I.K.G. PUNJAB TECHNICAL UNIVERSITY, JALANDHAR

Scheme & Syllabus of B. Tech. Electrical Engineering [EE]

(As per Course Objectives and Course Outcomes)

Board of Studies Electrical Engineering

Punjab Technical University B.Tech Electrical Engineering (EE) Batch 2011

Note: There will be 04 weeks BTEE309 Institutional training after 2nd semester. "S" for satisfactory and US for unsatisfactory.

The Department of Electrical Engineering

Program Scheme

Semester –III								
Course Code	Course Title	L	T	P	Marks Distribution		Total Marks	Credits
					Internal	External		
BTAM-301	Engineering Mathematics-III	4	1	-	40	60	100	5
BTEE-301	Circuit Theory	4	1	-	40	60	100	5
BTEE-302	Transformers & Direct Current Machines	4	1	-	40	60	100	5
BTEE-303	Electrical Measurements & Instrumentation	4	1	-	40	60	100	5
BTEE-304	Electronic Devices and Circuits	4	1	-	40	60	100	5
BTEE-305	Laboratory-I (Semiconductor Devices and Circuit Theory)	-	-	2	30	20	50	1
BTEE-306	Laboratory-II (Electrical Machines -I)	-	-	2	30	20	50	1
BTEE-307	Laboratory-III (Electrical Measurements)	-	-	2	30	20	50	1
BTEE-309	Institutional Training (Undertaken after 2nd semester)				60	40	100	S/US
	Total	**20**	**5**	**6**	**350**	**400**	**750**	**28**

Semester –IV								
Course Code	Course Title	L	T	P	Marks Distribution		Total Marks	Credits
					Internal	External		
BTEE-401	Asynchronous Machines	3	1	-	40	60	100	4
BTEE-402	Linear Control Systems	4	1	-	40	60	100	5
BTEE-403	Electromagnetic Fields	3	1	-	40	60	100	4
BTEC-404	Digital Electronics	3	1	-	40	60	100	4
BTEE-405	Power System-I (Transmission & Distribution)	3	1	-	40	60	100	4
BTEE-406	Power Plant Engineering	3	1	-	40	60	100	4
BTEE-407	Laboratory-IV (Instrumentation & Measuring Devices)	-	-	2	30	20	50	1
BTEE-408	Laboratory-V (Control System)	-	-	2	30	20	50	1
BTEC-409	Laboratory-VI (Electronic Circuits)	-	-	2	30	20	50	1
General Fitness					100	-	100	S/US
	Total	**19**	**6**	**6**	**430**	**420**	**850**	**28**

Semester –V								
Course Code	Course Title	L	T	P	Marks Distribution		Total Marks	Credits
					Internal	External		
BTEE-501	Synchronous Machines	4	1	-	40	60	100	5
BTEE-502	Electric Generation & Economics	4	1	-	40	60	100	5
BTEE-503	Microprocessors	4	1	-	40	60	100	5
BTEE-504	Power Electronics	4	1	-	40	60	100	5
BTEE-505	Numerical & Statistical Methods	4	1	-	40	60	100	5
BTEE-506	Laboratory-VII (Electrical Machines-II)	-	-	2	30	20	50	1
BTEE-507	Laboratory-VIII (Numerical Analysis)	-	-	2	30	20	50	1
BTEE-508	Laboratory-IX (Electrical: Estimation & Costing)	-	-	2	30	20	50	1
BTEE-509	Industrial Training (Undertaken after 4th semester)				60	40	100	S/US
	Total	**20**	**5**	**6**	**350**	**400**	**750**	**28**

Semester –VI								
Course Code	Course Title	L	T	P	Marks Distribution		Total Marks	Credits
					Internal	External		
BTEE-601	Electric Power Utilization	3	1	-	40	60	100	4
BTEE-602	Power System-II (Switch Gear & Protection)	3	1	-	40	60	100	4
BTEE-603	Non-Linear & Digital Control Systems	4	1	-	40	60	100	5
BTEE-604	Microcontroller and PLC	3	1	-	40	60	100	4
BTYY-6XX	Open Elective	3	1	-	40	60	100	4
BTEE-605X	Elective-I	3	1	-	40	60	100	4
BTEE-606	Laboratory-X (Power Electronics & Drives)	-	-	2	30	20	50	1
BTEE-607	Laboratory-XI (Power System-II)	-	-	2	30	20	50	1
BTEE-608	Laboratory-XII (Micro controller & PLC)	-	-	2	30	20	50	1
General Fitness					100	-	100	S/US
	Total	**19**	**6**	**6**	**430**	**420**	**850**	**28**

Semester –VII/VIII								
Course Code	Course Title	L	T	P	Marks Distribution		Total Marks	Credits
					Internal	External		
BTEE-801	Power System Analysis	3	1	-	40	60	100	4
BTEE-802	High Voltage Engineering	4	1	-	40	60	100	5
BTEE-803	Non-conventional Energy Sources	3	1	-	40	60	100	4
BTEE-804Y	Elective-II	3	1	-	40	60	100	4
BTEE-805Z	Elective-III	3	1	-	40	60	100	4
BTEE-806	Lab-XIII (Power System Analysis)	-	-	2	30	20	50	1
BTEE-807	Project Work	-	-	6	60	40	100	4
BTEE-808	Seminar	-	-	2	100	-	100	2
General Fitness					100	-	100	S/US
	Total	**16**	**5**	**10**	**490**	**360**	**850**	**28**

Semester –VII/VIII					
Course Code	Course Title	Marks Distribution		Total Marks	Credits
		Internal	External		
Industrial Training (One semester)					
BTEE-701	Software Training	150	100	250	8
BTEE-702	Industrial oriented Project Training	300	200	500	10
	Total	**450**	**300**	**750**	**18**

Semester-III

ENGINEERING MATHEMATICS-III (BTAM-301)

Internal Marks: 40	**L**	**T**	**P**
External Marks: 60	**4**	**1**	**0**
Total Marks: 100			

Course Objectives

The objective of this course is to:

1. Introduce the students to Fourier Series and their application in evaluation of different numeric harmonic series.
2. Introduce the students to Laplace & its inverse Transforms and their application to the solution of Ordinary Differential Equations.
3. To make students familiar with complex variable and theorems of vector integration.
4. Give a balanced introductory treatment of the area of Partial Differential Equations (PDEs) so that a student appreciates the power of PDE modeling and is aware of major techniques for their solution. The focus of the course is on analytical techniques for the classical linear PDE of physics and engineering (heat, wave and Laplace equations), and their frequent occurrence in applications.
5. Expose the students to some special functions fundamental to engineering specifically Bessel and Legendre.

Course Content

1. Fourier Series Periodic functions, Euler's formula. Even and odd functions, half range expansions, Fourier series of different wave forms.

2. Laplace Transforms Laplace transforms of various standard functions, properties of Laplace transforms, inverse Laplace transforms, transform of derivatives and integrals, Laplace transform of unit step function, impulse function, periodic functions, applications to solution of ordinary linear differential equations with constant coefficients, and simultaneous differential equations.

3. Special Functions Power series solution of differential equations, Frobenius method, Legendre's Equation, Legendre polynomial, Bessel's equation, Bessel functions of the first and second kind. Recurrence relations, equations reducible to Bessel's equation, Error function and its properties.

4. Partial Differential Equations Formation of partial differential equations, Linear partial differential equations, homogeneous partial differential equations with constant coefficients

5. Applications of Partial Differential Equations: Wave equation and Heat conduction equation in one dimension. Two dimensional laplace equation, solution by the method of separation of variables.

6. Functions of Complex Variable Limits, continuity, derivative of complex functions, analytic function, Cauchy-Riemann equation, conjugate functions, harmonic functions; Conformal Mapping: Mapping of a complex function, conformal mapping, standard transforms, mapping of standard elementary transformations, complex potential, applications to fluid flow problems; Complex Integration : Line integrals in the complex plane, Cauchy's theorem, Cauchy's integral formula and derivatives of analytic function. Taylor's and Laurent's expansions, singular points, poles, residue, complex integration using the method of residues, evaluation of real integrals by contour integration.

Course Outcomes

After the completion of the course the student will be able to:

CO1. Demonstrate their understanding of the Dirichlet's conditions over functions and use them to expand the Fourier series of qualified functions.

CO2. Calculate the Laplace transform of standard functions both from the definition and by using tables and use the appropriate shifts/theorems in finding Laplace and inverse Laplace transforms.

CO3. Select and combine the necessary Laplace & inverse Laplace transform techniques to solve Electrical Engineering problems involving linear and second-order ordinary differential equations, initial and boundary value problems.

CO4. Detect a complex variable function to be analytic & able to find their complex conjugates.

CO5. Find Taylor and Laurent expansions and hence define and find different types of singularities of a function (especially poles) so that complex integrals can be obtained using contour integration (Residue theory).

CO6. Apply the concept of transformation to find conformal mapping in a complex space (linear and non-linear).

CO7. Apply the fundamental concepts of partial differential equation formation and solution techniques and their role in modern mathematics and apply context to solve real life problems like heat diffusion, wave formation, Laplace equation and many more.

CO8. Find power series solutions of special differential equations about ordinary & singular points and use this tool to generate Legendre and Bessel polynomials and further utilize their properties.

