control system, ability to determine transient and steady state time response.
CO4	Illustrate the performance of a given system in time and frequency domains, stability analysis using Root locus and Bode plots

CO5	Discuss controllers and various compensators.
BEE613A Medium Voltage Substation Design	
CO1	Explain the key concepts of design, construction, operation, and maintenance of electrical substations.
CO2	Develop design calculations in substation engineering such as earth-mat, lightning protection, earthing, lighting, and cable sizing.
CO3	Develop design calculation for sizing of power transformers, diesel generator.
CO4	Select LV and HV equipment's in substation for power distribution, protection, and switchgear.
CO5	Explain Electrical Safety Rules, SOPs.
BEE613B EMBEDDED SYSTEM DESIGN	
CO1	Explain characteristics of Embedded System design
CO2	Acquire knowledge about basic concepts of circuit emulators, debugging and RTOS
CO3	Analyse embedded system software and hardware requirements
CO4	Develop programming skills in embedded systems for various applications
CO5	Design basic embedded system for real time applications
BEE613C FACTS AND HVDC TRANSMISSION	
CO1	Explain the basic concepts, definitions of flexible ac transmission systems and benefits from FACTS technology.
CO2	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.
CO3	Describe series Controllers Thyristor-Controlled Series Capacitor (TCSC) and the Static Synchronous Series Compensator (SSSC) for control of the transmission line current.
CO4	Explain advantages of HVDC power transmission, overview and organization of HVDC system.
CO5	Explain converter control for HVDC systems, commutation failure, control.
BEE613D Electric Motor and Drive Systems for Electric Vehicles	
CO1	Explain the Fundamental and Performance of EV
CO2	Understand the Characteristics of motor control and energy consumption for EV operation
CO3	Analyse the Power electronics and sensors in DC motor electric vehicles.
CO4	Design and Analysethe induction motor drives and discuss methods for controlling them.
CO5	Comprehend the construction, working principle and controlof BLDC and SRM motors.
BEE654A Utilization of Electric Power	
CO1	Discuss different methods of electric heating & welding.
CO2	Discuss the laws of electrolysis, extraction, refining of metals and electro deposition process.
CO3	Discuss the laws of illumination, different types of lamps, lighting schemes and design of lighting systems. Analyze systems of electric traction, speed time curves and mechanics of train movement.

CO4	Explain the motors used for electric traction, their control & braking and power supply system used for electric traction.

BEE654B   Technologies of Renewable Energy Sources

CO1	Discuss causes of energy scarcity and its solution, energy resources and availability of renewable energy. Outline energy from sun, energy reaching the Earth's surface and solar thermal energy applications.
CO2	Discuss types of solar collectors, their configurations, solar cell system, its characteristics and their applications.
CO3	Explain generation of energy from hydrogen, wind, geothermal system, solid waste and agriculture refuse.
CO4	Discuss production of energy from biomass, biogas.
CO5	Summarize tidal energy resources, sea wave energy and ocean thermal energy.

BEE654C Industrial Servo Control Systems

CO1	Explain the evolution and classification of servos, with descriptions of servo drive actuators, amplifiers, feedback transducers, performance, and troubleshooting techniques.
CO2	Discuss system analogs, vectors and transfer functions of differential equations.
CO3	Discuss mathematical equations for electric servo motors, both DC and brushless DC servo motors.
CO4	Represent servo drive components by their transfer function, to combine the servo drive building blocks into system block diagrams

BEE654D SEMICONDUCTOR DEVICES

CO1	Discuss power electronic concepts, electronic switches and semiconductor physics.
CO2	Explain representation of switches in P-spice and power computations.
CO3	Explain the internal structure, the principle of operation, characteristics and base drive circuits of power semiconductor devices; power diodes, power BJT, power MOSFET.
CO4	Explain the internal structure, the principle of operation, characteristics and base drive circuits of power semiconductor devices; thyristors, power IGBT, power FET

BEEL606 CONTROL SYSTEM LABORATORY

CO1	Utilize software package and discrete components in assessing the time and frequency domain response of a given second order system
CO2	Design, analyze and simulate Lead, Lag and Lag – Lead compensators for given specifications.
CO3	Determine the performance characteristics of ac and DC servomotors and synchro-transmitter receiver pair used in control systems.

CO4	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.
CO5	Develop a script files to plot Root locus, Bode plot and Nyquist plot to study the stability of

BEE657A Energy Management in Electric Vehicles	
CO1	Understand and analyse the energy storage technologies used in electric vehicles.
CO2	Understand the design and implementation of energy management strategies for electric vehicles, considering factors such as battery charging, power allocation and regenerative braking.
CO3	Understand optimization techniques and intelligent algorithms to optimize energy management in electric vehicles, considering real-time constraints and factors such as driving conditions and energy efficiency goals.

BEEL657B Simulation and Control of Power Electronics Circuits	
CO1	Simulate any given power electronic circuit and evaluate its performance under different test conditions and also observe the performance for different values of passive filtering elements used in the converter.

