DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY LONERE.

ELECTRICAL ENGINEERING DEPARTMENT

Second Year B. Tech. Electrical Engineering / Electrical Engineering (Electronics and Power)/ Electrical & Electronics Engg / Electrical & Power Engineering

With effect from November 2018

Teaching & Evaluation scheme of second year B. Tech. Electrical Engineering / Electrical Engineering (Electronics and Power)/ Electrical & Electronics Engg / Electrical & Power Engg .

III SEMESTER.									
S.No	Course Code	Course Title	Teaching Scheme			Evaluation Scheme			Credits
			L	T	P	MSE	CA	ESE	
1	BTBSC301	Engineering Mathematics-III	3	1	0	20	20	60	4
2	BTEEC302	Network Analysis and Synthesis	2	1	0	20	20	60	3
3	BTEEC303	Fluid Mechanics and Thermal Engineering	2	1	0	20	20	60	3
4	BTEEC304	Measurement and Instrumentation	2	1	0	20	20	60	3
5	BTEEE305A BTEEE305B BTEEE305C	Elective –I (A) Electrical Engineering Materials (B) Applied Physics (C) Signals and Systems	3	0	0	20	20	60	3
6	BTHM3401	Basic Human Rights	2	0	0	-	20	-	Audit
7	BTHM306	Engineering Economics	2	0	0	20	20	60	2
8	BTEEL307	Network Analysis and Synthesis Lab	0	0	2	-	60	40	1
9	BTEEL308	Measurement and Instrumentation Lab	-	0	4	-	60	40	2
10	BTEEM309	Electrical workshop/ Mini project	-	-	2	-	60	40	1
11	BTEEF310	Field Training/ Internship/ Industrial Training Evaluation						50	1
		TOTAL	16	04	08	120	320	530	23
IV SEMESTER.									
1	BTEEC401	Electrical Machine-I	3	1	0	20	20	60	4
2	BTEEC402	Power System-I	2	1	0	20	20	60	3
3	BTEEC403	Electrical Installation and Estimation	2	1	0	20	20	60	3
4	BTEEC404	Numerical Methods and Programming	2	1	0	20	20	60	3
5	BTID405	Product Design Engineering	1	0	2	30	30	40	2
6	BTEEE-406A BTEEE-406B BTEEE-406C	Elective –II (A) Solid State Devices (B) Analog and Digital electronics (C) Electromagnetic Theory	2	0	0	20	20	60	2
7	BTEEOE407-A BTEEOE407-B BTEEOE407-C	Elective –III (A) Industrial safety (B) Introduction to Non-Conventional energy sources (C) Software Techniques.	2	0	0	20	20	60	2
8	BTEEL408	Electrical Machine-I Lab	0	0	2	-	60	40	1
9	BTEEL409	Power System lab-I	0	0	2	-	60	40	1
10	BTEEL410	Numerical Methods and Programming Lab	-	0	2	-	60	40	1
11	BTEEEL411	Elective-II Lab	0	0	2	-	60	40	1
12		Field Training / Internship/ Industrial Training (minimum 4 weeks which can be completed partially in Third semester and Fourth Semester or in at one time.)							Credits to be evaluated in V Sem
	TOTAL		15	04	10	140	380	580	23

Semester III

BTBSC301. Engineering Mathematics III

Teaching Scheme	**Examination Scheme**
Theory : 03 Hrs/Week	Mid-term Test : 20 Marks
Tutorial : 01 Hr/Week	Internal Assessment: 20 Marks
	End Semester Exam: 60 Marks
	Duration: 03 Hrs.

Course Contents:

Unit 1: Laplace Transform

Definition – conditions for existence ; Transforms of elementary functions ; Properties of Laplace transforms - Linearity property, first shifting property, second shifting property, transforms of functions multiplied by t^n, scale change property, transforms of functions divided by t, transforms of integral of functions, transforms of derivatives ; Evaluation of integrals by using Laplace transform ; Transforms of some special functions- periodic function, Heaviside-unit step function, Dirac delta function.

[07 Hours]

Unit 2: Inverse Laplace Transform

Introductory remarks ; Inverse transforms of some elementary functions ; General methods of finding inverse transforms ; Partial fraction method and Convolution Theorem for finding inverse Laplace transforms ; Applications to find the solutions of linear differential equations and simultaneous linear differential equations with constant coefficients.

[07 Hours]

Unit 3: Fourier Transform

Definitions – integral transforms ; Fourier integral theorem (without proof) ; Fourier sine and cosine integrals ; Complex form of Fourier integrals ; Fourier sine and cosine transforms ; Properties of Fourier transforms ; Parseval's identity for Fourier Transforms.

[07 Hours]

Unit 4: Partial Differential Equations and Their Applications

Formation of Partial differential equations by eliminating arbitrary constants and functions; Equations solvable by direct integration; Linear equations of first order (Lagrange's linear equations); Method of separation of variables – applications to find solutions of one dimensional heat flow equation $\left(\frac{\partial u}{\partial t} = c^2 \frac{\partial^2 u}{\partial x^2}\right)$, and two dimensional heat flow equation (i.e. Laplace equation : $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$).

[07 Hours]

Unit 5: Functions of Complex Variables (Differential calculus)

Limit and continuity of f(z); Derivative of f(z) ; Analytic functions; Cauchy- Riemann equations in Cartesian and polar forms; Harmonic functions in Cartesian form; Mapping: Translation, magnification and rotation, inversion and reflection , bilinear transformation; Conformal mapping.

[07 Hours]

Unit 6: Functions of Complex Variables (Integral calculus)

Cauchy's integral theorem; Cauchy's integral formula; Residues; Cauchy's residue theorem (All theorems without roofs).

[07 Hours]

Text Books

1. Higher Engineering Mathematics by B. S. Grewal, Khanna Publishers, New Delhi.
2. Advanced Engineering Mathematics by Erwin Kreyszig, John Wiley & Sons, New York.
3. A Course in Engineering Mathematics (Vol III) by Dr. B. B. Singh, Synergy Knowledge ware, Mumbai.
4. A Text Book of Applied Mathematics (Vol I & II) by P. N. Wartikar and J. N. Wartikar, Pune Vidyarthi Griha Prakashan, Pune.
5. Higher Engineering Mathematics by H. K. Das and Er. Rajnish Verma, S. Chand & CO. Pvt. Ltd., New Delhi.

Reference Books

1. Higher Engineering Mathematics by B. V. Ramana, Tata McGraw-Hill Publications, New Delhi.
2. A Text Book of Engineering Mathematics by Peter O' Neil, Thomson Asia Pte Ltd., Singapore.
3. Advanced Engineering Mathematics by C. R. Wylie & L. C. Barrett, Tata Mcgraw-Hill Publishing Company Ltd., New Delhi.
4. Integral Transforms and Their Engineering Applications by Dr. B. B. Singh, Synergy . Knowledge ware, Mumbai.
5. Integral Transforms by I. N. Sneddon, Tata McGraw-Hill, New York.

General Instructions:

1. The tutorial classes in Engineering Mathematics-III are to be conducted batchwise. Each class should be divided into three batches for the purpose.
2. The internal assessment of the students for 20 marks will be done based on assignments, surprise tests, quizzes, innovative approach to problem solving and percentage attendance.
3. The minimum number of assignments should be eight covering all topics.

BTEEC 302. NETWORK ANALYSIS AND SYNTHESIS.

Teaching scheme:
Theory: 2 hrs
Tutorial: 1 hr
Total credit: 3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Pre requisite	Basic electrical engineering	
Course Outcome	To review basic components of electric network. To design and develop network equations and their solutions. To apply Laplace theorem for electric network analyses To analyze AC circuit.	
Unit	Contents	Contact Hrs
1	Active & Passive Circuit Element: Independent & dependent voltage & current sources, R, L, C & mutual inductance circuit parameters, Their mathematical modes, Voltage current power relations. Classification of element: Lumped distributed, Linear & non-linear, Unilateral, Bilateral, Time invariant & variant, Pace invariant & variant, Super position, Thevenin's, Norton's Reciprocity, Maximum power transfer, Substitution, Tellegen's theorem.	6
2	Network Equations: Network topology, Graph, Tree, Branches, Chords, Equilibrium equation on loop basis & node basis Number of network equation required, Choice between nodal & loop analysis, Source transformation, Network mutual inductance, Dot conventions, Concept of super mesh, Super node Concept of duality & dual networks.	6
3	Solution of Network Equations: Classification solution of first, Second order differential equations of series & parallel R-L, R-C, R-L-C circuits, General & particular solutions, Particular integral & complimentary functions, Time constant, Mathematical analysis of circuit transients, initial conditions in network, Procedure of evaluality, Conditions in network problems, Solution of D.C. resistive network & A. C. sinusoidal steady state networks, Writing loop equations, Node equations directly in matrices form. Numericals	6
4	Application of Laplace's Transform: Solution of differential equation using Laplace transform, Unit step, Impulse & ramp functions, Laplace transform of singular & shifted function, Convolution integral, Concept of complex frequency, Transform impedance & transform admittance, Series & parallel combination of these transform networks.	6
5	Two port network: Terminals& terminal pairs, Driving points & transfer admittance, Transfer functions, Concept of poles & zeroes, Two port networks, Z, Y & the transmission parameters relationship between parameter sets.	6
6	Sinusoidal Steady State A. C. Circuit: R-L-C series circuits, Series resonance Variation of Z with frequency, maximum value of VC & VL, Magnification, Bandwidth, Q factor. Parallel Resonance: Resonance frequency for tank circuit frequency, Locus diagram of series R-L, R-C with variable R & X. Filter: Introduction classification, Low pass, High pass, Band pass & band reject filter, active & passive filters. Application of Fourier series, Expansion for periodic & non-sinusoidal waveforms.	6
	Ref Books: 1. Mac.E Van Valkenburg, "Network Analysis", 2. Franklin Fa-Kun. Kuo, "Network Analysis & Synthesis", John Wiley & Sons. 3. M. L. Soni, J. C. Gupta, "A Course in Electrical Circuits and Analysis", 4. Mac.E Van Valkenburg, "Network Synthesiss", 5. Joseph A. Edminister, Mahmood Maqvi, "Theory and Problems of Electric Circuits", Schaum's Outline Series,	

BTEEC 303. FLUID MECHANICS AND THERMAL ENGINEERING.