CIRCUIT THEORY (BTEE-301)

Internal Marks: 40	**L**	**T**	**P**
External Marks: 60	**4**	**1**	**0**
Total Marks: 100			

Course Objectives

1. To develop an understanding of the fundamental laws and elements of electric circuits and networks.
2. To solve the electrical circuits using different theorems.
3. To represent the basic circuits in time and frequency response with application of mathematics in engineering like laplace transforms, first and second order differential equations.
4. To understand the concept of two port networks and realize the networks using different properties.
5. To design different types of passive filters.

Course Content

Unit I Circuit Concepts:
Independent and dependent sources, Signals and wave forms: Periodic and singularity voltages, step, ramp, impulse, doublet, loop currents and loop equations, node voltage and node equations, Network Theorems: Superposition, Thevenin's, Norton's, Maximum Power Transfer, and Reciprocity.

Unit II Time and Frequency Domain Analysis:

Representation of basic circuits in terms of generalized frequency and their response, Laplace transform of shifted functions, transient and steady response, Time domain behaviors from poles and zeros, Convolution Theorem.

Unit III Network Synthesis:

Network functions, Impedance and admittance function, Transfer functions, Relationship between transfer and impulse response, poles and zeros and restrictions, Network function for two terminal pair network, Sinusoidal network in terms of poles and zeros, Real liability condition for impedance synthesis of RL and RC circuits, Network synthesis techniques for 2-terminal network, Foster and Cauer forms.

Unit IV: Filter Synthesis

Classification of filters, characteristics impedance and propagation constant of pure reactive network, Ladder network, T-section, p-section, terminating half section, Pass bands and stop bands, Design of constant-K, m-derived filters, Composite filters.

Course Outcomes

After the completion of the course the student will be able to:

CO1. Know and express the basic circuit elements, energy sources and fundamentals of electric networks.

CO2. Solve the complex electrical circuits using different methods and theorems.

CO3. Correlate the time-domain and frequency response of electric circuits using laplace transform.

CO4. Relate the different input and output parameters of two port networks and can realize the networks using admittance and impedance properties.

CO5. Design the different types of passive filters and their applications.

TRANSFORMERS AND DIRECT CURRENT MACHINES (BTEE-302)

Internal Marks	**40**	**L**	**T**	**P**
External Marks	**60**	**4**	**1**	**0**
Total Marks	**100**			

Course Objectives

1. Be able to complete detailed study of Transformers and DC Machines.
2. Explain the analysis of various types of DC Machines: DC Motors and DC Generators.
3. Understand in detail the working principle, operation, equivalent circuit and characteristics of Transformers and both the DC Machines.

Course Content

Transformers: Working principle, construction of single phase transformer, EMF equation, phasor diagrams on no-load and on loaded conditions, open circuit and short circuit tests, equivalent circuit parameters estimation, voltage regulation and efficiency, back to back test. Effect of saturation on exciting current and in-rush current phenomenon. Parallel operation of single phase transformers.

Auto Transformers: Principle of operation, equivalent circuit and phasor diagrams, comparison with two winding transformer.

Three-Phase Transformers: Different types of winding connections, Voltage and current ratios, Parallel operation of three phase transformers. Three winding transformer's equivalent circuit, off-load and on-load tap changing transformer, Scott connections. Testing of transformers.

D.C. Generator: Working principle , construction of DC Machines, Armature windings, single and double layer winding diagrams, E.M.F. and torque equations, armature reaction, effect of brush shift, compensating winding, commutation, causes of bad commutation, methods of improving commutation, methods of excitation of d.c. generators and their characteristics.

D.C. Motor: Working principle characteristics, starting of shunt and series motor, starters, speedcontrol methods: field and armature control. Braking: plugging, dynamic and regenerative braking,Testing: Swinburn's test, Hopkinson test, Field test. Estimation of losses and efficiency.

Course Outcomes

After the completion of the course the student will be able to:

CO1. Appraise electrical supply equipment and be able to make selections from theoretical considerations.

CO2. Formulate and then analyze the working of any electrical machine using mathematical model under loaded and unloaded conditions of Transformers.

CO3. Analyze and describe aspects of the construction, principle of operation, applications, methods of speed control, and methods of direction reversal of d.c. machines.

CO4. Conduct testing and experimental procedures on different types of electrical machines.

ELECTRICAL MEASUREMENTS & INSTRUMENTATION (BTEE-303)

	L	T	P
Internal Marks: 40			
External Marks: 60	**4**	**1**	**0**
Total Marks: 100			

Course Objectives

1. To understand students how different types of meters work and their construction
2. To introduce students to monitor, analyze and control any physical system.
3. To introduce students a knowledge to use modern tools necessary for electrical projects.
4. To provide a student a knowledge to design and create novel products and solutions for real life problems.

Course Content

Units, Dimensions And Standards: Introduction to MKS & Rationalised MKSA System, SI Units, Standards of EMF, Resistance, Capacitance and Inductance, Systematic errors.

General Theory of Analog Measuring Instruments: Operating torque, damping & controlling torque, T/W ratio, Pointers & Scales. Principles of operation of various types of electro mechanical indicating / registering instruments viz. PMMC, dynamometer, induction, thermal, etc. for dc & ac measurement of voltage, current, power, frequency, phase & power factor etc., energy meter: their sources of error & compensation, shunts & multipliers, multi-meter.

Potentiometers: Basic D.C. potentiometer circuit, Modern form of D.C. potentiometer, measurement of voltage, current, Resistance and calibration of voltmeter & ammeter using D.C. potentiometer, volt ratio box, Self balancing potentiometer, A.C. potentiometers and their applications.

Bridges: Sources and Detectors, General equation for bridge balance, Wheatstone bridge and its sensitivity analysis, Kelvin double bridge, AC bridges: applications and conditions for balance, Maxwell's bridge, Hay's bridge, Schering bridge, Wien bridge, DeSauty's bridge, Insulation testing, Sources of errors in bridge circuits, Shielding of bridge elements, Wagner Earthling Device.

Magnetic Measurements: Flux meter, B-H Curve, Hysteresis loop, Permeameters, AC Testing of Magnetic materials, Separation of iron losses, iron loss measurement by Wattmeter and Bridge methods.

Instrument Transformers: Theory and construction of current and potential transformers, ratio and phase angle errors and their minimization, Characteristics of current transformers (CT).and potential transformers (PT). and their Testing.

Course Outcomes

After the successful completion of course, the student will be able to:

CO1. Design a system, component or process to meet desired needs in Electrical Engineering.

CO2. Understand the dimensions, standards and errors in measuring instruments and Measurement.

CO3. Apply the basic electrical laws for measurement of any Electrical quantity.

CO4. Ability to balance Bridges to find unknown values.

CO5. Ability to test the magnetic materials and hence to find iron losses.

CO6. Develop the capability to analyze and design simple circuits to enhance the ratings of the measuring instrument.

ELECTRONIC DEVICES AND CIRCUITS (BTEE-304)

Internal Marks:	**40**	**L**	**T**	**P**
External Marks:	**60**	**3**	**1**	**0**
Total Marks:	**100**			

Course Objectives

1. Introduce students to the fundamentals of Electronic Devices and Circuits.
2. Understand the physical principles that govern the analysis of Integrated Circuits.
3. Learn the quantitative measurement of Electronic Devices used for various applications.

Course Content

Basic Semiconductor And Diodes:
Intrinsic and extrinsic semiconductors, diffusion and drift currents, p-n junction under open-circuit, reverse bias and forward-bias conditions, p-n junction in the breakdown region, Ideal diode, terminal characteristics of junction diode, Load-line analysis of diode circuits, half wave rectifier and full wave rectifiers, Clippers and Clampers, capacitive filters, RC and LC filter, voltage multipliers. Principles, construction, characteristics and applications of Zener diodes, Light Emitting Diodes, Schottky Diode, Varactors

Bipolar and Unipolar Transistors:
Bipolar junction transistor (BJT)- physical structure and modes of operation, Transistor characteristic and parameters, Common Base, Common Emitter and Common Collector Configurations, Transistor biasing, Transistor as a switch, Basics characteristics of an amplifier, Simple transistor model (re model), Common Emitter, Common Collector and Common base amplifiers, hybrid equivalent circuit, H-parameters, circuit analysis using h-parameters. Junction field effect transistor (JFET): Characteristics, parameters and biasing. Metal oxide field effect transistor (MOSFET): Characteristics, parameters and biasing. Class a power amplifier, Class B, Class AB Push-pull and Class Camplifiers.

Integrated Circuit and Operational-Amplifiers:
Introduction to IC's, Op-Amps, OpAmp Characteristics, Feedback, Different feedback configurations, Current– to–voltage converter and voltage-to-current converters, voltage and current amplifiers, mathematical operations using Op-Amp, summing, differential, integrating amplifiers, Comparators and Schmitt trigger Oscillator.

Active Filters:
Oscillations, Feedback oscillator Principles,, RC phase shift oscillator, Wein bridge oscillator, Hartley oscillator, Colpitts oscillator, Crystal oscillators, frequency stability, negative resistance in oscillators. Active Filters (1 st order) with low pass, high pass, band pass, band stop and all pass. Pin configuration of 555 timer, 555 timer as Oscillator: monostable, bistable and astable multivibrator.

Regulated Power Supplies: Unregulated power supplies, line and load regulations, Zener diode voltage regulators, transistor series and shunt regulators, current limiting, Op-Amp voltage regulators, integrated circuit (LM-3XX) voltage regulators. Introduction to switching regulators. Working of Switched Mode Power Supply (SMPS).

Course Outcomes

After the completion of the course the student will be able to:-

CO1. Evaluate and describe the physical principles used as a basis for Electronic Circuits.