BxxLxxx Energy Audit Project	
CO1	Analyze the data collected for energy audit of a building or industry or organization.
CO2	Perform comparative analysis with and without energy audit.
CO3	Analyze the energy saving measures to be considered with economy considerations.
CO4	Analyse in a systematic way, think better, and perform better

BEEL657D Project on Renewable Energy Sources	
CO1	Analyse in a systematic way, think better, and perform better.

BEE701 Switchgear and Protection	
CO1	Discuss the general concepts of power system protection, construction and operation of relays.
CO2	Explain the construction and operation of different types of overcurrent relays and protection schemes.
CO3	Discuss pilot protection, construction, operating principles and performance of differential relays and discuss protection of generators, motors, transformer and Bus Zone Pro

CO4	Explain the construction and operation of different types of circuit breakers.
CO5	Outline features of fuse, causes of over voltages and its protection, also modern trends in Power System Protection.

BEE702 INDUSTRIAL DRIVES AND APPLICATION	
CO1	Explain the advantages, choice and control of electric drive
CO2	Explain the dynamics, generating and motoring modes of operation of electric drives
CO3	Analyze the performance & control of DC motor drives and AC motor drives using controlled rectifiers.
CO4	Analyze the solar powered drives.
CO5	Explain the application of drives in industry and in rural areas.

BEE 703 POWER SYSTEM ANALYSIS II	
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	Solve issues of economic load dispatch and unit commitment problems.
CO4	Analyse short circuit faults in power system networks using bus impedance matrix. Apply Point by Point method and Runge Kutta Method to solve Swing Equation.

BEE714A Power System Operation and Control	
CO1	Describe various levels of controls in power systems, architecture and configuration of SCADA.
CO2	Develop and analyse mathematical models of Automatic Load Frequency Control.
CO3	Develop mathematical model of Automatic Generation Control in Interconnected Power system.
CO4	Discuss the Control of Voltage, Reactive Power and Voltage collapse.
CO5	Explain security, contingency analysis, and state estimation of power systems.

BEE714B AI TECHNIQUES FOR ELECTRIC AND HYBRID ELECTRIC VEHICLES	
CO1	Discuss IoT Based Battery Management System and type of batteries for EV and HEV.
CO2	Explain AI Based BLDC drive for optimum operation of EV.
CO3	Explain Active Magnetic Bearing system for EVs.
CO4	Model and analyse three phase converters for EV applications
CO5	Model and analyse Energy Management of HESS in PHEV.

BEE714C Programmable Logic Controllers

CO1	Describe the hardware components of PLC: I/O modules, CPU, memory devices, other support devices, operating modes and PLC programming
CO2	Develop Fundamental PLC Wiring Diagrams and Ladder Logic Programs
CO3	Describe the operation of different program control instructions.
CO4	Discuss the execution of data transfer instructions, data compare instructions and the basic operation of PLC closed-loop control system.
CO5	Describe the operation of mechanical sequencers, bit and word shift registers, processes and structure of control systems and communication between the processes.

BEE714D BIG DATA ANALYTICS IN POWER SYSTEMS (PROFESSIONAL ELECTIVE)	
CO1	Discuss role of big data and machine-learning methods applicable to power systems and in particular to Smart Grid communications.
CO2	Discuss optimization methods which are suitable for big data models in power systems.
CO3	Discuss various cyber security issues, electricity theft detection and mitigation that exist in IoT-enabled future power systems
CO4	Discuss renewable energy planning concerns associated with planned future power systems that have high renewable penetration.

BEE755A ELECTRIC VEHICLE TECHNOLOGIES	
CO1	Explain the working of Electric Vehicles and recent trends.
CO2	Design Hybrid Electric Drive Train
CO3	Develop a converters for battery charging
CO4	Different power grid used for electric vehicle application.
CO5	Develop the modes of control for electrical vehicles.

BEE755B Energy Conservation and Audit	
CO1	Analyze about energy scenario nationwide and worldwide, also outline Energy Conservation Act and it features
CO2	Discuss load management techniques and energy efficiency.
CO3	Understand the need of energy audit and energy audit methodology
CO4	Understand various pillars of electricity market design.
CO5	Conduct energy audit of electrical systems and buildings.
CO6	Show an understanding of demand side management and energy conservation.

BEE755C PLC and SCADA

CO1	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
CO2	Describe field devices Relays, Contactors, Motor Starters, Switches, Sensors, Output Control Devices, SealIn Circuits, and Latching Relays commonly used with I/O module
CO3	Analyze PLC timer and counter ladder logic programs and describe the operation of different program control instructions
CO4	Discuss the execution of data transfer instructions, data compare instructions and the basic operation of PLC closed-loop control system.
CO5	Describe the operation of mechanical sequencers, bit and word shift registers, processes and structure of control systems and communication between the processes.

BEE755D OPTIMISATION TECHNIQUES	
CO1	Understand and formulate Linear Programming model
CO2	Solve problems on Duality theory, transportation, Assignment problems-Travelling sales man problem
CO3	Classify Non Linear programming and solve related problems.
CO4	Understand interior point methods.
CO5	Understand and formulate multi stage decision problem and explain the concept of sub optimisation.