Teaching scheme:
Theory: 2 hrs
Tutorial: 1hr
Total credit: 3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Pre requisite	Basic Mechanical engineering	
Course Outcome	To introduce properties of fluid and hydraulic measurement To understand dynamics of fluid flow To understand basic concepts of IC engines To understand concept of refrigeration and air conditioning	
Unit	Contents	Contact Hrs
1	Introduction to properties of fluids & hydraulic measurements (pressure at plane & curved surfaces, criteria of pressure), Fluid kinematics and dynamics & simple numerical.	6
2	Flow through pipe Laminar flow, Haugen Poisellie's equation Turbulent flow, Darcy Weisbach formula, Friction factor, use of Moddys Diagram only, Pipes in series & parallel, minor losses. Introduction to reciprocating and centrifugal pumps, their characteristics and applications	6
3	Internal Combustion Engines: Introduction to First Law & second Law of Thermodynamics, Concept of Entropy & Enthalpy Classification Otto, Diesel & air-fuel cycles, Constructional details of two stroke, four stroke engines, study of various systems such as fuel supply, ignition cycle, over heating, cooling, lubrication, calculation of IP, BP, MEP, efficiencies, heat balance, engine trial, performance, gas turbine, classification, cycles, performance improvement .	6
4	Air compressors: Classification, principle of operation of reciprocating & rotary compressors, Constructional details of single & multi stage compressor, work input, P-V diagram, efficiencies, improving compressor performance, reciprocating type only, use of compressed air	6
5	Refrigeration & Air conditioning: Refrigeration: Different systems, principle of cycles of operations of vapour compression & vapour absorption systems, COP calculations of vapour compression refrigeration system, refrigerants, desirable & undesirable properties, application of refrigeration.	6
6	Air conditioning: Psychrometry, DBT, WBT, RH, Psychometric chart, air conditioning processes such as heating, cooling, humidification, dehumidification, study of central air conditioning plant & its control, application of air conditioning.	6
	Ref Books: 1. Joel Reyner, "Engineering Thermodynamics",(Longman Publications) 2. Nag P. K., "Engineering Thermodynamics", (Tata McGraw Hill Publications) 3. Arora C.P, "Refrigeration & Air Conditioning", (Tata McGraw Hill Publications) 4. Eastop T. D. & Mcconkey A., "Applied Thermodynamics For Engineering Technologists" (Longman Publications) 5. Modi P.N & Seth S.M, "Hydraulic Fluid Mechanics",(Standard Book House Publications) 6. Lewitt W., "Hydraulic & Fluid Mechanics",(Sir Issac Pitman Publications),10th Edition	

BTEEC 304 MEASUREMENT AND INSTRUMENTATION

Teaching scheme:
Theory: 2 hrs
Tutorial: 1 hr
Total credit: 3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Pre requisite	Basic electrical engineering	
Course Outcome	To understand philosophy of measurement. To understand different methods analog and digital measurement. To study principle of construction and operation of different transducer and dismay methods.	
Unit	Contents	Contact Hrs
1	Philosophy Of Measurement- Methods of Measurement, Measurement System, Classification of instrument system, Characteristics of instruments & measurement system, Errors in measurement & its analysis, Standards.	6
2	Analog Measurement of Electrical Quantities – Electro dynamic, Thermocouple, Electrostatic & Rectifier type Ammeters & Voltmeters, Electro dynamic Wattmeter, Three Phase Wattmeter, Power in three phase system, errors & remedies in wattmeter and energymeter. Instrument Transformer and their applications in the extension of instrument range, Introduction to measurement of speed, frequency and power factor	6
3	Measurement of Parameters - Different methods of measuring low, medium and high resistances, measurement of inductance & capacitance with the help of AC Bridges, Q Meter	6
4	Digital Measurement of Electrical Quantities-Concept of digital measurement, block diagram Study of digital voltmeter, frequency meter Power Analyzer and Harmonics Analyzer; Electronic Multimeter.	6
5	Transducers: Definition - different types of transducers – criteria for selection –general characteristics–dynamic characteristics – transducers for measurement of displacement (RVDT &LVDT), speed, angular rotation, altitude, force, torque, humidity and moisture, pressure, strain and temperature (Thermocouple and RTD method), Hall Effect transducer and applications Instrumentation amplifiers – differential amplifiers) Data transmission and telemetry – methods of data transmission, General telemetry systems – Digital methods of frequency, phase, time and period measurements.	6
6	Display methods, recorders: Display methods and devices – different types of recorders – galvanometric recorders – pen driving system– magnetic recorders – digital recorders, digital storage oscilloscope (Block Diagram, theory and applications only)	6
	Reference Books: 1. A.K.Sawhney, A course in Elect. & Electronic Measurement and Instrumentation, Dhapat Rai & Co. 2. Golding & Widis, Electrical Measurement and Measurement instrument, Wheelar Books H.S. Kalsi, Electronic Instruments, Tata Mc-Graw hill 3.Carr, Elements of Electronic Instrumentation and Measurement, Pearson Education. 4. D. Patranabis, Sensors & Transducers, PHI. 5. A.J. Bouwens, Digital Instrumentation, Tata Mc-Graw hill. 6. A.D. Heltric & W.C. Copper, Modern Electronic instrumentation & Measuring instruments, Wheeler Publication. 7. H.K.P. Neubert, Instrument transducers, Oxford University press.	

BTHM3401 - Basic Human Rights

Teaching scheme:
Theory: 2 hrs
Total credit: Audit

Examination Scheme:
Continuous Assessment: 50 Marks

Pre requisite		
Course Objective		
Course Outcome	To study concept of time value of money To study about demand in detail To understand Meaning of Production and factors of production, To understand dif. Concept about market	
Unit	Contents	Contact Hrs
1	The Basic Concepts: Individual, Group, Civil Society, State, Equality, Justice, Human Values: - Humanity, Virtues, Compassion.	6
2	Human Rights and Human Duties: Origin, Civil and Political Rights, Contribution of American Bill of Rights, French Revolution, Declaration of Independence, Rights of Citizen, Rights of working and Exploited people, Fundamental Rights and Economic program, India's Charter of freedom	6
3	Society, Religion, Culture, and their Inter-Relationship: Impact of Social Structure on Human behaviour, Roll of Socialization in Human Values, Science and Technology, Modernization, Globalization, and Dehumanization.	6
4	Social Structure and Social Problems: Social and Communal Conflicts and Social Harmony, Rural Poverty, Unemployment, Bonded Labour, Migrant workers and Human Rights Violations, Human Rights of mentally and physically challenged.	6
5	State, Individual Liberty, Freedom and Democracy: The changing of state with special reference to developing countries, Concept of development under development and Social action, need for Collective action in developing societies and methods of Social action, NGOs and Human Rights in India: - Land, Water, Forest issues.	6
6	Human Rights in Indian Constitution and Law: The constitution of India: (i) Preamble (ii) Fundamental Rights (iii) Directive principles of state policy (iv) Fundamental Duties (v) Some other provisions Universal declaration of Human Rights and Provisions of India, Constitution and Law, National Human Rights Commission and State Human Rights Commission	6
	Reference Books: 1. Shastry, T. S. N., India and Human rights: Reflections, Concept Publishing Company India (P Ltd.), 2005. 2. Nirmal, C.J., Human Rights in India: Historical, Social and Political Perspectives (Law in India), Oxford India.	

BTHM306. ENGINEERING ECONOMICS

Teaching scheme:
Theory: 2 hrs
Total credit: 2

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Pre requisite		
Course Outcome	To study concept of time value of money To study about demand in detail To understand Meaning of Production and factors of production, To understand dif. Concept about market	
Unit	Contents	Contact Hrs
1	Introduction to the subject: Micro and Macro Economics, Relationship between Science, Engineering, Technology and Economic Development. Production Possibility Curve, Nature of Economic Laws.	4
2	Time Value of Money: concepts and application. Capital budgeting; Traditional and modern methods, Payback period method, IRR, ARR, NPV, PI (with the help of case studies)	4
3	Meaning of Demand, Law of Demand, Elasticity of Demand; meaning, factors effecting it and its practical application and importance. Demand forecasting (a brief explanation)	4
4	Meaning of Production and factors of production, Law of variable proportions and returns to scale. Internal and external economies and diseconomies of scale. Concepts of cost of production, different types of costs; accounting cost, sunk cost, marginal cost, Opportunity cost. Break even analysis, Make or Buy decision (case study). Relevance of Depreciation towards industry.	5
5	Meaning of market, types of market, perfect competition, Monopoly, Monopolistic, Oligopoly. (Main features). Supply and law of supply, Role of demand and supply in price determination.	4
6	Indian Economy, nature and characteristics. Basic concepts; fiscal and monetary policy, LPG, Inflation, Sensex, GATT, WTO and IMF. Difference between Central bank and Commercial banks	2
	Reference Books: 1. Chopra P. N., Principle of Economics, Kalyani Publishers 2. Dewett K. K., Modern economic theory, S. Chand 3. H. L. Ahuja., Modern economic theory, S. Chand 4. Dutt Rudar & Sundhram K. P. M., Indian Economy 5. Mishra S. K., Modern Micro Economics, Pragati Publications	

BTEEE 305A . ELECTRICAL ENGINEERING MATERIALS.

Teaching scheme:
Theory: 3 hrs
Total credit: 3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Pre requisite	Basic electrical engineering, Physics, Chemistry	
Course Outcome	To study about crystal structure To understand magnetic material structure To study about conducting and superconducting materials To study dielectric and nano materials.	
Unit	Contents	Contact Hrs
1	Crystallography Crystal directions and planes, Diatomic Crystal (CsCl, NaCl, Diamond, $BaTiO_3$) Crystal imperfection, Point defects, Line defects, Surface and Volume defects, Structure properties relationship, structure determination by X-ray diffraction.	6
2	Magnetic Materials Origin of magnetization using atomic theory, classification of magnetic materials and properties, Langevin's theory of Dia, Para and ferromagnetism, Soft and Hard magnetic materials and their uses, Domain theory of ferromagnetism, Hysteresis loss, Antiferromagnetic and Ferrimagnetic materials, Ferrites and Garnets, magnetic bubbles, magnetic recording.	7
3	Conducting and Superconducting Materials Band theory of solids, Classical free electron theory of metals, Quantum free electron theory, Density of energy states and carrier concentration, Fermi energy, Temperature and Fermi energy distribution, Superconductivity, Factor affecting Superconductivity, Meissner effect, Type-I and Type-II superconductors, BCS theory, Josephson effect, High temperature superconductors, Application of superconductors (Cryotron, magnetic levitation)	7
4	Semiconducting Materials Band structure of semiconductor, Charge carrier concentration, Fermi level and temperature, Electrical conductivity, Hall effect in semiconductors, P-N junction diode, Preparation of single crystals, LED, Photovoltaic Cell	6
5	Dielectric Materials Dielectric constant and polarizability, types of polarization, temperature and frequency dependences of Dielectric parameter, internal fields in solids, Clausius-Mosotti equation, dielectric loss, dielectric breakdown, ferroelectric, pyroelectric and piezoelectric materials, applications of dielectric materials	7
6	Nano Materials Nanomaterials : Introduction and properties, synthesis of nanomaterials, Carbon Nano Tubes, Characterization techniques of nanomaterials- SEM, TEM, EDAX, FMR, XRD. Applications of nanomaterials.	7
	Reference Books : 1. Material Science and Engineering – V. Raghavan 2. Electrical Engineering Materials – A.J. Dekker 3. Solid State Physics – A.J. Dekker 4. Science of Engineering Materials and Carbon Nanotubes - C.M. Srivastava and C. Srinivasan	

BTEEE305B. APPLIED PHYSICS

Teaching scheme:
Theory: 3hrs
Total credit: 3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Pre requisite	Physics-II	
Course Outcome	1.Understand concept of Electromagnetic theory and Magnetism 2. Understand concept od Dielectric and Super conductivity 3. Understand concept of nanomaterial	
Unit	Contents	Contact Hrs
1	Electromagnetic Theory covering, Coulomb‟s law for distribution of charges, Polarization Gauss‟s law, Electric current and equation of continuity, Magnetic induction and Lorentz force, Steady current and Biot-Savert law, Ampere‟s law, Magnetization and magnetic intensity, Faradays law of induction, Generalization of Ampere‟s law, Maxwell‟s equations	4
2	Dielectrics: Introduction to dielectrics, Concept of Polarization; Dipole and dipole moment, Electric field due to dipole (without derivation); Depolarization field, depolarization factors, Local electric field at an atom, Lorentz field, Lorentz relation; Dielectric constant and polarizability – ClausiusMossotti equation (with derivation); Types of polarization – electronic, ionic, dipolar, space charge; Temperature and frequency dependence of dielectric constant	5
3	Magnetism : Magnetic field and Magnetization; Magnetic susceptibility, Paramagnetism - Paramagnetism due to partially filled shells, transition elements (3d), rare earths (4f) and actinides, Magnetization and total angular momentum (definition and relationship); Concept of magnetic moment, gyromagnetic ratio, Lande‟s g-factor, Bohr Magneton, Curie‟s Law – derivation for „spin only‟ system (L = 0), expression for non-zero orbital angular momentum system (J = L + S); Ferromagnetism, antiferromagnetism, and ferrimagnetism; Exchange interaction between magnetic ions; Molecular field, Expression for Curie-Weiss law, concept of θP ;Ferromagnetism and Ferrimagnetism – Curie temperature, hysteresis, Hard ferromagnets, permanent magnets – SmCo5, Nd2Fe14B, Sintered Alnico, Sintered Ferrite – 3 etc. – Comparison and applications; Soft ferromagnets –Permalloys, Ferrites etc. – Comparison and applications; Neel temperature, Curie-Weiss law; Magnetic resonance, NMR and MRI, MASER;	5
4	Superconductivity :Zero resistance, Critical temperature Tc ,Perfect diamagnetism, Meissner effect, Critical field Hc, Type I and Type II superconductors, Cooper pairs and formation of superconducting gap at Fermi level, Electron-Phonon interaction and BCS theory, Isotope effect, Applications – Superconducting magnets, Transmission lines, Josephson effect (DC & AC, qualitative), SQUID; (7 Lectures)	4
5	Physics of Nanomaterials : Nanoscale; Properties of nanomaterials- Optical (SPR, luminescence, tuning band gap of semiconductor nanoparticles), Electrical (SET), Magnetic, Structural, Mechanical; Brief description of different methods of synthesis of nanomaterials (physical - laser ablation, ball milling; chemical - vapor deposition, sol gel); Reduction of dimensionality, Quantum wells (two dimensional), Quantum wires (one dimensional), Quantum dots (zero dimensional); Density of states and energy spectrum for Zero dimensional solid, One dimensional quantum wire, Two dimensional potential well, Particle in a three dimensional box; Some special nanomaterials like, Aerogels – properties and applications, Carbon nanotubes - properties and applications, Core shell nanoparticles - properties and applications; Applications of nanomaterials: Electronics, Energy, Automobiles, Space, Medical, Textile, Cosmetics; Nanotechnology and Environment;	7
6	Quantum Computation and Communication covering, the idea of „qubit‟ and examples of single qubit logic gates- Classical bits, Qubit as a two level system; Bloch vector representation of state of qubit; Polarization states of photon and measurements; Pauli gates, Hadamard gate, Phase shift gate, Quantum gates as rotations in Bloch sphere; EPR paradox, concept of entanglement and Bell‟s inequality- The paradox, joint state of entangled particles; Proof of Bell‟s inequality; Two-qubit controlled gates; entanglement generation and the Bell basis- Generic twoqubit state, Controlled-NOT gate; Quantum circuit for transforming computational basis to Bell basis; Qualitative discussion on the „circuit‟ model of „quantum computation; An overview of classical cryptography: Vernam cypher; Public key cryptosystem; The „Rivest-Shamir-Adleman‟ or „RSA‟ protocol; Comments on No-cloning theorem and impossibility of faster-than-light transfer of information; The	8