CO2. Explain and suggest the variations in analyzing the response of Integrated Circuits.

CO3. Develop and apply electrical engineering concepts and principles to a range of problems in Electronic Devices.

Semester-IV

ASYNCHRONOUS CONTROL SYSTEM (BTEE-401)

		L	T	P
Internal Marks	**40**			
External Marks	**60**	**3**	**1**	**0**
Total Marks	**100**			

Course Objectives

1.This course aims to expose the students to the principle of induction machines.
2.To get familiar with various principle of operation and construction , starting and speed control of Induction machines.
3.To learn about basic principle of induction generator.
4.To acquaint beginners to various basic technical concepts, applications of Induction motors, single phase and special purpose motors and their applications.

Course Content

Polyphase Induction Machines: Analogy between induction motor and transformer, production of rotating field in space distributed three-phase winding, constructional features, concept of slip and operation, rotor frequency, current and power, equivalent circuit, phasor diagram, torque-slip characteristics, effect of rotor circuit resistance, starting torque, crawling and cogging, cage motors(double cage and deep bar motor).

Starting Methods and Speed Control: Starting methods, speed control: (i) control of speed of rotating field, (ii) control of slip speed. Effect of voltage injection in rotor circuit of slip ring induction motor. Motor tests for estimation of equivalent circuit parameters.

Induction Generator: Isolated and Grid mode operation, method of excitation, performance characteristics of three-phase self-excited induction generator.

Special Purpose Motors: Stepper Motors: construction, principle of operation and applications. Linear Induction Machines: construction, principle of operation and applications. Universal Motor: construction, principle of operation and applications.

Single –Phase Motors: Double revolving field theory, types of single phase motors, characteristics and equivalent circuit. Shaded pole motor: working principle and characteristics.

Course Outcomes

After the completion of the course the student will be:

CO1. Know the basic working principles of synchronous machines.
CO2. Apply knowledge about starting methods, speed control of squirrel cage induction and slip ring induction motors, etc.
CO3. Develop applications on single phase motors and special purpose motors.
CO4. Design and implement small projects like star-delta starters and auto-transformers etc.
CO5. Understand the importance of extensive research in Electrical Machines.

LINEAR CONTROL SYSTEM (BTEE-402)

			L	T	P
Internal Marks	**40**				
External Marks	**60**		**4**	**1**	**0**
Total Marks	**100**				

Course Objectives

1. To provide the students in getting a basic idea of different control systems.
2. To analyze the system stability both in frequency and time domains.
3. To train the students to have the solid foundation in mathematical and engineering fundamentals required to solve engineering problems.
4. To prepare the students to excel in post graduate programs or to succeed in industry.

Course Content

Introductory Concepts:

Plant, Systems, Servomechanism, regulating systems, disturbances, Open loop control systems, closed loop control systems, linear and non- linear systems, time variant & invariant, continuous and sampled data control systems, illustrative examples.

Modelling :

Formulation of equation of linear electrical, mechanical, thermal, pneumatic and hydraulic systems, electrical and mechanical analogies. Use of Laplace transform, Transfer function, concepts of state variable modelling. Block diagram representation, signal flow graphs and associated algebra, characteristics equation.

Time Domain Analysis :

Typical test -input signals, Transient response of the first and second order systems. Time domain

specifications, Dominant closed loop poles of higher order systems. Steady state error and co-efficient, pole-zero location and stability, Routh-Hurwitz Criterion.

Root Locus Technique :

The extreme points of the root loci for positive gain. Asymptotes to the loci, Breakaway points, intersection with imaginary axis, location of roots with given gain & sketch of the root locus plot. .

Frequency Domain Analysis:

Closed loop frequency response, Bode plots, stability and loop transfer function. Frequency response

specification, Relative stability, Relation between time and frequency response for second order systems. A and N- circles, log. Magnitude versus Phase angle Plot, Nyquist criterion.

Compensation : Necessity of compensation, series and parallel compensators, compensating network, application of lag and lead compensation.

Control Components: Error detectors- potentiometers and synchros, servo motors, A.C. and D.C. techogenerators, Magnetic amplifiers.

Course Outcomes

After the completion of the course the student will be able to:

CO1. Know and express the basic elements and structures of different control systems.

CO2. Correlate the pole-zero configurations of transfer functions and their time-domain and frequency response to known test inputs.

CO3. Apply Routh-Hurwitz criterion, Root Locus, Bode Plot and Nyquist Plot to determine the domain of stability of linear time-invariant systems .

CO4. Determine the steady-state response, errors of stable control systems and design compensators to achieve the desired performance.

CO5. Know the different control components & their applications and can express control system models on state space models.

ELECTROMAGNETIC FIELDS (BTEE -403)

Internal Marks	**40**	**L**	**T**	**P**
External Marks	**60**	**3**	**1**	**0**
Total Marks	**100**			

Course Objectives

1. Student will have Technical Knowledge of electromagnetic waves and electromagnetic fields.
2. Student will be able to solve problems related to electromagnetic waves and electromagnetic fields.
3. Student will generate an attitude of research oriented continuous learning about electromagnetic waves and fields.

Course Content

1. Review of Vector Analysis
Vector analysis, Physical interpretation of gradient, divergence and curl; vector relations in other coordinate systems, integral theorems: divergence theorem, stoke's theorem, green's theorem and Helmholtz theorem.

2. Electrostatics
Introduction to fundamental relations of electrostatic field; Gauss's law and its applications; potential function; Field due to continuous distribution of charges; Equipotential surfaces; Divergence theorem; Poisson's equation and Laplace's equation, capacitance, electrostatic energy, Conditions at Boundary between dielectrics, Uniqueness theorem.

3. **The Steady Magnetic Field**
Magnetic induction and Faraday's laws; magnetic Flux Density; magnetic field strength and magnetomotive force; Ampere's work Law in the differential vector form; permeability; energy stored in a magnetic field ; ampere's force law; magnetic vector potential, Analogies between electric and magnetic fields.

4. **Maxwell's equations and Poynting vector**
Equation of continuity for time varying fields, Inconsistency of ampere's law, Maxwell's equations, conditions at a Boundary surface, Poynting Theorem, Interpretation of ExH

5. **Electromagnetic Waves**
Solutions for free-space conditions; Uniform plane Wave Propagation; Wave equations for a conducting medium; Sinusoidal time variations; Polarization; Conductors and Dielectrics; Direction Cosines; Reflection by Perfect Conductor -normal and oblique incidence, Perfect Dielectric-normal incidence, Perfect Insulator – Oblique incidence; Reflection at a surface of Conductive medium.

Course Outcomes

After the completion of the course the student will be able to:

CO1. Apply formula's to solve the problems related to electromagnetic waves & electromagnetic fields in space and in medium.

CO2. Apply skills for analysis, operation & control of electromagnetic waves.

CO3. Apply Maxwell equations for applications of electromagnetic fields and waves.

DIGITAL ELECTRONICS (BTEC-404)

Internal Marks	**40**	**L**	**T**	**P**
External Marks	**60**	**3**	**1**	**0**
Total Marks	**100**			

Course Objectives

1. Student will retrieve different laws and rules of Boolean Algebra.
2. Student will be able to analyze concepts and steps involved in designing digital systems of combinational, sequential and state machines.
3. Student can create different digital to analog and analog to digital converters.

Course content

Number System & Codes: Binary number system, octal number system, hexadecimal number system, BCD Code, Gray code, signed & unsigned binary numbers, 1's & 2's complement of a number, different types of codes, Binary operations- addition, subtraction, multiplication, division, Parity for error detection, Check sum and Hamming Code for error detection and correction.

Combinational Circuits: Concept of positive and negative logic, Introduction to Boolean variables, Boolean theorems and DeMorgan Theorem, Sum of product and Product of sum form of Logic expressions, Duality, Logical functions using Karnaugh map and Quine-McClusky methods, multiplexers, demultiplexers, encoders, decoders, adders, subtractors, parity generators, parity checkers, code converters.

Sequential Logic Circuits: Flip-flops, JK flip-flops, D flip-flops, T flip- flops, SR flip- flops, edge triggered and clocked flip-flops. Registers and Counters: Series and Parallel registers; Synchronous & Asynchronous counters, Up and Down counters, Ring counters & Mod- Counters.

Introduction to VHDL: Overview of digital design with very-high-speed integrated circuits (VHSIC) hardware description language (VHDL), HDL format and Syntax, entity, Data representation in VHDL, Truth table using VHDL, Decision Control structure and Sequential Circuit using VHDL.

Digital Logic Families: Introduction, characteristics of digital ICs, resistor-transistor logic, integrated-injection logic, direct-coupled transistor logic, diode-transistor logic & transistor-transistor logic, emitter-coupled logic and MOS logic.

Digital to Analog (D/A) and Analog to Digital (A/D) Converters: Introduction, weighted register *D/A* converter, binary ladder, *D/A* converter, specifications for *D/A* converters, parallel *A/D* converter, successive approximation *A/D* converter single & dual slope *A/D* converter, *AID* converter using voltage to frequency conversion, *A/D* converter using voltage to time conversion, countertype *AID* converters.

Semiconductor Memories: Introduction, memory organization, classification & characteristics of memories, sequential memories, read only memories, read & write memories, content addressable memories, Programmable array Logic, programmable logic arrays and Programmable Logic Device, Field Array Programmable Gate array

Course Outcomes

After the completion of the course the student will be able to:

CO1. Understand the difference between analog and digital systems.
CO2. Learn to design different A/D and D/A converters.
CO3. Know the intricacies to design distinct types of combinational and sequential circuits.
CO4. Learn the concept of semiconductor memories and create digital specific application based working projects.

POWER SYSTEM-I (BTEE-405)

Internal Marks	**40**	**L**	**T**	**P**
External Marks	**60**	**3**	**1**	**0**
Total Marks	**100**			

Course Objectives

1. To understand about transmission line construction and erection.
2. To understand the different types of transmission and distribution systems and their technical and economic comparison.
3. To calculate the transmission line parameters and performance of different types of transmission lines.
4. To understand transmission line compensation.
5. To compare underground and overhead transmission lines and performance of underground cables.

Course Content

Supply System: Introduction to Transmission and Distribution systems, Comparison between DC and AC systems for Transmission and Distribution, comparison of cost of conductors, choice of working voltage for transmission and distribution, economic size of conductors - Kelvin's law, Radial and mesh distribution networks, Voltage regulation.

Conductors and Transmission Line Construction: Conductor materials; solid, stranded, ACSR, hollow and bundle conductors. Different types of supporting structures for overhead lines. Elementary ideas about transmission line construction and erection. Stringing of conductors, spacing, sag and clearance from ground, overhead line insulators, and concept of string efficiency.

Transmission Line Parameters: Introduction to line parameters, Resistance of transmission line, inductance of single phase two wire line, concept of G.M.D., Inductance of three phase line, Use of bundled conductor, transposition of power lines, capacitance of 1-phase and 3-phase lines. Effect of earth on capacitance of conductors.

Performance of Transmission Lines: Representation of short transmission line, medium length line (nominal T & II circuits). Long length line by hyperbolic equations and equivalent T & II circuits. Power flow through transmission lines, ABCD constants, Voltage regulation.

Circle Diagram and Line Compensation: Receiving end circle diagram for long transmission lines based on ABCD constants, equivalent T circuits, power loci, surge impedance loading, reactive power requirement of system series and shunt compensation, Synchronous phase modifiers , rating of phase modifiers.

Underground Cables: Classification of cables based upon voltage and dielectric material, insulation resistance and capacitance of single core cable, dielectric stress, Capacitance of 3 core cables, methods of laying, heating effect, Maximum current carrying capacity, cause of failure, comparison with overhead transmission lines.

Course Outcomes

After the completion of the course the student will be able to:

CO1: Compare different transmission and distribution systems on technical and economical basis.

CO2: Work out mechanical design of transmission and distribution lines and Compute transmission line parameters

CO3: Analyze performance of transmission lines via different techniques.

CO4: Classify and compare underground cables with overhead transmissions lines.

POWER PLANT ENGINEERING (BTEE-406)

Internal Marks	**40**	**L**	**T**	**P**
External Marks	**60**	**3**	**1**	**0**
Total Marks	**100**			

Course Objectives

1. To introduce the concepts and phenomenon of different sources of power generation.
2. To impart the knowledge of different turbines used in the generating stations with the analytical methods.
3. To learn about the different types of power plants supplying base load and peak load.
4. To understand the electrical power generation by combined operation of power plants.
5. To provide knowledge to the students to design and create novel systems of electrical power generation and find solutions for real life problems.

Course Content

Steam Generators, Condensers And Turbines: Classification of steam generators, selection, operation of locomotive, Babcock Wilcox, Cochran boilers, Types of condensers, effect of air in condensers, Dalton's law of partial pressure, cooling water calculations, steam nozzles, types of steam turbine efficiencies, compounding, governing and control.

Steam Power Plant: Classification, Operation, Description of Rankin cycle, Regenerative cycle, Reheat-Regenerative Cycle, Binary Vapour Cycle, Selection of plant site and its layout, coal handling system, combustion system, Fluidised bed combustion, Ash handling, Feed pumps, Heat exchangers, Economizers, Super heaters, Reheaters, Air preheaters, Feed water heaters, Evaporators.

Hydro-Electric Power Plants: Hydrological Cycle, Hydrograph, Flow duration curve, Selection of site, Essential features, Classification of hydro plants, Selection of water turbines for hydro power plant, Automatic and remote control of hydro-station, layout of hydro power plant.

Nuclear Power Plants: Nuclear physics, Binding energy, Radioactive decay. Fertile material, Mass defect, Nuclear reactions type and application, Generation of nuclear energy by fission, Nuclear reactors. Site selections, safety measures, plant layout, Fusion reaction, Future of nuclear power.

Gas Turbine: Elements of gas turbines, Open and closed cycles for gas turbines, Performance terms, Thermal refinement to gas turbines cycle, Plant layout, applications, gas turbines Cycle calculations.

Diesel Power Plants: Classifications of IC Engines and their performance, Four stroke and two stroke diesel engines, combustion phenomenon; Essential components, Celane number, knocking, super charging, operation and layout of diesel power plant.

Combined Operation Of Different Power Plants: Advantages of combined operation of plants, load division between power stations, coordination of different types of Power Plants.

Pollution Control: Pollution from thermal & nuclear plants, Particulate emission and control, electrostatic precipitator, solid waste disposal.

Course Outcomes

After the completion of the course the student will be able to:

CO1: articulate power generation concepts required in engineering problems.

CO2: discuss various sources of power generation with their Merits/Demerits.

CO3: calculate the power generation and represent the power-load curves graphically.

CO4: understand the necessity and importance of combined generation of power plants.

CO5: gain knowledge about environment pollution occurred from power plants and their remedial solution.

Semester-V

SYNCHRONOUS MACHINES (BTEE-501)

Internal Marks	**40**	**L**	**T**	**P**
External Marks	**60**	**4**	**1**	**0**
Total Marks	**100**			

Course Objectives

The objectives of this course are to:

1. Introduce students to the operating principles and Phasor diagrams of synchronous machines
2. Understand the concept of modeling and behavior of synchronous machines
3. To learn the use of power circle diagrams for synchronous motors.
4. To learn the parallel operation of synchronous machines
5. To learn about concepts of regulation methods and starting methods of synchronous machines.

Course Content

General Aspects: Construction and working principle of synchronous machines, Excitation systems, production of sinusoidal electromotive force (EMF), flux and magnetomotive force (MMF) phasors in syn. machines; cylindrical and salient pole rotors.

Windings: Classification of windings, pitch factor, distribution factor. Electromagnetic Force equation.

Alternators: Construction, Phasor diagram of cylindrical rotor alternator, ratings, nature of armature reaction, determination of synchronous reactance; open-circuit characteristics, shortcircuit characteristics, short-circuit ratio, short-circuit loss. Effect of variation of power factor on voltage. Determination of voltage regulation: EMF method, MMF. method. Zero power factor (Z.P.F).method. Alternator on infinite bus bar, operation at constant load and variable excitation, power flow through inductive impedance. Power-angle characteristics of synchronous machines:- cylindrical and salient pole. Two reaction theory of salient pole machines, power factor control.

Synchronous Motors: Operating characteristics, power-angle characteristics, conditions for maximum power developed. V-curves and inverted V-curves, methods of starting, synchronous motors applications, synchronous condensers. Hunting and damper windings.

Parallel Operation Of Alternators: Conditions for proper synchronizing for single phase and three phase alternators, conditions for parallel operation, synchronizing power, current and torque, effect of increasing excitation of one of the alternators, effect of change of speed of one of the alternators, effect of unequal voltages, load sharing.

Transients: Transient reactances and time constants from equivalent circuits, synchronous machine reactances and their determination, Short circuit. Oscillogram, Synchronization with the grid system, Qualitative introduction to the transient stability of the synchronous machines.

Single Phase Synchronous Motors: Reluctance and Hysteresis motors.

Course Outcomes

CO1. Able to learn about the modern excitation systems in alternators to have real and reactive power control.

CO2. Design of windings in the synchronous machines and its emf production

CO3. Outline the basic features of alternators and extensive machines and recognize their utility in power generation.

CO4. Identify the power system problems and their power factor control with synchronous machines.

CO5. Get familiar with various methods used to determine voltage regulation and their applications in the grid stations etc.

CO6. Understand the concept of synchronization of alternators and apply it to Generating stations and power grids.

CO7. Understand the concept of Reluctance and Hysteresis motor and their Applications.

ELECTRIC GENERATION AND ECONOMICS (BTEE-502)

			L	T	P
Internal Marks	**40**				
External Marks	**60**		**4**	**1**	**0**
Total Marks	**100**				

Course Objectives

1. This subject deals with the fundamentals of conventional and non-conventional sources of energy, organization of power sector and economic energy generation.
2. It gives the comprehensive study on power plant economics & load curves.
3. The course deals to provide broad engineering view on scheduling of thermal and hydrothermal power plants
4. The course aims to provide the awareness of cogeneration and reducing pollution simultaneously.

Course Content

Introduction: Electrical energy sources, organization of power sector in India, single line diagram of thermal, hydro and nuclear power stations. Classification of power plants in base load and peak load plants.

Loads and Load curves: Types of load (fixed voltage loads, resistive loads, Inductive motor loads, Mechanical load), effect of load on supply voltage, Maximum demand, Group diversity factor, Peak diversity factor, Types of load, chronological load curves, load-duration Curve, mass curves, load factor, capacity factor, utilization factor, base load and peak load plants, load forecasting.
Power Plant Economics: Capital cost of plants, annual fixed cost, operating costs and effect of load factor on cost of energy, depreciation.