	BB84 protocol in quantum cryptography- The protocol; its validity on the basis of Heisenberg‟s uncertainty principle; Quantum Teleportation- Basic idea; measurement using Bell operator, need for classical communication channel; quantum circuit describing teleportation protocol;	

	Ref Books: 1. Kittel C., Introduction to Solid State Physics, Wiley Eastern 2. Callister W.C. Jr., Material Science and Engineering: An Introduction, 6th Edn., John Wiley & Sons 3. Kulkarni Sulabha K., Nanotechnology: Principles & Practices, Capitol Publishing Co. **4.** Charles P. Poole, Jr., Frank J. Owens, Introduction to Nanotechnology, Wiley Eastern **5.** Nielsen M. A., I. L. Chuang, Quantum Computation & Quantum Information, Cambridge Univ. Press

BTEEE305C. SIGNALS AND SYSTEMS

Teaching scheme:
Theory: 3 hrs
Total credit: 3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Pre requisite	Basic electrical engineering	
Course Outcome	To study classification of signals and system To analyze diff. types of time signal	
Unit	Contents	Contact Hrs
1	CLASSIFICATION OF SIGNALS Continuous time signals (CT signals), discrete time signals (DT signals) - Step, Ramp, Pulse, Impulse, Exponential, Classification of CT and DT signals - periodic and periodic, random singals,	5
	CLASSIFICATION OF SYSTEMS CT systems and DT systems, Basic properties of systems - Linear Time invariant Systems and properties.	5
2	ANALYSIS OF CONTINUOUS TIME SIGNALS Fourier series analysis, Spectrum of C.T. singals, Fourier Transform and Laplace Transform in Signal Analysi	7
3	LINEAR TIME INVARIANT –CONTINUOUS TIME SYSTEMS Differential equation, Block diagram representation, Impulse response, Convolution integral, frequency response , Fourier and Laplace transforms in analysis, State variable equations and matrix representation of systems	7
4	ANALYSIS OF DISCRETE TIME SIGNALS Sampling of CT signals and aliasing, DTFT and properties, Z-transform and properties of Z-transform.	7
5	LINEAR TIME INVARIANT - DISCRETE TIME SYSTEMS Difference equations, Block diagram representation, Impulse response, Convolution sum, LTI systems analysis using DTFT and Z-transforms , State variable equations and matrix representation of systems.	7
	REFERENCES: 1. Allan V.Oppenheim, S.Wilsky and S.H.Nawab, Signals and Systems, Pearson Education, 2007. 2. Edward W Kamen & Bonnie's Heck, "Fundamentals of Signals and Systems", Pearson Education, 2007 3. H P Hsu, Rakesh Ranjan" Signals and Systems", Schaum's Outlines, Tata McGraw Hill, Indian Reprint, 2007 4. S.Salivahanan, A. Vallavaraj, C. Gnanapriya, Digital Signal Processing, McGraw Hill International/TMH, 2007. 5. Simon Haykins and Barry Van Veen, Signals and Systems John Wiley & sons , Inc, 2004. 6. Robert A. Gabel and Richard A.Roberts, Signals & Linear Systems, John Wiley	

BTEEL307. NETWORK ANALYSIS AND SYNTHESIS LABORATORY

Teaching scheme:
Lab work : 2 hrs
Total credit: 1

Examination Scheme:
Continuous Assessment (T/W): 30 Marks
Pr/oral: 20 Marks

Pre requisite	Basic electrical engineering	
Course Objective	To understand principles of various network theorems and network principles	
Course Outcome	Verifies principles of network	
Expt No	Title of Expt	
1	Verification of Superpostion theorem	
2	Verification of Thevinion's theorem	
3	Verification of Norton's theorem	
4	Verification of maximum power transfer theorem	
5	Verification of reciprocating theorem	
6	Determination of transient response of current in RL & RC circuits with step voltage input	
7	Analysis of RL/ RC and RLC circuits	
8	Determination of transient response of current in RLC circuit with step voltage input for under damped, critically damped and over damped cases	
9	Determination of frequency response of current in RLC circuit with sinusoidal ac input	
10	Determination of driving point and transfer functions of a two port ladder network and verify with theoretical values	
11	Determine characters tics of filter	

BTEEL308. MEASUREMENTS AND INSTRUMENTATION LABORATORY

Teaching scheme:
Lab work : 4 hrs
Total credit: 2

Examination Scheme:
Continuous Assessment (T/W): 60 Marks
Pr/oral: 40 Marks

Pre requisite	Basic electrical engineering	
Course Objective		
Course Outcome		
Expt No	Title of Expt	
1	Study of Reyleigh's current balance method	
2	To study AC bridges	
3	Study of different types of ohm meter	
4	Study of megger	
5	Study of instrument T/F and it's types	
6	Study of wattmeter	
7	Construction of ammeter and voltmeter	
8	To study different types of transdusers	
9	Study digital frequency meter and digital voltmeter	
10	To study linear variable differential transformer	
11	Study of digital torque measurement	

BTEEM309. ELECTRICAL WORKSHOP/ MINI PROJECT

Teaching scheme:
Lab work : 2 hrs
Total credit: 1

Examination Scheme:
Continuous Assessment (T/W): 30 Marks
Pr/oral: 20 Marks

Pre requisite	Basic electrical engineering	
Course Objective	To provide hands on experience towards building of prototype	
Course Outcome	Build and verifies basic scientific principles.	
Expt No	Title of Expt	
1	Study various resources and components in electrical engineering projects	
2	Study datasheet of basic circuit components of a project	
3-5	Study various software in building of project like: Electric Circuit, X-Circuit, Electrician app, Electronic Tutorials, Logisim, Circuit simulator, Free PCB Ki CAD EDA softwer suit, SYC labs, Tina-TI etc	
6	Preparation of PCB for a given project	
7	Verification and analysis of project	
8	Report writing	

Semester IV

BTEEC 401. ELECTRICAL MACHINES – I

Teaching scheme:
Theory: 3 hrs
Tutorial: 1 hr
Total credit: 4

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Pre requisite	Basic electrical technology,	
Course Outcome	To study diff. types, construction and operating principle of diff. types of electrical machines	
Unit	Contents	Contact Hrs
1	Single Phase Transformer: Transformer construction, Ideal and practical transformer, exact and approximate equivalent circuits, no load and on load operation, phasor diagrams, power and energy efficiency, voltage regulation, parallel operation, effect of load on power factor, Per Unit system, excitation phenomenon in transformers, switching transients, Auto transformers, Variable frequency transformer, voltage and current transformers, welding transformers, Pulse transformer and applications.	7
2	Three Phase Transformers: Constructional features of three phase transformers, Cooling methodology, Standard and special transformer connections, Phase conversion, Parallel operation of three phase transformers, three winding transformers and its equivalent circuit, On load tap changing of transformers, Modern trends in transformers, Type and routine tests, Standards.	8
3	Electromechanical Energy Conversion Principles: Energy in a magnetic systems, field energy and mechanical force, energy in singly and multiply excited magnetic systems, determination of magnetic force and torque from energy and coenergy, Forces and torques in magnetic field systems, dynamic equations of electromechanical systems and analytical techniques	6
4	DC Generators: Construction of armature and field systems, Working, types, emf equation, Armature windings, Characteristics and applications, Building of emf, Armature reaction - Demagnetizing and Cross magnetizing mmfs and their estimation; Remedies to overcome the armature reaction; Commutation process, Causes of bad commutation and remedies	9
5	D.C. Motors: Principles of working, Significance of back emf, Torque Equation, Types, Characteristics and Selection of DC Motors, Starting of DC Motors, Speed Control, Losses and Efficiency, Condition for Maximum Efficiency, Braking of DC Motors, Effect of saturation and armature reaction on losses; Applications, Permanent Magnet DC Motors, Type and Routine tests.	9
6	Special Machines: Constructional details of reluctance machine, variable-reluctance machines, basic VRM analysis, practical VRM analysis, stepper motors and their analysis, Brushless DC motors.	6
	REFERENCES: 1. Bhattacharya S. K, "Electrical Machines",(Tata McGraw Hill Publications) 2. Kothari Nagrath, "Electrical Machines", (Tata McGraw Hill Publications) 3. M. N. Bandopadhyay, "Electrical Machines", (Tata McGraw Hill Publications) 4. Fitzaralda, "Electrical Machines", (Tata McGraw Hill Publications)	

BTEEC402 : POWER SYSTEM-I:

Teaching scheme:
Theory: 2 hrs
Tutorial: 1 hr
Total credit: 3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Pre requisite	Basic electrical engineering	
Course Outcome	To Understand basic operation of power system, power system components and their characteristics.	
Unit	Contents	Contact Hrs
1	**Load and Energy survey**: load duration curve, plant factor and plant economics. Introduction to different sources of energy. Construction, principle and working of different thermal power plants with neat block diagram of main parts, fuel economisation, for thermal power plants based on Coal, Oil and nuclear energy. Hydroelectric Power Plant: Advantages and limitations, selection of site, hydrological cycles and hydrographs, storage and pondage, essential elements of hydroelectric plant, classification, different types of turbines and their selection, layout of hydro-station, simple numerical.	7
2	**Major Electric Equipments**: Descriptive treatment of alternator exciter & excitation systems, Transformers, Control panels, Metering & other control room equipments. Inductance: Definition, Inductance due to internal flux of two wire single phase line of composite conductor line, Concept of GMD, Inductance of three phase line with equal & unequal spacing, vertical spacing.	5
3	**Capacitance**: Concept of electric field, Potential difference between two points in space, Effect of earth's surface on electric field, Computation of capacitance of single phase, three phase transmission lines with & with out symmetrical spacing for solid & composite conductors.	6
4	**Transmission:** Types of conductors, Choice of conductor materials, Stranded copper & ACSR conductor, Insulation consideration, Different types of insulator, supports, distribution of voltage across the insulator string, String efficiency, skin effect, Ferranty effect, proximity effect	6
5	**Current and Voltage relation:** Representation of short, medium & long transmission lines, P. U. quantities, evaluation of ABCD parameters and surge impedance loading, power flow through transmission line, circle diagram, evaluation of relation between sending and receiving end current & voltage, Interpretation of transmission line equation, Numericals, Line current, % regulation, Transmission efficiency, numericals based on above	7
6	**Mechanical Design of Transmission Line**: Effect of wind & ice coating on transmission line, sag due to equal & unequal supports, with their derivation, Numericals. Corona: Phenomenon of corona, factors affecting the corona, Power loss & disadvantages of corona.	5
	REFERENCES: 1. Gupta B. R. " Power Plant Engineering".(Eurasia publications) 2. Nag P. K. " Power Plant Engineering",(Tata McGraw Hill Publications) 3. Kothari Nagrath, "Electric Power System", (Tata McGraw Hill Publications) 4. Wadhva S. L.,"Electric Power System",(Tata McGraw Hill Publications) 5. Stevension W. B., "Power System", (English Language Book Society publications)	