Tariffs and power factor improvement: Objectives of tariff making, different types of tariff (domestic, commercial, agricultural and industrial loads). Need for power factor (p.f.) improvement, power factor improvement using capacitors, determination of economic power factor.
Selection of plant: Plant location, plant size, number and size of units in plants, economic comparison of alternatives based on annual cost, rate of return, present worth and capitalized cost methods.

Economic operation of steam plants: Methods of loading turbo-generators, input- output curve, heat rate, incremental cost, method of Lagrangian multiplier, effect of transmission losses, co-ordination equations, and iterative procedure to solve co-ordination equations.

Hydro-thermal co-ordination: Advantages of combined working of Run-off River plant and steam plant, reservoir hydro plants and thermal plants, long-term operational aspects, scheduling methods.

Pollution and environmental problems: Energy and environment, Air pollution, Aquatic impacts, nuclear plant and hydro plant impacts.

Cogeneration: Definition and scope, Topping and Bottoming Cycles, Benefits, cogeneration technologies.

Course Outcomes

After the completion of the course the student will be able to:

CO1. know the performance of different energy sources and organization of power sector.

CO2. to make use of load curves and related factors for determining power generation and selection of plants.

CO3. carry out the economic analysis of electrical energy generation for different power plants.

CO4. aware of different tariff plans with need and methods to improve power factor.

CO5. to demonstrate the engineering issues in scheduling of thermal and combined hydro & thermal power plants, cogeneration plants along with their environmental aspects.

MICROPROCESSORS (BTEE-503)

Internal Marks	**40**	**L**	**T**	**P**
External Marks	**60**	**4**	**1**	**0**
Total Marks	**100**			

Course Objectives

1. To provide a solid foundation of concepts of assembly language programs and peripheral interfacing.
2. This course provides knowledge to design various microprocessor based systems like Microprocessor Controlled Temperature Systems (MCTS), Traffic Light Systems, and Stepper Motor Control etc.
3. The course aims to acquaint beginners to basic architectures of advanced processors like 8086, Motorola 68000, and Pentium Processors.

Course Content

Introduction to Microprocessors: Types of computers, Microprocessor evolution and types, Central Processing Unit (CPU) operation and terminology, idea of 8- bit, 16-bit, 32-bit and 64- bit Microprocessors from Intel, Motorola and Zilog and their comparisons.
Introduction to 8-bit Microprocessor: 8085 Microprocessor architecture, classification of instructions, Instruction format, and overview of the 8085 instruction set.

Introduction to 16-bit Microprocessor: 8086 Internal Architecture, Addressing modes, program development steps, 8086 instruction set, Assembler directives, Assembly language, program development tools.

Programming of 8086: Simple sequence programs, jumps, flags, conditional Jumps, IF-THEN, IF-THEN-ELSE, Multiple IF-THEN-ELSE, WHILE-DO, REPEAT-UNTIL, Instruction Timing and delay loops, strings, procedures, Macros. 8086 System Connections, Timing, Troubleshooting: Pin-diagram, maximum/minimum. modes, timing diagrams, use of logic analyzer to observe Bus signals, troubleshooting a simple 8086 based system

8086 Interrupts and Applications: 8086 Interrupts, responses and applications, 8254 software programmable timer/counter, 8259 a priority.

Interrupt Controller Interfacing of 8086: Programmable parallel ports and handshake, Interfacing a Microprocessor to Keyboards and alphanumeric displays, Digital to Analog (D/A) converter operation, interfacing and applications, Analog-to Digital (A/D) converter specifications and Interfacing

Course Outcomes

CO1. After studying this course, the students will be able to know the internal architecture of 8085 microprocessor and other advanced microprocessors.

CO2. Students will be able to write programs in Assembly Language programming will have knowledge about interfacing of hardware devices to the microprocessors.

CO3. Students will be able to design and implement small projects; like, microprocessor based temperature control system, car parking system, and other sensor and transducer based projects.

POWER ELECTRONICS (BTEE-504)

Internal Marks	**40**	**L**	**T**	**P**	
External Marks	**60**		**4**	**1**	**0**
Total Marks	**100**				

Course Objectives

1. To Learn the Static and Dynamic characteristics of Power Semiconductor Devices and SCR.
2. Ability to analyze various single phase and three phase *power* converter circuits and understand their
   applications.
3. Demonstrate the ability to design electrical and electronic circuit.
4. To provide an overview of choppers, cycloconverters and inverters.

Course Content

Thyristors And Their Characteristics: Introduction to Thyristor family, V-I characteristics of silicon-controlled rectifier (SCR), gate turn-off thyristor (GTO), Bidirectional diode for alternating current (DIAC) and Bidirectional, Triode for Alternating Current (TRIAC). Principle of operation of silicon-controlled rectifier (SCR). Two transistor analogy. Turn on methods of a thyristor Switching characteristics of thyristors during tum-on and turn-off. Gate characteristics. Firing of thyristors. Gate triggering circuits. Series and parallel operation of silicon-controlled rectifiers (SCR) and their triggering circuits. Thyristor specifications; such as latching current and holding current, critical rate of rise of off-state voltage (dv/dt) and critical rate of rise of on-state current (di/dt) etc. Protection of SCR from over voltage and over current. Snubber circuits. Power dissipation.

Thyristor Commutation Techniques: Self commutation by resonating the load (Class A), Self commutation by LC circuit (class B), Complementary commutation (class C), Auxiliary commutation (class D), External pulse commutation (class E), AC Line commutation (class F).

Phase Controlled Techniques: Introduction to phase angle control. Single phase half wave controlled rectifiers. Single phase half controlled and full controlled bridge rectifiers. Three phase full controlled bridge rectifiers. Effect of resistive, inductive and resistive cum inductive loads. Basic circuit and principle of operation of Dual Converter, circulating current mode and non-circulating current mode of operation. Applications of rectifiers and dual converters to speed control of DC motor drives.

Choppers: Introduction of chopper, Basic chopper classification, Basic chopper operations. Control strategies, Chopper configuration, voltage commutated chopper, Current commutated chopper, Load commutated chopper.

Cycloconverters: Basic principle of operation, Single phase to. single phase cycloconverter. Three phase half wave cycloconverter. Advantages disadvantages of cycloconverters.

Inverters: Introduction & Classification of inverter. Operating principle, Single phase half bridge voltage source inverters, Single phase full bridge inverter. Modified McMurray half-bridge and full-bridge inverter. Three-phase bridge inverter. Voltage control (Pulse-width modulation (PWM) control etc.) and reduction of harmonics in the inverter output voltage. Series inverter.

Symbols And V-I Characteristics of Silicon Unilateral Switch (SUS), Silicon Controlled Switch (SCS), Silicon Bilateral Switch (SBS), Unijunction Transistor (UJT), Programmable Unijunction Transistor (PUT), Light-activated silicon-controlled rectifier (LASCR), Reverse conducting

Thyristors (RCT), Static Induction Thyristor (SITH), N- Metal Oxide Semiconductor Controlled Thyristor (N-MCT), Field Controlled Thyristors (FCT).

Course Outcomes

After the completion of the course the student will be able to:

CO1. Understand the implementation of power switches graphically and mathematically.

CO2. Learn the turn on and turn off switching characteristics.

CO3. Comprehend the concepts of power conversion.

CO4. Recognize fundamental principles of controlled power converters.

CO5. Know the importance of cycloconverters, choppers and Inverters

NUMERICAL AND STATISTICAL METHODS (BTEE-505)

			L	T	P
Internal Marks	**40**				
External Marks	**60**		**4**	**1**	**0**
Total Marks	**100**				

Course Objectives

1. This course aims at providing the in depth knowledge of floating point numbers and non linear equations.
2. The course will make familiarize with different methods of Linear systems and Eigen values applicable to electrical power systems.
3. The course will help to solve complex numerical problems with suitable techniques.

Course Content

Floating-Point Numbers: Floating-point representation, Rounding, Chopping, Error analysis, Condition and instability.

Non-Linear Equations: Bisection, Fixed-point iteration and Newton-Raphson methods, Order of convergence.

Linear Systems and Eigen-Values: Gauss-elimination method (using Pivoting strategies) and Gauss-Seidel Iteration method. Rayleigh's power method for Eigen-values and Eigen-vectors

Interpolation: Lagrange's formula with error, divided difference, Newton's divided difference formula

Numerical Integration: Newton-Cote's quadrature formula (with error) and Gauss-Legendre quadrature formula.

Differential Equations: Solution of initial value problem using Taylor Series, Euler's and Runge-Kutta (up to fourth order) methods Statistical Methods

Random Variables: Definition, Probability distribution, Distribution functions, probability distribution function (pdf) and cumulative distribution function (cdf), Expectation and Variance.

Special Probability Distributions: Binomial, Poisson, Geometric, Uniform, Normal and Exponential distributions.

Sampling Distributions: Population and samples, Concept of sampling distributions, Sampling distribution of mean, Chi-square, t and F distributions (pdf only). Tests of Hypotheses: Basic ideas, Important tests based on normal, Chi-square, t and F distribution.

Curve Fitting: Method of least squares, Fitting of simple curves using this method, Regression and Correlation: (Two variables case only).

Course Outcomes

After the completion of the course the student will be able to:

CO1. Apply the knowledge of floating point numbers and non linear equations.

CO2. Learn about various methods of linear systems and eigen values applicable to electrical power systems.

CO3. Recognize and apply random variables to power system network.

CO4. Understand special probability distribution, sampling distribution and least square curve fittings.

Semester-VI

ELECTRIC POWER UTILIZATION (BTEE-601)

Internal Marks	**40**	**L**	**T**	**P**
External Marks	**60**	**3**	**1**	**0**
Total Marks	**100**			

Course Objectives

1. This subject gives a comprehensive idea in utilization of electrical power such as

- Drives,
- electric heating,
- Electric welding
- illumination,
- electric traction,
- electrolysis, refrigeration air conditioning

Course Content

Electric Drives: Electrical drives & Mechanical drives, Concept of electrical drives, Basic features of industrial drives, review of operating and starting characteristics of different types of electric motors for various drives (AC and DC motors). Estimation of rating and heating of motors, Load equalization (Fly wheel effect), Drives for particular services.

Electric Traction: Introduction to Indian railways system , Electric Locomotive Classes, Various types of Traction system, single phase feeding arrangement prevalent in India. Substation. arrangements, Different Types of Catenary construction and line insulation, Span and dropper design Calculations.

Electric Heating and Welding: Methods of electric heating, types of electric heating, constructional details and performance of resistance heating furnace. Dielectric heating, Alternating current (AC).and Direct current (DC) Welding, Resistance and Arc Welding. Electric Beam Welding, Laser Welding. Typical construction of electrical welding AC and DC set.

Illumination: Production of light by different methods, terms used, laws of illumination, Different Artificial light sources, their construction and operating principles, Design of lighting schemes and equipment used for indoor, industrial and flood lighting.

Refrigeration and Air conditioning: Refrigeration system, Domestic refrigeration, Air conditioner, Comfort Air conditioning, Effective temperature.

Electrolysis: Laws of Electrolysis, Process voltage, current, energy, efficiency, Applications of electrolysis..

Course Outcomes

After the completion of the course the student will be able to:

CO1. maintain electric drives used in an industries

CO2. identify a heating/ welding scheme for a given application

CO3. maintain/ Trouble shoot various lamps and fittings in use

CO4. figure-out the different schemes of traction schemes and its main components

CO5. design a suitable scheme of speed control for the traction systems

CO6. identify the job/higher education / research opportunities in Electric Utilization industry.

POWER SYSTEM-II (SWITCH GEAR AND PROTECTION) : BTEE-602

		L	T	P
Internal Marks	**40**			
External Marks	**60**		**3**	**1**	**0**
Total Marks	**100**			

Course Objectives

1. To introduce students to power system protection and switchgear.
2. To teach students theory and applications of the main components used in power system protection for electric machines, transformers, bus bars, overhead and underground feeders.
3. To teach students the theory, construction, applications of main types Circuit breakers,
4. Relays for protection of generators, transformers and protection of feeders from over- voltages and other hazards. It emphasis on neutral grounding for overall protection.
5. To develop an ability and skill to design the feasible protection systems needed for each
6. main part of a power system in students.

Course Content

Sub-Station: Types, Main equipment in Substation, substation layout, Busbar-arrangements.

Isolators and Fuses: Isolating switches functions, Types, Rating and operation. Fuse-types, Rating, Selection, theory and characteristics, applications.

Circuit Breakers: Need for Circuit Breakers, Arc phenomenon, Theory of Arc Interruption, Recovery Voltage and Restriking Voltage, Various Types of Circuit Breakers. Principles and Constructional Details of Air Blast, Minimum Oil, SF6, Vacuum Circuit Breakers etc.

Protective Relays: Introduction, classification, constructional features; and Characteristics of Electromagnetic, Induction, Thermal, Overcurrent relays, Directional relays, Distance relays, Differential, Translay, Negative sequence relay, introduction to static and up-based relays.

Protection of Feeders: Time graded protection, Differential and Distance protection of feeders, choice between Impedance, Reactance and Mho relays, Elementary idea about carrier current protection of lines.

Protection of Generators and Transformers: Types of faults on alternator, Stator and rotor protection, Negative sequence protection, Loss of excitation and overload protection. Types of fault on transformers, percentage differential protection, Gas relays.

Protection against over voltage and Earthing: Ground wires, Rod gap, Impulse gap, Valve type and Metal Oxide Arresters, Line Arrester/Surge Absorber. Ungrounded neutral system, Grounded neutral system and Selection of Neutral Grounding.

Course Outcomes

After the completion of the course the student will

CO1. gain knowledge on different Protective Equipments or Power Systems

CO2. Know about various protective systems- how it works and where it works?

CO3. Learn the applications of relays, circuit breakers, grounding for different elements of power system are also discussed in the subject.

CO4. Be Able to discuss recovery and Restriking.

CO5. be able to express Oil circuit Breaker, Air Blast circuit Breakers, SF6 Circuit Breaker.

CO6. Able to identify Rotor, Stator Faults, inter turn faults and their protection.

NON-LINEAR AND DIGITAL CONTROL SYSTEMS (BTEE-603)

Internal Marks	**40**	**L**	**T**	**P**
External Marks	**60**	**4**	**1**	**0**
Total Marks	**100**			

Course Objectives:

1. To understand the concept of state and to be able to represent a system in the state space format and to solve the state equation and familiarize with STM and its properties.
2. To familiarize with various nonlinearities and their behaviour observed in physical system and to understand the Describing function method and phase plane method.
3. To understand the basic digital control scheme, the concept of sampling and reconstruction

Course Content

State Variable Techniques: State variable representation of systems by various methods, solution of state variable model. Controllability and observability.

Phase Plane Analysis: Singular points, Method of isoclines, delta method, phase portrait of second order nonlinear systems, limit cycle.

Describing Function Analysis: Definition, limitations, use of describing function for stability analysis, describing function of ideal relay, relay with hystersis, dead zone, saturation, coulomb friction and backlash.

Lyapunov's Stability Method: Lyapunov's direct method, generation of Lyapunov's function by Krasovskii's and Variable Gradient methods

Sampled Data Systems: Sampling process, mathematical analysis of sampling process, application of Laplace transform. Reconstruction of sampled signal, zero order, first order hold. Z- transform definition, evaluation of Z-transform, inverse Z-transform, pulse transfer function, limitations of Z-transform, State variable formulation of discrete time systems, solution of discrete time state equations. Stability definition, Jury's test of stability, extension of Routh-Hurwitz criterion to discrete time systems.

Course Outcomes

After the completion of the course the student will be able to:

CO1. Represent a physical system in state space format and analyze the same and to realize a controller using state space technique.

CO2. Compensate for saturation (anti-windup), friction, back-lash and quantization with the indepth knowledge about stability using describing function analysis.

CO3. Solve simpler control design problems using Lyapunov design methods and feedback linearization.

CO4. Evaluate programming strategies in the domain of control systems.

CO5. Design modern control systems with computer simulation.

MICROCONTROLLER AND PLC (BTEE-604)

Internal Marks	**40**	**L**	**T**	**P**
External Marks	**60**	**3**	**1**	**0**
Total Marks	**100**			

Course Objectives

1.To be familiar with the architecture, working and features of 8051 microcontroller.
2.To be able to write assembly language programs for typical problems.
3.To understand the importance of interfacing circuits and their design.
4.To provide Knowledge levels needed for PLC operation.

Course Content

Introduction: Microprocessor, Micro-controllers and their comparison. The 8051 Architecture: Introduction, 8051 micro-controller hardware, input/ output, pins, ports and circuits, external memory, counters and timers, serial data input/ output, interrupts

8051 Assembly Language Programming: The mechanics of programming, assembly language programming process, programming tools and techniques, instruction set (data moving, logical operations, arithmetic operations, jump and call instructions)

8051 Microcontroller Design: Micro-controller specification, external memory and memory space decoding, reset and clock circuits, expanding input and output (I/O), memory mapped I/O, memory address decoding, memory access times, testing the design, timing subroutines, lookup tables for the 8051, serial data transmission

Microcontroller Applications: Interfacing keyboards, displays, Digital-to-Analog (D/A) and Analog-to-Digital (A/D), multiple interrupts, serial data communications, introduction to the use of assemblers and simulators Embedded Systems: Introduction to PLDs and FPGA- architecture, technology and design issues, implementation of 8051 core.

Programmable Logic Controllers (PLC): Introduction, operation of PLC, difference between PLC and Hardwired system, difference between PLC and Computer, relay logic and ladder logic, ladder commands and examples of PLC ladder diagram realization, PLC timers, PLC counters, PLC classification.

Course outcomes

After the completion of course, the

CO1. Students will be able to understand the detailed architecture, working and features of 8051 microcontroller.

CO2. Students will be able to apply the knowledge of addressing modes and instruction set for writing assembly language programs for problem solving.

CO3. Students will be able to demonstrate the interfacing of various peripheral devices to microcontroller and design of interfacing systems.

CO4. Students will be able to gain detailed knowledge on PLC and its working

INSTRUMENTATION IN POWER SYSTEM (BTEE-605C)

Internal Marks	**40**	**L**	**T**	**P**
External Marks	**60**	**3**	**1**	**0**
Total Marks	**100**			

Course Objectives

1. To introduce different methods for measurement of electrical quantities, power in power plants and instrument transformers
2. To elucidate basic instrumentation techniques used in power plants
3. To discuss the SCADA System and its implementation
4. To explicate the instrumentation used for different power plants
5. To introduce the different signal transmission techniques used in power plants
6. To describe the different telemetry methods and systems.

Course Content

Introduction: Measurement of electrical quantities, Active and reactive power in power plants, Energy meters, Instrument transformers and their transient response.

Instrumentation Techniques: Telemetry, Remote Control, remote signaling and supervisory control and data acquisition (SCADA), signal formation, conversion and transmission.