BTEEC 403 ELECTRICAL INSTALLATION AND ESTIMATION

Teaching scheme:
Theory: 2 hrs
Tutorial-1hr
Total credit: 3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Pre requisite	Basic electrical engineering, electrical measurement and instrumentation.	
Course Outcome	To prepare estimates and costing of electrical installations of power system, To understand procedures of contracting and purchase.	
Unit	Contents	Contact Hrs
1	Estimating and Determination of conductor size for internal wiring, HT and LT Overhead Lines and Underground Cables: Various steps to form an estimate, Price catalogue, Schedule of labour rates, Schedule of rates and estimating data, Conductor size, calculations for internal domestic wiring, Permissible voltage drops for lighting and industrial load, simple numericals, Conductor size calculation for underground cables: General considerations, Simple numericals, Conductor size calculations for overhead lines with A.C.S.R. conductors, simple numericals.	7
2	Preparation of estimate of quantity of material required for wiring of a house (typical plan of house including electric layout is to be given). Drawing of electrical circuit for such electrification. Specification for accessories like AC energy meter, main switch, Tumbler switch, Electric heater, Fluorescent tube, Chokes for tubes, starters, bulbs, and Insulation tapes.	5
3	**Principles of Contracting**: Purchasing techniques, Spot quotations, Floating limited enquiry, Typical example of quotation form, preparation of comparative statement, Analysis of comparative statement, Tenders types (Single tender, Open tender), Earnest money, Security deposit, Various steps involved in complete purchase, Typical order formats, various criteria for selecting the supplier, General considerations in order form, Procedures to be followed for submitting the tenders & quotations. Purchase Department, Objective, activities, duties and functions, purchase organization, Centralized and decentralized purchasing, relative advantages and disadvantages, Applications	6
4	**Study of different types of components in electrical distribution system:** Cables: Classification, general construction, types of cables, jointing of cables, measurement of insulation resistance, Insulators: Requirements, materials used, types (Pin, Suspension, Strain, Stay) Substation: Different types, classification, design consideration, various symbols, complete arrangement of substation (Single and double bus bar), key diagrams for typical substations. Review of Insulated Wires: Types: Rubber covered taped and compounded or VIR, Lead alloy sheathed, Tough rubber sheathed, Weather proof, Flexible wire splicing, Termination (Twist splicing, Married joint, Tap joint, Pig tail joint) Different Types of Switches: Tumbler, flush, pull, grid, architrave, rotary snap, Push button, Iron clad water proof, Quick break knife switch. Ceiling roses, Mounting blocks, Socket outlets plugs, Main switches, Distribution fuse boards, MCB (Miniature Circuit Breakers)	7
5	**Different Tools Used**: Screwdriver, Pliers of various types, wrench, and blowlamp, Precaution for using tools	4
6	**Wiring System**: Selection of types of wiring. Methods of wiring (Cleat, Casing capping, Metal sheathed and Conduit) Calculation and Estimation of power rating of different AC and DC machines, schematic and wiring diagrams for motor control and protection circuit	6
	REFERENCES: 1. Uppal .S. L – Electrical Wiring, Estimation & Costing(Khanna Publication). 2. Raina & Bhattacharaya – Electrical Design Estimating & Costing (Willy Estern).	

BTEEC404. NUMERICAL METHODS AND PROGRAMMING.

Teaching scheme:
Theory: 2 hrs
Tutorial-1hr
Total credit: 3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Pre requisite	Mathematics 1, mathematics 2, mathematics 3, C programming	
Course Outcome	To study and understand MATLAB programming. To review mathematical concepts . To develop computer program for linear and nonlinear equations.	
Unit	Contents	Contact Hrs
1	Introduction to MATLAB Programming: Array operations , Loops and execution control Lecture . Working with files: Scripts and Functions , Plotting and program output	5
2	Approximations and Errors: Defining errors and precision in numerical methods Taylor's / Maclaurin series, Truncation and round-off errors, Error propagation, Global and local truncation errors.	6
3	Numerical Differentiation and Integration: Methods of numerical differentiation and integration, trade-off between truncation and round-off errors, error propagation and MATLAB functions for integration	6
4	Linear and Nonlinear Equations: numerical methods in linear algebra, and use of MATLAB to solve practical problems. Gauss Elimination ,LU decomposition and partial pivoting, Iterative methods: Gauss Siedel and Special Matrices: Tri-diagonal matrix algorithm, Nonlinear equations: NewtonRaphson method and MATLAB routines fzero and fsolve., Nonlinear equations in single variable , MATLAB function fzero in single variable, Fixed-point iteration in single variable , Newton-Raphson in single variable , MATLAB function fsolve in single and multiple variables, Newton-Raphson in multiple variab	6
5	Regression and Interpolation: Linear least squares regression(including lsqcurvefit function) , Functional and nonlinear regression (including lsqnonlin function), Interpolation in MATLAB using spline and p chip	5
6	Ordinary Differential Equations (ODE) – 1 Explicit ODE solving techniques in single variable, Introduction to ODEs; Implicit and explicit Euler's methods, Second-Order Runge-Kutta Methods, Higher order Runge-Kutta methods, Error analysis of Runge-Kutta method. Stiff ODEs and MATLAB ode15s algorithm ,Practical example for ODE-IVP ,Solving transient PDE using Method of Lines	7
	Reference Books: 1. Fausett L.V. (2007) Applied Numerical Analysis Using MATLAB, 2nd Ed., and Pearson Education. 2. Chapra S.C. and Canale R.P. (2006) Numerical Methods for Engineers, 5th Ed., and McGraw Hill. 3. NPTEL notes. http://nptel.ac.in/courses/122106033/	

Product Design Engineering

Teaching Scheme:	Examination Scheme:
Lecture-cum-demonstration: 1 hr/week Design Studio: 2 hr/week	Continuous Assessment 1: 30 Marks Continuous Assessment 2: 30 Marks Final Assessment: 40 Marks

- Pre-requisites: Knowledge of Basic Sciences, Mathematics and Engineering Drawing
- Design Studio : 2 hr/week to develop design sketching and practical skills, learning digital tools
- Continuous Assessment: Progress through a product design and documentation of steps in the selected product design
- Final Assessment: Product Design in Studio with final product specifications

Course Outcomes: At the end of the course, students will be able to

1. Create simple mechanical or other designs
2. Create design documents for knowledge sharing
3. Manage own work to meet design requirements
4. Work effectively with colleagues

Course Contents:

Unit 1. Introduction to Engineering Product Design:

Trigger for Product/ Process/ System, Problem solving approach for Product Design, Disassembling existing Product(s) and understanding relationship of components with each other, Sketching of components, identifying materials and their processing for final product, fitting of components, understanding manufacturing as scale of the components, Reverse engineering concept, case studies of products in markets, (or in each discipline), underlying principles, Case studies of product failures, revival of failed products, Public/Society's perception of products, and its input into product design.

Unit 2. Ideation:

Generation of ideas, Funnelling of ideas, Short-listing of ideas for product(s) as an individual or group of individuals, Sketching of products, Market research for need, competitions, scale and cost, Initial specifications of products

Unit 3. Conceptualisation:

Computer operation principles and image editing through a graphical Composition; Computer aided 2D drafting and 3D Modeling through simple exercises.

Designing of components, Drawings of parts and synthesis of a product from its component parts, Rendering the designs for 3-D visualization and to create a photo realistic image, Parametric modelling of product, 3-D Visualization of mechanical products, Detail Engineering drawings of components

BTEEE406A. SOLID STATE DEVICES.

Teaching scheme:
Theory: 2 hrs
Total credit: 2

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Pre requisite	basic electrical engineering,	
Course Outcome	1. To study construction and characteristics of solid state devices. 2. To apply operational amplifier models in circuits employing negative feedback. 3. To design electronics circuit using Timer IC and voltage regulators. 4. To perform analysis of amplifiers using small signal models for the circuit elements. 5. To calculate the frequency response of circuits containing BJT, Op-Amp etc	
Unit	Contents	Contact Hrs
1	Semiconductor Devices and their applications: Applications of diodes - clippers, clampers, multipliers, Types of diodes - Zener diode, Tunnel diode, schottky diode, LED, PIN diode, Photodiode etc, BJT- CB, CE, CC configurations, biasing, FET biasing, MOSFET biasing, NMOS, PMOS, CMOS, Device modeling.	4
2	Signal and Power Amplifiers: Analysis of CB, CC, CE and FET amplifiers. Low and high frequency response of transistor and FET amplifier, Feedback in amplifiers, Oscillators. Transistor power amplifiers.	4
3	Operational Amplifiers: The ideal Op-Amp, equivalent circuit of Op-Amp, ideal voltage transfer curve, open loop Op-Amp configurations, Op-Amp parameters, block diagram representation of feedback configurations, frequency response, high frequency Op-Amp.	4
4	Active Filters and Oscillators: Active filters: low pass filter, high pass filter, band-pass filters, band reject filters, all pass filters, comparators and oscillators.	4
5	Generalized Linear Applications: DC and AC amplifiers, instrumentation amplifier, logarithmic amplifier, voltage to current converter, current to voltage converter, the integrator, the differentiator.	4
6	Specialized IC Applications: The 555 Timer as monostable, astable multivibrator, phase locked loops operating principles, 565 PLL applications, voltage regulators- fixed, adjustable, switching, special. Analog switch and analog multiplier.	4
	Ref Books: 1. Millman, Halkias and Satyabrata Jit, " Electronic Devices and Circuits", 4th edition, McGraw Hill Education (India) Private Limited, 2015. 2. Robert L. Boylestad and Louis Nashelsky, "Electronic devices and circuit theory", 11th edition, Prentice Hall India Ltd, 2015. 3. Ramakant A. Gayakwad, "Op-Amps and linear integrated Circuits" 4th edition, Pearson Education, 2015.	

BTEEE405B. ANALOG AND DIGITAL ELECTRONICS

Teaching scheme:
Theory: 2 hrs
Total credit: 2

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Pre requisite	basic electrical engineering,	
Course Outcome	To review basic number system. To understand deign and characteristics of digital logic gates. To study different techniques in use of digital circuits. To design digital systems.	
Unit	Contents	Contact Hrs
1	Transistor as an Amplifier, load line, Small signal low frequency analysis of single stage amplifier in different configuration, High frequency equivalent circuit of transistor (hybrid pi), Cascade amplifier, High input resistance circuits-C coupled amplifier Frequency response, Definition of 3 db bandwidth, Effect of cascading on gain & BW, Classification of amplifiers	4
2	Block diagram of operational amplifier, Properties of ideal operational amplifier, Explanation of different terms appearing in OP-Amp application (offset, bias, quantities, PSRR, CMRR, Ad, AC, Slew rate etc.), Operation of circuit diagram of OP-Amp using discrete components & I.C. diagram, Different types of current of current sources in I.C. technology, frequency response of OP-Amp, OP-Amp parameters & minimization technique of temperature effect, Inverting & Non-inverting operation of Op-Amp & analysis for AG, RI, RO, Linear & non-linear circuit application of OP-Amp	4
3	Number Systems, Basic Logic Gates & Boolean Algebra: Binary Arithmetic & Radix representation of different numbers. Sign & magnitude representation, fixed point representation, complement notation, various codes & arithmetic in different codes & their inter conversion. Features of logic algebra, postulates of Boolean algebra. Theorems of Boolean algebra. Boolean function. Derived logic gates: Exclusive-OR, NAND, NOR gates, their block diagrams and truth tables. Logic diagrams from Boolean expressions and Vica-versa. Converting logic diagrams to universal logic. Positive, negative and mixed logic. Logic gate conversion	4
4	Digital Logic Gate Characteristics: TTL logic gate characteristics: Theory & operation of TTL NAND gate circuitry. Open collector TTL. Three state output logic. TTL subfamilies. MOS & CMOS logic families. Realization of logic gates in RTL, DTL, ECL, and C-MOS & MOSFET. Interfacing logic families to one another. Sequential Systems: Latches, flip-flops, R-S, D, J-K, Master Slave flip flops. Conversions of flip-flops Counters: Synchronous & asynchronous ripple and decade counters, Modulus counter, skipping state counter, counter design, state diagrams and state reduction techniques. Ring counter. Counter applications. Registers: buffer register, shift register	4
5	Minimization Techniques: Minterm, Maxterm, Karnaugh Map, K map upto 4 variables. Simplification of logiConversion of truth tables in POS and SOP form. Incomplete specified functions.Variable mapping.Quinn-McKlusky minimization techniques. c functions with K-map	4
6	Combinational Systems: Combinational logic circuit design, half and full adder, subtractor. Binary serial and parallel adders.BCD adder. Binary multiplier. Decoder: Binary to Graydecoder, BCD to decimal, BCD to 7-segment decoder' Multiplexer, DE multiplexer, encoder. Octal to binary, BCD to excess-3 encoder. Diode Switching matrix. Design of logic circuits by multiplexers, encoders, decoders and DE multiplexers.	4
	Ref Books: 1. Mandal, Digital Electronics: Principles and Applications, TMH 2009 2. Leach, Digital Principles and Applications, ed. 7, TMH 2008 3. M. Morris Mano, Digital Logic and Computer Design, Pearson Edu. 2014	

BTEEE 405C. ELECTRO MAGNETIC THEORY

Teaching scheme:
Theory: 2 hrs
Total credit: 2

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Pre requisite	Basic electrical engineering, machine 1, physics	
Course Outcome	To understand vector relations in diff. forms To analyze diff. laws and their solution To study about magneto static To understand time varying field and effect of magnetism in transmission line	
Unit	Contents	Contact Hrs
1	Introduction: Vector Relation in rectangular, cylindrical, spherical and general curvilinear coordinate system. Concept and physical interpretation of gradient, Divergence and curl, Green's Stoke's and Helmholz theorems	4
2	Electrostatics: Electric field vectors-electric field intensity, flux density & polarization. Electric field due to various charge configurations. The potential functions and displacement vector.	4
3	Gauss's law, Poisson's and Laplace's equation and their solution. Uniqueness theorem. Continuity equation. Capacitance and electrostatics energy. Field determination by method of images. Boundary conditions. Field mappings and concept of field cells	5
4	Magnetostatics: Magnetic field vector: Magnetic field intensity, flux density & magnetization, Bio-Savart's law, Ampere's law, Magnetic scalar and vector poten Energy stored in magnetic field, Boundary conditions, Analogy between electric and magnetic field, Field mapping and concept of field cellstial, self & mutual inductance.	5
5	Time Varying Fields: Faraday's law, Displacement currents and equation of continuity. Maxwell's equations, Uniform plane wave in free space, dielectrics and conductors, skin effect sinusoidal time variations, reflections, refraction & polarization of UPW, standing wave ratio. Pointing vector and power considerations.	4
6	Transmission Lines: The high-frequency circuit. LCR ladder model. The transmission Lin equation. Solution for loss-less lines. Wave velocity and wave impedance. Reflection and Transmission coefficients at junctions. VSWR	4
	Ref Books: 1. G. S. N. Raju: Electromagnetic Field Theory and Transmission Lines, Pearson. 2006 2. S. Baskaran and K. Malathi: Electromagnetic Field and Waves, Scitech Pub. 2013 3. R. S. Kshetrimayum, Electromagnetic Field Theory, Cengage Learning. 2012 4. J. D. Kraus: Electromagnetic. 5th edition, MGH. 1999	

BTEEOE 407A. INDUSTRIAL SAFETY.

Teaching scheme:
Theory: 2 hrs
Total credit: 2

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Pre requisite	Basic electrical engineering, electrical measurement and instrumentation, machine 1	
Course Outcome	To understand importance of safety in industrial environment. To understand different safety procedures in an industrial environment.	
Unit	Contents	Contact Hrs
1	SAFETY IN METAL WORKING MACHINERY AND WOOD WORKING MACHINES General safety rules, principles, maintenance, Inspections of turning machines, boring machines, milling machine, planning machine and grinding machines, CNC machines, Wood working machinery, types, safety principles, electrical guards, work area, material handling, inspection, standards and codes- saws, types, hazards	4
2	PRINCIPLES OF MACHINE GUARDING Guarding during maintenance, Zero Mechanical State (ZMS), Definition, Policy for ZMS – guarding of hazards - point of operation protective devices, machine guarding, types, fixed guard, interlock guard, automatic guard, trip guard, electron eye, positional control guard, fixed guard fencing- guard construction- guard openin Selection and suitability: lathe-drilling-boring-milling-grinding-shaping-sawingshearingpresses- forge hammer-flywheels-shafts-couplings-gears-sprockets wheels and chains-pulleys and belts-authorized entry to hazardous installations-benefits of good guarding systems.	5
3	SAFETY IN WELDING AND GAS CUTTING Gas welding and oxygen cutting, resistances welding, arc welding and cutting, common hazards, personal protective equipment, training, safety precautions in brazing, soldering and metalizing – explosive welding, selection, care and maintenance of the associated equipment and instruments – safety in generation, distribution and handling of industrial gases-colour coding – flashback arrestor – leak detection-pipe line safety-storage and handling of gas cylinders.	4
4	SAFETY IN COLD FORMING AND HOT WORKING OF METALS Cold working, power presses, point of operation safe guarding, auxiliary mechanisms, feeding and cutting mechanism, hand or foot-operated presses, power press electric controls, power press set up and die removal, inspection and maintenance-metal sheers-press brakes.	4
5	Hot working safety in forging, hot rolling mill operation, safe guards in hot rolling mills – hot bending of pipes, hazards and control measures. Safety in gas furnace operation, cupola, crucibles, ovens, foundry health hazards, work environment, material handling in foundries, foundry production cleaning and finishing foundry processes.	4
6	SAFETY IN FINISHING, INSPECTION AND TESTING Heat treatment operations, electro plating, paint shops, sand and shot blasting, safety in inspection and testing, dynamic balancing, hydro testing, valves, boiler drums and headers, pressure vessels, air leak test, steam testing, safety in radiography, personal monitoring devices, radiation hazards, engineering and administrative controls, Indian Boilers Regulation	4
	References: 1. “Accident Prevention Manual” – NSC, Chicago, 1982. 2. “Occupational safety Manual” BHEL, Trichy, 1988. 3. “Safety Management by John V. Grimaldi and Rollin H. Simonds, All India Travelers Book seller, New Delhi, 1989. 4. “Safety in Industry” N.V. Krishnan JaicoPublishery House, 1996. 5. Indian Boiler acts and Regulations, Government of India. 6. Safety in the use of wood working machines, HMSO, UK 1992. 7. Health and Safety in welding and Allied processes, welding Institute, UK, High Tech. Publishing Ltd., London, 1989	

BTEEOE 407B. INTRODUCTION TO NON-CONVENTIONAL ENERGY SOURCES,

Teaching scheme:
Theory: 2 hrs
Total credit: 2

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Pre requisite	Energy and environmental engineering, basic electrical engineering	
Course Outcome	To review energy scenario. To understand basic concepts , construction and operational features of different non-conventional sources.	
Unit	Contents	Contact Hrs
1	Introduction: World energy situation, conventional and non-conventional energy sources, Indian energy scene.	2
2	Solar Energy: Solar radiation, solar radiation geometry, solar radiation on tilted surface. Solar energy collector. Flat- plate collector, concentrating collector - parabolidal and heliostat. Solar pond. Basic solar power plant. Solar cell, solar cell array, basic photo-voltaic power generating system	4
3	Wind Energy: Basic principle of wind energy conversion, efficiency of conversion, site selection. Electric power generation-basic components, horizontal axis and vertical axis wind turbines, towers, generators, control and monitoring components. Basic electric generation schemes- constant speed constant frequency, variable speed constant frequency and variable speed variable frequency schemes. Applications of wind energy	6
4	Geothermal Energy: Geothermal fields, estimates of geothermal power. Basic geothermal steam power plant, binary fluid geothermal power plant and geothermal preheat hybrid power plant. Advantages and disadvantages of geothermal energy. Applications of geothermal energy. Geothermal energy in India. Tidal Energy: Introduction to tidal power. Components of tidal power plants, double basin arrangement. Power generation. Advantages and limitations of tidal power generation. Prospects of tidal energy in India	5
5	Nuclear Fusion Energy: Introduction, nuclear fission and nuclear fusion. Requirements for nuclear fusion. Plasma confinement – magnetic confinement and inertial confinement. Basic Tokamak reactor, laser fusion reactor. Advantages of nuclear fusion. Fusion hybridand cold fusion	4
6	Biomass Energy: Introduction, biomass categories, bio-fuels. Introduction to biomass conversion technologies. Biogas generation, basic biogas plants-fixed dome type, floating gasholder type, Deen Bandhu biogas plant, Pragati design biogas plant. Utilization of bio gas. Energy plantation. Pyrolysis scheme. Alternative liquid fuels –ethanol and methanol. Ethanol production	4
	Ref Books: 1. A. N. Mathur: Non-Conventional Resources of Energy. 2010 2. V. V. N. Kishore: Renewable Energy Engineering and Technology, TERI. 2006	

BTEEOE 407C. SOFTWARE TECHNIQUES.

Teaching scheme:
Theory: 2 hrs
Total credit: 2

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Pre requisite	Basic C programming	
Course Outcome	To understand different techniques of software models. To understand verification and validation of software. To analyze software project management.	
Unit	Contents	Contact Hrs
1	Introduction- Notion of Software as a Product – characteristics of a good Software Product. Engineering aspects of Software production – necessity of automation. Job responsibilities of Programmers and Software Engineers as Software developers	3
2	Process Models and Program Design Techniques- Software Development Process Models – Code & Fix model, Waterfall model, Incremental model, Rapid Prototyping model, Spiral (Evolutionary) model.	3
3	Good Program Design Techniques – Structured Programming, Coupling and Cohesion, Abstraction and Information Hiding, Automated Programming, Defensive Programming, Redundant Programming, Aesthetics. Software Modelling Tools – Data flow Diagrams, UML and XML. Jackson System Development	7
4	Verification and Validation: Testing of Software Products – Black-Box Testing and White-Box Testing, Static Analysis, Symbolic Execution and Control Flow Graphs – Cyclomatic Complexity. Introduction to testing of Real-time Software Systems.	5
5	Software Project Management: Management Functions and Processes, Project Planning and Control, Organization and Intra-team Communication, Risk Management. Software Cost Estimation – underlying factors of critical concern. Metrics for estimating costs of software products – Function Points. Techniques for software cost estimation – Expert judgement, Delphi cost estimation, Work break-down structure and Process break-down structure, COCOMO and COCOMO-II.	6
6	Advanced Topics: Formal Methods in Software Engineering – Z notation, Hoare‟s notation. Formalization of Functional Specifications – SPEC. Support environment for Development of Software Products. Representative Tools for Editors, Linkers, Interpreters, Code Generators, Debuggers. Tools for Decision Support and Synthesis, Configuration control and Engineering Databases, Project Management. Petrinets. Introduction to Design Patterns, Aspectoriented Programming.	7
	Reference books: 1. Fundamentals of Software Engineering – Carlo Ghezzi et. al. 2. Software Engineering – Design, Reliability Management – Pressman. 2. Software Engineering – Ian Sommerville. 2. Software Engineering - Shoeman. 3. Software Engineering with Abstraction – Berzins and Luqi	

BTEEL408. ELECTRICAL MACHINE-I LABORATORY

Teaching scheme:
Lab work : 2 hrs
Total credit: 1

Examination Scheme:
Continuous Assessment (T/W): 60 Marks
Pr/oral: 40 Marks

8-10 experiments covering full content of the syllabus and at least one experiment from each unit.