Signal Transmission Techniques: Analog pulse and digital modulation, Amplitude modulation(AM) and Frequency modulation (FM), AM and FM Transmitter and Receiver, Phase Modulation, Pulse modulation, Digital transmission techniques, error detection and correction.

Telemetry: Telemetry errors, DC, pulse and digital telemetry methods and systems.

Supervisory Control and Data Acquisition: Function of SCADA system remote terminal unit (RTU) details, Control center details, Communication between control centers, control center and remote terminal unit.

Power Plant Instrumentation: Hydroelectric power plant instrumentation, Thermal power plant instrumentation, Nuclear Power plant Instrumentation. Applications of SCADA system to Indian Power Systems.

Course Outcomes

After the completion the students will be able to:

CO1. Know the techniques used for measuring different electrical quantities, characteristics and applications of instrument transformers and powers and its importance in power systems.

CO2. Used instrumentation techniques in power plants like telemetry, SCADA, remote signals, signal formation and conversion.

CO3. Gain knowledge about different signal transmission techniques like multiplexing techniques, modulation techniques and their use in power plants.

CO4. Know about the different functional elements of SCADA system and its implementation in power plant.

CO5. To have knowledge about different instruments used in different power plants like thermal, hydro and nuclear.

BIOMEDICAL INSTRUMENTATION (BTEE-605D)

Internal Marks	**40**	**L**	**T**	**P**
External Marks	**60**	**3**	**1**	**0**
Total Marks	**100**			

Course Objectives

The objective of this course is to:-

1. Explore students to the fundamentals of bioelectric phenomena and neural stimulation.
2. Understand the physical principles that govern the measurement of human physiological system.
3. Learn the quantitative measurement of biomedical instruments used for medical procedures.

Course Content

Transducers: Strain gauge for respiratory flow transducer, piezo resistive transducer for intracardiac catheter, thermistor as temperature sensing elements - its characteristics and compensation for non-linearity.

Piezoelectric transducer: its equivalent circuits and impedance frequency characteristics. Its applications as intra cardiac microphone, heart assist device and ultrasonic instruments. Variable inductance transducer, different configuration and application for measurement of muscular tremor. linear variable differential transformer (LVDT) and its signal processing circuitry. Magnetostrictive and variable capacitance transducers, stretched diaphragm transducer and its characteristics.

Measurement and recording of bioelectric signals: electrocardiogram (ECG), electromyogram (EMG), electroencephalogram (EEG) and instruments for picking up and reproducing bioelectric signals, specific design characteristics, sources of noise and its removal.

Measurement and recording of non-electric signal: Measurement and recording of pressure, temperature, respiration rate, pulse rate and blood flow. Electromagnetic blood flow meter, thermography, pH measurements, gas analysis, ESR (erythrocyte sedimentation rate) measurement, plethysmograph, X-Ray, tonometer and dialysis. Ultrasonics and echoencephalography radiography imaging isotopes and nuclear medicine.

Equipment for effecting the human body: Stimulator, defibrillator, pacemaker, diathermy.
Prosthetics: Upper and lower extremity prostheses, harness control, EMG-controlled externally powered prosthesis, basic concept of monofunctional and multifunctional devices.

Biotelemetry: Radio-telemetry of biological signal, signal source, antenna and frequency design considerations, example of single channel FM units.

Course Outcomes

After the completion of the course the student will be able to:-

CO1. Evaluate and describe the physical and biomedical principles used as a basis for biomedical instrumentation.

CO2. Calibrate the measuring and recording instruments of human physiological systems

CO3. Develop and apply electrical engineering concepts and principles to a range of problems in biomedical applications.

COMPUTER AIDED MACHINE DESIGN (BTEE-605A)

Internal Marks	**40**	**L**	**T**	**P**
External Marks	**60**	**3**	**1**	**0**
Total Marks	**100**			

Course Objectives

1. Students will gain Technical Knowledge of electrical machines.
2. Students will be able to solve problems related to designing of electric machines.
3. Student will generate an attitude of research oriented continuous learning about electrical machines.

Course Content

Review of Magnetic and insulating materials.

Principles of design of Machines: Factors and limitations in design, specific magnetic and electric loadings, output, real and apparent flux densities, separation of main dimensions for D.C., induction and synchronous machines.

Heating, Cooling and Ventilation: Temperature rise calculation, continuous, short time and intermittent ratings, types of ventilation, hydrogen cooling and its advantages.

Design of Transformers: General considerations, output equation, main dimensions, leakage reactance, winding design, tank and cooling tubes, calculation of magnetizing current, losses, efficiency and regulation.

Design Three-phase induction motors: General considerations, output equation, choice of specific electric and magnetic loadings, No. of slots in stator and rotor, elimination of harmonic torques, design of stator and rotor windings, leakage reactance, equivalent resistance of squirrel cage rotor, magnetizing current, temperature rise and efficiency. Introduction to computer aided electrical machine design.

Course Outcomes

After the completion of the course the student will be able to :

CO1. Apply formula's to solve the problems related to designing of electric machines.

CO2. Apply skills for analysis, operation & control of electric machines.

CO3. Design transformers and electric motors for different applications.

Semester-VII

POWER SYSTEM ANALYSIS (BTEE-801)

Internal Marks	**40**	**L**	**T**	**P**
External Marks	**60**	**3**	**1**	**0**
Total Marks	**100**			

Course Objectives

1. To make the students familiar with the types of per unit system, modeling of various components of power system such as synchronous machines, transformers, loads etc.
2. The course aims to provide in-depth knowledge related load flow studies in a power system.
3. To develop an understanding about various types of fault analysis methods in a power system.
4. To provide understanding about power system stability study.

Course Content

System Modelling: System modelling of synchronous machines, transformers, loads etc, per unit system, single line diagram of electrical networks, single phase impedance diagrams. Formulation of impedance and admittance matrices for the electrical networks.

Load Flow Studies: Data for the load flow studies, Swing Bus, Formulation of simultaneous equations, Iterative solutions by the Gauss-Seidal method and Newton Raphson Method.

Fault Analysis: Transients on transmission line, short circuit of synchronous machine, selection of circuit breakers, Algorithm for short circuit studies, Symmetrical Component transformation, construction of sequence networks of power systems. Symmetrical Analysis of Unsymmetrical Line-to-ground (LG), Line-to line (LL), double line to ground (LLG) faults using symmetrical components.

Power System Stability: Steady state stability, Dynamics of a synchronous machine , Power angle equations , Transient stability, equal area criterion, Numerical solution of swing equation , factors effecting transient stability.

Course Outcomes

After the completion of the course the student will be able to:

CO1. Exhibit single phase impedance diagrams corresponding to single line diagram.

CO2. Have complete knowledge about modeling used for particular applications.

CO3. Find the iterative solutions by the Gauss-Seidal Method & by Newton Ralphson Method.

CO4. Predict the Symmetrical Component transformation and various faults.

CO5. Interpret the numerical solution of swing equation.

HIGH VOLTAGE ENGINEERING (BTEE-802)

Internal Marks	**40**	**L**	**T**	**P**
External Marks	**60**	**3**	**1**	**0**
Total Marks	**100**			

Course Objectives

1. This course aims to expose the students to the various effects of EHV &HV transmission systems.
2. It gives the comprehensive study on applications of insulating materials.
3. Gain the knowledge of conduction and breakdown in solids, liquids and gases.
4. To get familiar with the generation and measurement of high voltages.

Course Content

Extra High Voltage (EHV) Transmission and Corona Loss: Need for EHV Transmission. Use of bundled conductors, corona characteristics of smooth bundled conductors with different configurations, Corona loss. Factors affecting the corona loss. Radio interference due to corona. Shunt and series compensation in EHV lines. Tuned power lines. Insulation Co-ordination.

High Voltage Direct Current (HVDC) Transmission: Advantages, disadvantages and economics of HVDC Transmission system. Types of Direct Current (DC) links, converter station equipment, their characteristics.

Insulating materials for High Voltage Applications of insulating materials used in power transformers rotating machines, circuit breakers, cables, power capacitors.

Conduction and breakdown in Gases, Liquids and Solid Dielectrics: Solids - Intrinsic, electromechanical and thermal breakdown composite dielectrics, solid dielectrics used in practice. **Liquids:-** Conduction and breakdown in pure and commercial liquids, suspended particle theory, cavitation and bubble theory, stressed oil volume theory, Liquids used in practice. **Gases:-** Ionization process, Townsend's current growth equations, Ist and 2nd ionization coefficients. Townsend's criterion for breakdown. Streamer theory of breakdown, Pashen's law of Gases. Gases used in practice.

Generation of High Voltages: High Voltage Direct Current (HVDC), High Voltage Alternating Current (HVAC), Power frequency and High frequency: Impulse voltage and impulse current Generation, Tripping and contact of Impulse Generator. Measurement of voltage and current: High voltage direct current, Alternating current and Impulse voltage and currents.

Course Outcomes

CO1. Acquire and apply knowledge of mathematicsand electromagnetic fields in Electrical Engineering.

CO2. Design EHV and HV transmission system with better performance.

CO3. Comprehend conduction and breakdown of gases, liquids and solid dielectrics.

CO4. Optimally design insulation scheme for power apparatus.

CO5. Formulate, design, simulate, generate and measure high voltages and current in high voltage laboratory.