Pre requisite	Basic electrical engineering	
Course Objective		
Course Outcome		
Expt No	Title of Expt	
1	To verify turn ratio of transformer	
2	To determine equivalent circuit diagram of transformer through OC and SC test	
3	To determine efficiency by direct load test on single phase transformer	
4	To verify V-I relation & to draw phasor diagram of i) star-star ii) star-delta iii) delta-star iv) delta-delta connection of 3 phase transformer	
5	To verify relation in i) scott connection ii) open delta connection	
6	To study the parallel operation of 3 phase transformer	
7	To study construction of stator and rotor of DC machine	
8	To determine magnetization, internal and external characteristics of a series generator	
9	To determine internal and external characteristics of dc machine	
10	To determine ST characteristics of DC motor	
11	To determine efficiency of DC motor	
12	To control the Speed of DC motor	
13	To conduct braking test on DC motor	

BTEEL409. POWER SYSTEM-I LABORATORY

Teaching scheme:
Lab work : 2 hrs
Total credit: 1

Examination Scheme:
Continuous Assessment (T/W): 60 Marks
Pr/oral: 40 Marks

8-10 experiments covering full content of the syllabus and at least one experiment from each unit.

Pre requisite	Basic electrical engineering	
Course Objective		
Course Outcome		
Expt No	Title of Expt	
1	Study of Thermal power plant layout and its components	
2	Study of Hydropower plant layout and its components	
3	Study of alternator exciter systems	
4	Study of control panel and metering equipment	
5	Study of different OHT System conductors	
6	Study of different OHT System insulator	
7	Determination of performance parameter of short transmission line	
8	Determination of performance parameter of medium transmission line	
9	Determination of performance parameter of long transmission line	
10	Determination of ABCD parameters of transmission line	
11		
12		

PS: A visit to nearby typical power plant which includes study of expt 1-6 is recommended.

BTEEL410. NUMERICAL METHODS AND PROGRAMMING LABORATORY

Teaching scheme:
Lab work : 2 hrs
Total credit: 1

Examination Scheme:
Continuous Assessment (T/W): 60 Marks
Pr/oral: 40 Marks

8-10 experiments covering full content of the syllabus and at least one experiment from each unit.

Pre requisite	Basic electrical engineering	
Course Objective		
Course Outcome		
Expt No	Title of Expt	
1	Program for scan conversion of a straight line	
2	Program for scan conversion of a circle	
3	Program for scan conversion of an ellipse	
4	Program for scan conversion of a rectangle	
5	Program for scan conversion of an arc	
6	Program for scan conversion of a sector	
7	Program for finding roots of f(x)=0 by newton raphsonm method	
8	Program for finding roots of f(x)=0 by bisection method	
9	Program for solving numerical integration by simpson's 1/3 rule	
10	Program for solving ordinary differential equation by runge kutta method	

BTEEL411. ELECTIVE-II LABORATORY

Teaching scheme:
Lab work : 2 hrs
Total credit: 1

Examination Scheme:
Continuous Assessment (T/W): 60 Marks
Pr/oral: 40 Marks

8-10 experiments covering full content of the syllabus and at least one experiment from each unit.

Analog and digital Electronics Lab

Pre requisite	Basic electrical engineering	
Course Objective		
Course Outcome		
Expt No	Title of Expt	
1	Measurement of op Amp parameters	
2	Design and implementation of integrator, differentiator and comparator	
3	Design and implementation of phased locked loop and its applications	
4	Design and implementation of various signal generator	
5	Design and implementation of instrument amplifier	
6	Design and implementation of arithmetic circuits	
7	Design and implementation of various code converters and its applications.	
8	Design and implementation of multiplexer and demultiplexer and its applications.	
9	Design and implementation of encoders and decoders and its applications	
10	Design and implementation of synchronous and asynchronous counters and its applications	
11	Design and implementation of non-sequential counters.	
12	Design and implementation of shift registers and its applications.	
13	Implementation and verifications of Combinational circuits on programmable logic devices	

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR
B.E. (Electrical Engineering)
SCHEME OF EXAMINATION

FIFTH SEMESTER

S.N.	Sub Code	Subject	Board	Teaching Scheme				Credits	Examination Scheme			Min. Passing Marks	Paper Duration
				L	T	P	Total		College Assessment	Univ. Assessment	Total Marks		
1	BEELE501T	ELECTRICAL POWER SYST - I	EE	4	1	0	5	5	20	80	100	40	3 Hours
2	BEELE502T	UTILIZATION OF ELECTRIC ENERGY	EE	3	1	0	4	4	20	80	100	40	3 Hours
3	BEELE503T	ELECTRICAL MACHINE DESIGN	EE	4	1	0	5	5	20	80	100	40	3 Hours
4	BEELE504T	MICROPROCESSOR & INTERFACING	EN	3	1	0	4	4	20	80	100	40	3 Hours
5	BEELE504P	MICROPROCESSOR & INTERFACING	EN	0	0	2	2	1	25	25	50	25	
6	BEELE505T	ELECTRICAL MACHINES-II	EE	4	1	0	5	5	20	80	100	40	3 Hours
7	BEELE505P	ELECTRICAL MACHINES-II	EE	0	0	2	2	1	25	25	50	25	
8	BEELE506P	ELECTRICAL DRAWING & SIMULATION	EE	0	0	2	2	2	25	25	50	25	
9	BEELE507P	ELECTRICAL ENGINEERING WORKSHOP	EE	0	0	2	2	2	25	25	50	25	
		Total		18	5	8	31	29			700		

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR
B.E. (Electrical Engineering)
SCHEME OF EXAMINATION

SIXTH SEMESTER

S.N.	Sub Code	Subject	Board	Teaching Scheme				Credits	Examination Scheme			Min. Passing Marks	Paper Duration
				L	T	P	Total		College Assessment	Univ. Assessment	Total Marks		
1	BEELE601T	POWER STATION PRACTICE	EE	3	1	0	4	4	20	80	100	40	3 Hours
2	BEELE602T	ENGINEERING ECONOMICS & INDUSTRIAL MANAGEMENT	ASH	3	1	0	4	4	20	80	100	40	3 Hours
3	BEELE603T	ELECTRICAL DRIVES & THEIR CONTROL	EE	4	1	0	5	5	20	80	100	40	3 Hours
4	BEELE604T	POWER ELECTRONICS	EE	4	1	0	5	5	20	80	100	40	3 Hours
5	BEELE604P	POWER ELECTRONICS	EE	0	0	2	2	1	25	25	50	25	
6	BEELE605T	CONTROL SYSTEM-I	EE	4	1	0	5	5	20	80	100	40	3 Hours
7	BEELE605P	CONTROL SYSTEM-I	EE	0	0	2	2	1	25	25	50	25	
8	BEELE606P	INDUSTRIAL VISITS & REPORT WRITING	EE	0	0	2	2	2	50	0	50	25	
9	BEELE607T	FUNCTIONAL ENGLISH	ASH	2	0	0	2	2	10	40	50	20	2 Hours
		Total		20	5	6	31	29			700		

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR
B.E. (Electrical Engineering)
SCHEME OF EXAMINATION

SEVENTH SEMESTER

S.N.	Sub Code	Subject	Board	Teaching Scheme				Credits	Examination Scheme			Min. Passing Marks	Paper Duration
				L	T	P	Total		College Assessment	Univ. Assessment	Total Marks		
1	BEELE701T	CONTROL SYSTEM-II	EE	4	1	0	5	5	20	80	100	40	3 Hours
2	BEELE702T	**ELECTRICAL POWER SYSTEM –II**	EE	4	1	0	5	5	20	80	100	40	3 Hours
3	BEELE703T	**ELECTIVE –I**	EE	3	1	0	4	4	20	80	100	40	3 Hours
4	BEELE704T	HIGH VOLTAGE ENGINEERING	EE	4	1	0	5	5	20	80	100	40	3 Hours
5	BEELE704P	HIGH VOLTAGE ENGINEERING	EE	0	0	2	2	1	25	25	50	25	
6	BEELE705T	ELECTRICAL INSTALLATION DESIGN	EE	4	1	0	5	5	20	80	100	40	3 Hours
7	BEELE705P	ELECTRICAL INSTALLATION DESIGN	EE	0	0	2	2	2	25	25	50	25	
8	BEELE706P	PROJECT SEMINAR	EE	0	0	3	3	3	50	0	50	25	
		Total		19	5	7	31	30			650		

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR
B.E. (Electrical Engineering)
SCHEME OF EXAMINATION

EIGHTH SEMESTER

S.N.	Sub Code	Subject	Board	Teaching Scheme				Credits	Examination Scheme			Min. Passing Marks	Paper Duration
				L	T	P	Total		College	Univ.	Total		
1	BEELE801T	ELECTIVE- II	EE	3	1	0	4	4	20	80	100	40	3 Hours
2	BEELE802T	ELECTIVE- III	EE	3	1	0	4	4	20	80	100	40	3 Hours
3	BEELE803T	SWITCHGEAR & PROTECTION	EE	4	1	0	5	5	20	80	100	40	3 Hours
	BEELE803P	SWITCHGEAR & PROTECTION	EE	0	0	2	2	1	25	25	50	25	
4	BEELE804T	COMPUTER APPLICATIONS IN POWER SYSTEM	EE	4	1	0	5	5	20	80	100	40	3 Hours
	BEELE804P	COMPUTER APPLICATIONS IN POWER SYSTEM	EE	0	0	2	2	1	25	25	50	25	
5	BEELE805P	PROJECT	EE	0	0	6	6	6	75	75	150	75	
		Total		14	4	10	28	26			650		

S. NO.	ELECTIVE-I	ELECTIVE-II	ELECTIVE - III
1	IT and Its Applications in Power System Control	Entrepreneurship Development	Bio-medical Engineering
2	Fuzzy Logic and Neural Networks	Digital Signal Processing	Advanced Microprocessor Peripherals
3	Flexible AC Transmission Systems	Power Quality	Power Semiconductor Based Electric
4	Energy Management and Audit	EHV AC and HVDC Transmission	Electrical Distribution System

Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur

Absorption Scheme for the students of B. E. Electrical Engg. (Electronics & Power)

from OLD semester pattern to NEW semester pattern

V Semester B. E. Electrical Engineering

Subject Code	Name of subject in Old semester pattern	Subject Code	Name of subject in New semester pattern
5S-EE-01	ELECTRICAL POWER SYSTEM-I (Th.)	BEELE501T	ELECTRICAL POWER SYSTEM - I
5S-EE-02	INSTRUMENTATION (Th.)		----
5S-EE-03	ELECTRICAL MACHINES DESIGN (Th.)	BEELE503T	ELECTRICAL MACHINE DESIGN
5S-EE-04	MICROPROCESSOR & INTERFACING (Th.)	BEELE504T	MICROPROCESSOR & INTERFACING
	MICROPROCESSOR & INTERFACING (Pract.)	BEELE504P	MICROPROCESSOR & INTERFACING
5S-EE-05	ELECTRICAL MACHINES-II (Th.)	BEELE505T	ELECTRICAL MACHINES-II
5S-EE-05	ELECTRICAL MACHINES-II (Pract.)	BEELE505P	ELECTRICAL MACHINES-II
5S-EE-06	ELECTRICAL ENGG. WORKSHOP	BEELE507P	ELECTRICAL ENGINEERING WORKSHOP
	-------	BEELE506P	ELECTRICAL DRAWING & SIMULATION*
	-------	BEELE502T	UTILIZATION OF ELECTRIC ENERGY *

***** The students who fail to clear any subject(s) of the V semester (old pattern) by the last chance prescribed, shall be required to clear the respective equivalent subject of V semester (new pattern) along with an additional subject marked with (*****).

Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur

Absorption Scheme for the students of B. E. Electrical Engg. (Electronics & Power)

from OLD semester pattern to NEW semester pattern

VI Semester B. E. Electrical Engineering

Subject Code	Name of subject in Old semester pattern	Subject Code	Name of subject in New semester pattern
6S-EE-01	POWER STATION PRACTICE (Th.)	BEELE601T	POWER STATION PRACTICE
6S-EE-02	ENGG.ECO. & IND. MGT. (Th.)	BEELE602T	ENGG.ECO. & IND. MGT
6S-EE-03	ELECT. DRIVES & THEIR CONTROL (Th.)	BEELE603T	ELECT. DRIVES & THEIR CONTROL
6S-EE-04	LINEAR ELECTRONIC CIRCUITS (Th.)		----
	LINEAR ELECTRONIC CIRCUITS (Pract.)		----
6S-EE-05	CONTROL SYSTEM-I (Th.)	BEELE605T	CONTROL SYSTEM-I
	CONTROL SYSTEM-I (Pract.)	BEELE605P	CONTROL SYSTEM-I
6S-EE-06	COMP. AIDED ELECT.ENGG. DRAWING (Pract.)	---	------
		BEELE604T	POWER ELECTRONICS*****
		BEELE604P	POWER ELECTRONICS*****
		BEELE606P	INDUSTRIAL VISITS &REPORT WRITING*
		BEELE607T	FUNCTIONAL ENGLISH*

***** The students who fail to clear any subject(s) of the VI semester (old pattern) by the last chance prescribed, shall be required to clear the respective equivalent subject of VI semester (new pattern) along with an additional subject marked with (*****).

V SEM. ELECTRICAL ENGG.

BEELE501T	**ELECTRICAL POWER SYST - I**	**L = 4**	**T = 1**	**P = 0**	**Credits = 5**
Examination Scheme	College Assessment	University Examination		Total	Univ. Exam. Duration
	20	80		100	3 Hrs

Learning Objective	Learning Outcomes
Students will develop the ability ▪ To model and represent the system components used in power system. ▪ To represent and understand the transmission line parameters. • To understand the load flow analysis of power system.	students should be able to ▪ Modeling and representation of the system components used in power system. ▪ Concept of designing transmission line parameters • The basic concept of load flow analysis.

UNIT- 1:

Structure of electrical power system, brief exposure to generation, transmission and distribution aspects, elementary consideration of economic bulk power supply system, use of high voltage general system consideration, idea about substation, concept of real, reactive and complex power. Load and their characteristics, voltage and frequency dependence of loads. (10hrs)

UNIT- 2:

Representation of power system elements, models and parameters of generator, transformer and transmission lines, Transmission line parameters calculation (R,L,C), per unit system representation. 8hrs

UNIT-3:

Elementary distribution scheme: Feeders and distributors. LT and HT cables, Introduction to distribution automation.
Concept of insulator, types of insulator, string efficiency. 10 hrs

UNIT-4:

Voltage regulation and efficiency of power transmission lines using equivalent pi and T representation. Representation using circle diagram with generalized constants. 10 hrs

UNIT-5:

Interconnection of system elements to form two bus systems. Illustration of active and reactive power transmission, types of buses. Introduction to load flow studies in multibus system (Methods of solution not expected). Introduction of frequency and voltage as system state indicators. 10 hrs

UNIT-6:

Elementary concepts of real and reactive power control. Steady state performance of turbine governors, load sharing between generators, preliminary concepts of automatic voltage regulator, 8 hrs

Text Books		
Title of Book	**Name of Author/s**	**Edition & Publisher**
Elements of power system analysis	W. D. Stevenson	**PHI**
Modern Power system analysis	Nagrath I.J. & Kothari D.P.	Mc-Graw Hill
Power system analysis	Wadhwa C.L.	New-Age international
Power System Analysis	Asfaque Hussain	CBS
Reference Books		
A Text book of Electric Power Distribution Automation	Dr. M. K. Khedkar & Dr. G. M. Dhole	Laxmi Publications
Electric Energy System Theory	O. E. Elgerd	
Westinghouse transmission and distribution handbooks		

BEELE502T	**UTILIZATION OF ELECTRIC ENERGY**	**L = 4**	**T = 1**	**P = 0**	**Credits = 5**
Examination Scheme	College Assessment	University Examination		Total	Univ. Exam. Duration
	20	80		100	3 Hrs

Learning Objective	Learning Outcomes
Students will • understand application of electrical supply for different applications • to calculate electrical equivalent rating for mechanical application	students should be able to • understand applications for heating, welding, illumination using electric power • understand applications for fan, lowers, compressor, pumps and refrigeration using electric power

Unit I: Electric Heating: **(8 Hrs)**

i) Electric Heating : Types and methods of electrical heating, advantages of electrically produced heat, types & application of electric heating equipments, transfer of heat.

ii) Resistance Ovens : General constructions, design of heating elements, efficiency & losses, radiant heating.

iii) Induction heating: Core type & core less induction furnace, indirect induction oven, medium and high frequency eddy - current heating.

iv) Dielectric heating: Principle and application.

v) Arc furnace : Direct & indirect arc furnace, power supply, characteristics & control.

Unit II: Electric Welding: **(8 Hrs)**

i) Importance, Advantages & Disadvantages of welding, classification of welding processes.

ii) Resistance welding, Butt welding, Spot welding, Projection welding, Seam welding.

iii) Electric arc welding: Carbon arc welding, metal arc welding, submerged arc welding, Stainless Steel welding

iv) Ultrasonic welding, electron beam welding, laser beam welding.

Unit III : Illumination : **(8 Hrs)**

Nature of light, terms used in illumination, solid angle, laws of illumination, polar curves, Colour Rendering Index (CRI), Design of illumination systems, indoor lighting systems, factory lighting, outdoor lighting design, flood lighting, street lighting, energy saving in lighting systems.

Unit IV: **Refrigeration & Air conditioning**: **(8 Hrs)**

Terminology, refrigeration cycle, refrigeration systems (Vapor compression, vapor absorption), domestic refrigerator, drinking water cooler, desert air cooler.

Air conditioning: Factors involved in air conditioning, comfort air conditioning, industrial air conditioning, effective temperature, summer / winter air conditioning systems, types of air conditioning systems, room air conditioning, and central air conditioning.

Unit V: Fans & Pumps: **(10 Hrs)**

Fans and Blowers: Fan types, fan performance evaluation & efficient system operation, fan design & selection criteria, flow control strategies, fan performance assessment, energy saving opportunities.

Pumps: Pump types, system characteristics. Pump curves, factors affecting pump performance, efficient pumping system operation, flow control strategies, energy conservation opportunities in pumping system.

Unit VI: Compressors and DG Sets: **(8 Hrs)**

Compressors: Compressor types, Compressor efficiency, Compressed air system components.

Diesel Generating Systems: Introduction, selection and installation factors, operational factors, energy performance assessment in DG sets, energy saving measures for DG sets.

Books :

Text Books		
Title of Book	**Name of Author/s**	**Edition & Publisher**
Utilization of Electric Power & Electric Traction	J.B. Gupta	Kataria & Sons
Art and Science of Utilization of Electrical Energy	H Partap	Dhanpat Rai & Sons, Delhi
Utilization of Electrical Power	Dr N. V. Suryanarayana	Wiley Eastern Ltd, New Age International
Electronics in Industry	Chute & Chute	McGraw Hill
Utilization of Electric Energy	E. Openshaw Taylor	Orient Longman
Guide book for National Certification Examination for Energy Managers and Energy Auditors, Bureau of Energy Efficiency		

BEELE503T	**ELECTRICAL MACHINE DESIGN**	**L = 4**	**T = 1**	**P = 0**	**Credits = 5**
Examination Scheme	College Assessment	University Examination		Total	Univ. Exam. Duration
	20	80		100	3 Hrs

Learning Objective	Learning Outcomes
Students will develop the ability • To analyze different materials and their properties used in design of machine. • To calculate and understand the core design and main dimension of transformer. • To understand the performance characteristics and cooling of transformers.	students should be able to • Select proper material for design of a machine. • Design a overall transformer and estimates its performance characteristics as per requirement and constraints specified. • Design rotor core of Induction motor • Design overall dimensions of synchronous machines

Unit. 1:

REVIEW OF MATERIAL USED IN CONSTRUCTION OF ELECTRICAL MACHINES: - Classification of insulating materials depending upon permissible temperature rise, properties of transformer oil. Standard specification, C.M.R. and short time rating of machines. Heating and cooling characteristics. (10 Hrs)

Unit. 2:

TRANSFORMER DESIGN: - Specific loading, equation for voltage per turn for power and distribution transformer output equation. (10Hrs)

Unit. 3:

Principal of electric and magnetic circuit design, method of cooling and cooling circuit design. Estimation of performance characteristics from the design data. (10 hrs)

Unit. 4:

INDUCTION MOTOR: - Main dimensions, output equation, loading constant estimation of axial lengths, air gap diameter, winding design. (9 hrs)

Unit. 5:

Air gap length, slot combination for stator and rotor of I.M., cage rotor and wound rotor design. Calculation of on load current and other performance on characteristics for design data. (8hrs)

Unit. 6:

SYNCHRONOUS MACHINE: Air gap length, methods of obtaining sinusoidal O/P voltage, field coil design for salient pole machine and for turbo generator rotor, ventilation of synchronous generator, cooling air circuits, closed ventilation / quantity of cooling medium hydrogen and water as cooling media. (8hrs)

Text Books		
Title of Book	**Name of Author/s**	**Edition & Publisher**
Electrical machine Design	A.K. Sawhney	Dhanpatrai and Sons, Delhi
Electrical Machine Design	Balbir Singh	Brite students Publication, Pune
Electrical Machine Design	M.V. Deshpande	
Reference Books		
Performance and Design of A.C. Machines	M.G. Say	
Power Transformer	S.B. Vasntinsky	P.S.G. College of Technology Coimbtore-4
Principle of Electrical Machine Design	R. K. Agrawal	S. Chand Publication

BEELE504T	**MICROPROCESSOR & INTERFACING**	**L = 3**	**T = 1**	**P = 0**	**Credits = 4**
Examination Scheme	College Assessment	University Examination		Total	Univ. Exam. Duration
	20	80		100	3 Hrs

Learning Objective	Learning Outcomes
This subject helps student to learn the • Microprocessor applications in electrical engineering. • The principle of microprocessor chip working, programming with microprocessor is also explained in this subject.	students should be able touse and apply • VLSI circuit concept • Introduction to Intel 8085A architecture • Programming instructions • Interrupts • Methods of data transfer • Hardware and Interface

UNIT-1:

VLSI circuit concept. Approach to integrated system design using Microprocessors. Bus concepts. Address, Data and control. Organization of computer with MPU, Bits/ Byts / Words/ Long wards - their ranges accuracy and precision. Memory organization. Linear / Absolute decoding.

UNIT-2:

Introduction to Intel's 8085A Architecture description software instructions. Address mode- advantages, Timing diagrams assess, Assemblers and Dissemblers (By Hand Coding).

UNIT-3:

Flag structure, concept of PSW stacks and subroutines simple and Nested. PUSH, POP instructions and CALL/RETURN instruction. Stack manipulations, simple programs.

UNIT-4:

Interrupts - Concept and structure in 8085. Interrupt services routines. Advanced instructions and programming of 8085A.

UNIT-5:

Method of data transfer - serial, parallel, synchronous asynchronous, IN/OUT instructions. Timing diagrams, simple hardware interface to 8085 of standard Latches/Buffers/Keys/display devices as I/O ports. Handshaking concept. Architecture and interface of 8255 and 8253 to 8085.

UNIT-6:

Hardware considerations - bus contention. Slow memory interfacing complete signal description of 8085. Multiplexed Key board/Display interface and assembler directives. General awareness about micro computer system related products.