NON CONVENTIONAL ENERGY SOURCES (BTEE-803)

Internal Marks	**40**	**L**	**T**	**P**
External Marks	**60**	**3**	**1**	**0**
Total Marks	**100**			

Course Objectives

1. To understand and analyze the present and future energy demand of world and nation and techniques to exploit the available renewable energy resources such as solar, bio-fuels, wind, power, tidal and geothermal effectively.
2. To study various types of conventional and non-conventional energy resources including solid, liquid and gaseous fuels.
3. To provide knowledge, understanding and application oriented skills on all renewable energy sources and relevant technologies towards their effective utilization for meeting energy demand.

Course Content

Introduction: Limitation of conventional energy sources, need and growth of alternative energy source, basic scheme and application of direct energy conservation.

Mhd Generators: Basic principles, gaseous, conduction and hall effect, generator and motor effect, different types of Magneto-Hydro-Dynamic (MHD) generator, types of MHD material, conversion effectiveness, analysis of constant area MHD generator, practical MHD generator, application and economic aspects.

Thermo-Electric Generators: Thermoelectric effects, Seeback effect, Peltier effect, Thomson effect, thermoelectric converters, figures of merit, properties of thermoelectric material, brief description of the construction of thermoelectric generators, application and economic aspect.

Photovoltaic Effect And Solar Energy: Photovoltaic effect, different types of photovoltaic cells, cell fabrication, characteristics of photovoltaic cells, conversion efficiency, solar batteries, application, solar radiation analysis, solar energy in India, solar collectors, solar furnaces and applications.

Fuel Cells: Principle of action, Gibb's free energy, general description of fuel cells, types, construction, operational characteristics and application.

Miscellaneous Sources: Geothermal system, hydro-electric plants, wind power, tidal energy, Bio-mass energy.

Course Outcomes

CO1. The student shall have understanding of energy demand of the world, nation and available resources and also fulfill the demand.

CO2. The student shall have the knowledge about the exploration of non conventional energy resources and their effective tapping technologies.

CO3. Students would be able to implement practically-effective utilization of available renewable energy resources.

CO4. The students will learn about modern energy conversion technologies.

ENERGY AUDITING AND MANAGEMENT (BTEE-804B)

Internal Marks	**40**	**L**	**T**	**P**
External Marks	**60**	**3**	**1**	**0**
Total Marks	**100**			

Course Objectives

1.Be able to complete detailed study of Energy Audit.
2.Be able to complete detailed study of Energy Management.
3.Be able to understand the correlation between Energy Audit and Energy Management.

Course Content

Energy Scenario: Energy needs of growing economy, Long term energy scenario, Energy pricing, Energy sector reforms, Energy and environment: Air pollution, Climate change, Energy security, Energy conservation and its importance, Energy strategy for the future, Energy conservation Act- 2001 and its features.

Energy Management and Audit: Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution, Energy audit instruments

Material and Energy balance: Facility as an energy system, Methods for preparing process flow, Material and energy balance diagrams.

Financial Management: Investment-need, Appraisal and criteria, Financial analysis techniques- Simple payback period, Return on investment, Net present value, Internal rate of return, Cash flows, Risk and sensitivity analysis, Financing options, Energy performance contracts and role of energy savings companies (ESCOs).

Electrical system: Electricity tariff, Load management and maximum demand control, Power factor improvement, Distribution and transformer losses. Losses in induction motors, Motor efficiency, Factors affecting motor performance, Rewinding and motor replacement issues, energy efficient motors. Light source, Choice of lighting, Luminance requirements, and Energy conservation avenues

Compressed air system: Types of air compressors, Compressor efficiency, efficient compressor operation, Compressed air system components, Capacity assessment, Leakage test Factors affecting the performance and efficiency

High Voltage Alternating Current and Refrigeration System: Vapor compression refrigeration cycle, Refrigerants, Coefficient of performance, Capacity, Factors affecting refrigeration and air conditioning system performance and savings opportunities, Vapor absorption refrigeration system: Working principle, Types and comparison with vapor compression system, Saving potential, Fans, Blowers and pumps- Types, Performance evaluation, Efficient system operation, Flow control strategies and energy conservation opportunities.

Course Outcomes

CO1. Learn how to do the Energy audit of an area.

CO2. Become adept at using various analyses, including simplified diagrams of energy audit.

CO3. Develop the capability to analyze the energy management.

ENERGY EFFICIENT MACHINES (BTEE-805D)

Internal Marks	**40**	**L**	**T**	**P**
External Marks	**60**	**3**	**1**	**0**
Total Marks	**100**			

Course Objectives

1. This course aims to expose the students to the Energy audit and energy management systems.
2. To get familiar with various parameters of Induction motors and drives for energy management studies.
3. The course aims to acquaint beginners to various energy efficient machines, drives and effect of power factor on energy efficiency of the system.

Course Content

Introduction: Need for energy efficient machines, energy cost and two part tariff, energy conservation in industries and farms -a necessity, introduction to energy management and energy audit system. Review of induction motor characteristics.

Energy Efficient Motors: Standard motor efficiency, why more efficient motors? An energy efficient motor, efficiency determination methods, Direct Measurement method, Loss segregation method, Comparison, motor efficiency labeling, energy efficient motor standards. Motor life cycle

Power Factor: The power factor in sinusoidal systems, power factor improvement, power factor with nonlinear loads, Harmonics and the power factor

Induction Motors And Adjustable Drive Systems: Energy Conservation, adjustable speed systems, Application of adjustable speed systems to fans, pumps and constant torque loads.

Course Outcomes

A student who has met the objectives of the course will be able to:

CO1. Formulate and evaluate the energy management/ energy audit schemes for industries and farms sector.

CO2. Ascertain the use of standard motors vs energy efficient motors according to load characteristics for improving the system efficiency.

CO3. Analyze and compare different methods of efficiency determination of Induction motors.

CO4. Determine power factor in linear and non linear environment, its effect on system efficiency and power factor improvement techniques.

CO5. Select and implement Variable Speed Drives for energy conservation.

HVDC TRANSMISSION (BTEE-805B)

Internal Marks	**40**	**L**	**T**	**P**
External Marks	**60**	**3**	**1**	**0**
Total Marks	**100**			

Course Objectives

1. To be able to understand the concepts of Converter systems and to apply them for power conversion.
2. To understand the practical implementation of concepts in Electrical Engineering for power quality improvement, cost minimization with increased efficiency.
3. To deal with power conversion between Ac to DC and DC to AC.
4. To deal with firing angle, Reactive power control and protection of HVDC System.

Course Content

Direct Current (DC) power transmission technology: Introduction, comparison of Alternating Current (AC) and Direct Current (DC) transmission, application of DC transmission, application of DC transmission, description of DC transmission system, Configurations, planning for High Voltage Direct Current (HVDC) transmission, modern trends in DC transmission. Introduction to Device: Thyristor valve, valve tests, recent trends.

Analysis of High Voltage Direct Current (HVDC) converters: Pulse number, choice of converter configuration, simplified analysis of Graetz circuit, converter bridge characteristics, characteristics of a twelve-pulse converter, detailed analysis of converters with and without overlap.

Converter and HVDC system control: General, principles of DC link control, converter control characteristics, system control hierarchy, firing angle control, current and extinction angle control, starting and stopping of DC link, power control, higher level controllers, telecommunication requirements.

Converter faults and protection: Introduction, converter faults, protection against over-currents, over-voltages in a converter station, surge arresters, protection against over-voltages.

Smoothing reactor and DC line: Introduction, smoothing reactors, DC line, transient over voltages in DC line, protection of DC line, DC breakers, Monopolar operation, effects of proximity of AC and DC transmission lines.

Component models for the analysis of AC/DC systems: General, converter model, converter control, modeling of DC network, modeling of AC networks.

Course Outcomes

After the completion of the course,

CO1. Students have greater awareness regarding the potential of DC transmission from the point of view of interactions with AC systems.

CO2. Students will be able to investigate the design stage of HVDC controllers, their principle, their characterstics and controlling techniques.

CO3. Students will acquire knowledge in HVDC systems faults and protection.

CO4. Students will be able to understand the solutions incorporated to overcome the adverse effects of transient overvoltages and concept of DC breakers.

CO5. Students will be able to use modeling skills of converter, DC and AC networks for the full realization of potential benefits of HVDC transmission.

PROJECT WORK (BTEE-807)

		L	T	P
Internal Marks	**60**			
External Marks	**40**	**0**	**0**	**6**
Total Marks	**100**			

Design, Fabrication, Simulation, Evaluation, Testing etc. related to Electrical Engineering is to be carried out under the supervision of guide(s).

SEMINAR (BTEE-808)

Internal Marks	**100**	**L**	**T**	**P**
External Marks	**0**	**0**	**0**	**2**
Total Marks	**100**			

Students will be required to prepare a report on a given topic related to latest developments in electrical engineering and deliver a seminar on that topic along with seminar report.

Semester-VIII

SOFTWARE TRAINING (BTEE-701)

Internal Marks	**150**	**L**	**T**	**P**
External Marks	**100**	**0**	**0**	**2**
Total Marks	**200**			

Students will be provided training on any of three of the programming language/ application softwares. All the applications shall be related to the Electrical components and systems.

- Any high level procedure oriented or object oriented programming language. Such language should be covered under regular or elective subject(s).
- MatLab
- LabView
- PSpice
- PSCAD

Students will undertake one project related to the Electrical components and systems based on the software training imparted during the semester in a group of three students. The entire group will select different projects. Students will be required to prepare a report on the Project undertaken and deliver a seminar on the project undertaken. The students will be evaluated based on Project undertaken, project report, seminar and viva-voce examination.