Text Books		
Title of Book	**Name of Author/s**	**Edition & Publisher**
Programming and interfacing 8085A	Gaonkar	Wiley Eastern
Programming of 8085	D.V. Hall	McGraw Hill
Microprocessor principals and Applications	Pal	Tata Mc Graw Hill
Reference Books		
Intel Microprocessors	Goody	Tata McGraw Hill
Microprocessors principals and Applications	Gomorra	Tata Mc Graw Hill

BEELE504P	**MICROPROCESSOR & INTERFACING**	**L = 0**	**T = 0**	**P = 2**	**Credits = 1**
Examination Scheme	College Assessment	University Examination		Total	Univ. Exam. Duration

	25	25		50	Practical
BEELE505T	**ELECTRICAL MACHINES-II**	**L = 4**	**T = 1**	**P = 0**	**Credits = 5**
Examination Scheme	College Assessment	University Examination		Total	Univ. Exam. Duration
	20	80		100	3 Hrs

Learning Objective	Learning Outcomes
This subject helps student to learn the • Understand the basic principle, construction, operation, performance characteristics and steady state and transient analysis of synchronous machines. • Understand the principle, construction, operation, control and applications of special electric motors.	• The student has understood principle , construction, laying of armature and field windings, types, generation of emf, steady state and transient behavior, synchronization and parallel operation of synchronous generators • The student has understood principle, construction, methods of starting of synchronous motor, its operation with variable load, operation with variable excitation, performance evaluation. • The student has understood special motors ,like Repulsion, Hysteresis, Reluctance, Universal and Schrage motors.

UNIT-1:THREE PHASE SYNCHRONOUS MACHINES
Introduction, constructional features of cylindrical and salient pole rotor machines, introduction to armature winding and field windings MMF of armature and field windings induced EMF. (9 Hrs)
UNIT-2: STEADY STATE OPERATION OF THREE PHASE SYNCHRONOUS MACHINES:
Phasor diagram, voltage regulation using synchronous impedance and Potier triangle method, steady state performance of three phase synchronous machines, circle diagrams. (9 Hrs)
UNIT-3: SYNCHRONIZATION:
Parallel operation, experimental determination of parameters (positive sequence reactance, negative sequence reactance, Zero sequence reactance, short circuit ratio, losses and efficiency. (9 Hrs)
UNIT-4: SYNCHRONOUS MACHINES ON INFINITE BUS
Phasor diagram, expression for torque, load / torque angle, synchronous machine operation, effects of variable excitation and power input on generator operation and effect of variable excitation and load on motor operation. (10 Hrs)
UNIT-5:TRANSIENT BEHAVIOR
Sudden 3– phase short circuit. Transient and sub- transient reactance's and their measurement. Time constant and equivalent circuit diagram,hunting & damper windings. (10Hrs)
UNIT-6: INTRODUCTION TO SPECIAL MACHINES:
Repulsion motors, AC series motors, universal motors, reluctance motor, hysteresis motor, brushless dc motor, power selsyns, position selsyns (only elementary aspects are expected). (8Hrs)

Text Books		
Title of Book	**Name of Author/s**	**Edition & Publisher**
Electrical Machine	Dr.P.K.Mukherjeeand S. Chakravarti	Dhanpat Rai
Electrical Machinery	Nagrath and Kothari	3rd , Tata Mcgraw Hill
Generalised Theory of Electrical Machinery	P.S. Bhimbra	Tata Mcgraw Hill
Reference Books		
Electrical Machinery	Fitzgerald and Kingsley and Kusco	McGraw Hill
Electrical Machinary	P. S. Bhimra	

BEELE505P	**ELECTRICAL MACHINES-II**	**L = 0**	**T = 0**	**P = 2**	**Credits = 1**
Examination Scheme	College Assessment	University Examination		Total	Univ. Exam. Duration
	25	25		50	Practical

BEELE506P	**ELECTRICAL DRAWING & SIMULATION**	**L = 0**	**T = 0**	**P = 2**	**Credits = 2**
Examination Scheme	College Assessment	University Examination		Total	Univ. Exam. Duration
	25	25		50	Practical

Objective: -

Drawings are the powerful tools used by Engineers to represent the concepts on paper Conventional drawing methods are time consuming & difficult to edit. With the availability of powerful package for drawing and analysis of Electrical Systems, need is being felt to introduce this practical to converse the Electrical Engineering students with the latest trends in drawing, designing & analysis*.

Efforts should made to make this as practically oriented as possible so that the students are not only able prepare the drawing, but also have fair insight into the different aspects of the components of the electrical systems.

The packages suggested are only as guidelines. Similar other packages may also be used to achieve **objectives & scope.**

* Detailed analysis is not expected.

SCOPE:

Line diagram single phase, three phases of a factory layout and a substation.

1. Drawing & layouts of DP structures and its components, insulators & bushings, substation assemblies, indoor/outdoor, plinth/pole mounted transformers/switchgears, cable layouts, transmission towers & transmission systems, winding diagrams for motors.
2. General arrangement diagram of power & motor control centers, schematic/single line diagrams of electrical/electronic/illumination layout in industry/office/house, flow charts.
3. Circuit's simulation(Voltage, Current, Power etc.).

Softwares Proposed: - MATLAB, PSCAD, ETAP, PSIM, Power World Simulator, VISIO, AUTOCAD

BEELE507P	**ELECTRICAL ENGINEERING WORKSHOP**	**L = 0**	**T = 0**	**P = 2**	**Credits = 2**
Examination Scheme	College Assessment	University Examination		Total	Univ. Exam. Duration
	25	25		50	Practical

VI – SEM. ELECTRICAL ENGG.

BEELE601T	**POWER STATION PRACTICE**	**L = 3**	**T = 1**	**P = 0**	**Credits = 4**
Examination Scheme	College Assessment	University Examination		Total	Univ. Exam. Duration
	20	80		100	3 Hrs

Learning Objective	**Learning Outcomes**
• To understand different sources of energy, methods of energy conversion, economics of generation, load survey, fixation of tariffs for all types of power generating stations and to study voltage control for AC generator.	On completion of this course student will be able to • Work in Power Generation plant. • To calculate the tariff for different customers.

UNIT-1:

SOURCES OF ELECTRICAL ENERGY: - Coal, oil and natural gas water power, nuclear fission and fusion, their scope and potentialities for energy conversion.

Generation: - different factors connected with a generating station, connected load, maximum demand, demand factor, load factor, diversity factor, plant capacity and utilization factor, load curve, load duration curve, load survey, base load and peak load station, advantages of interconnection. 10 Hrs

UNIT-2:

THERMAL STATIONS: - Choice of site, location, size and number of units, general layout, major equipment, essential and non-essential auxiliaries, electric supply to auxiliaries, cost of generation, factors affecting costs of generation. 10 Hrs

UNIT- 3:

HYDRO STATION: - Hydrology, stream flow, flow duration curve, power duration curve, mass curve, reservoir capacity, type of hydro plants and their field of use, pumped storages plants and their utility, surge tanks, governing characteristics of turbine and hydro generators. 10 Hrs

UNIT-4:

NUCLEAR STATION : - Principle of Nuclear energy, materials, types of nuclear reactors, breeder reactors, location, material for moderator and control rods, cost economics. 8 Hrs

UNIT-5:

VOLTAGE CONTROL OF A.C. GENERATOR : - Exciter instability, methods of stabilizing exciter voltage, Automatic voltage regulator action.

Tariff – different consideration of flat rate and two part economical choice. 8 hrs

UNIT-6: COGENERATION, CAPTIVE POWER GENERATION & SUSTAINABLE DEVELOPMENT

Definition and scope, cogeneration technologies, industries suitable for cogeneration, captive generation advantages and constraints, captive generation options, type of captive power plants, financing of captive power plants, Energy problems, prospects of changes in energy supply, agenda for sustainable development. 8Hrs

Text Books		
Title of Book	**Name of Author/s**	**Edition & Publisher**
Elements of Power Station design	M.V. Deshpande	PHI
Energy Conversion and power generation	L.D. Agrawal and G.K. Mittal	Khanna
Generation of Electrical Energy	B. R. Gupta	S. Chand
Reference Books		
Electric power stations	Car	
Electric power system control	H.P. Young	Chapman and Hall
Generating Stations	Lowels	

BEELE602T	**ENGINEERING ECONOMICS & INDUSTRIAL MANAGEMENT**	**L = 3**	**T = 1**	**P = 0**	**Credits = 4**
Examination Scheme	College Assessment	University Examination		Total	Univ. Exam. Duration
	20	80		100	3 Hrs

Learning Objective	**Learning Outcomes**
• Every engineer has to manage the things during his working. This subject helps student to understand material, production, personnel, finance and marketing management.	• After the completion of course the students will be able to manage the thing economically.

UNIT-1:

Demand utility and indifference curves, Approaches to analysis of demand, Elasticity of demand, Measures of demand elasticity, factors of production. Advertising elasticity, Marginalism.

UNIT-2:

Laws of returns and costs, Price and output determination under perfect competition, monopoly, Monopolistic competition, oligopoly, Depreciation and methods for its determination.

UNIT-3:

Function of central and commercial banks inflation, deflation, stagflation, Direct and Indirect taxes monetary and cycles, New Economic Policy, Liberalization, Globalization, Privatization, Market friendly state.
Fiscal policy of the government, Meaning and phases of business.

UNIT-4:

Definition, nature and scope of management function of management – planning, organizing, Directing, Controlling, Communicating.

UNIT-5:

Meaning of Marketing managements, concepts of Marketing. Marketing Mix, Administrative and cost plus pricing, Channels of distribution, Advertising and sales promotion.

UNIT-6:

Meaning, nature and scope of financial management, Brief outline of profit and loss account, balance sheet, Budgets and their importance, Ratio analysis, Principles of costing.

Text Books		
Title of Book	**Name of Author/s**	**Edition & Publisher**
Modern Economics	H.L. Ahuja	
Monetary Economics	M.L. Seth	
Industrial Management	I.K. Chopde, A.M. Sheikh	
Business Organization and Management	S.A. Sherlekar	
Reference Books		
Modern Economic Theory	K.K. Dewett	
Managerial Economics	Joel Dean	
Economics	Samuelson	

BEELE603T	**ELECTRICAL DRIVES & THEIR CONTROL**	**L = 4**	**T = 1**	**P = 0**	**Credits = 5**
Examination Scheme	College Assessment	University Examination		Total	Univ. Exam. Duration
	20	80		100	3 Hrs

Learning Objective	**Learning Outcomes**
• To understand the starting, speed control/braking, heating and cooling characteristics of electric motors and to learn the necessity of flywheel. • To learn the basics of Programmable Logic Controllers and become familiar with Ladder Programming. • To Study the motors used in Electric Traction.	The student will develop an ability • To solve numericals on starting, speed control and braking. • To solve numericals on heating and cooling of motors. • It will lay the foundation for studying the advanced subject Power Semiconductor based drives to be studied in 8th semester. • to work on the drives used in the Industry. • to work with PLC's in the Industry • will gain an insight in the working of drives used in traction.

UNIT-1;
Definition classification and speed torque characteristics of common drive motors and their characteristics under starting, running, braking and speed control. 8 Hrs.

UNIT-2:
SELECTION OF MOTOR: Power capacity for continuous and intermittent periodic duties flywheel effect. 10 Hrs

UNIT-3:
PLC, its Programming and its application in electrical drives. 8 Hrs.

UNIT-4:
AC AND DC CONTACTORS AND RELAYS: Lock out contactors, magnetic structure, operation arc interruption contactor rating, H.V. contactors, control circuits for automatic starting and braking of DC motor and three phase induction motor. Control panel design for MCC. 10 Hrs

UNIT-5:
TRACTION MOTORS: Motors used in AC/DC traction, their performance and desirable characteristics, requirements and suitability of motor for traction duty. Traction motor control – control of DC traction motor. Series parallel control with numerical starting and braking of traction motor. 10Hrs

UNIT-6:
Brief idea about drives commonly used in industries. Digital control of electric motor. Block diagram arrangement, comparison with other methods of control. 8 Hrs

Text Books		
Title of Book	**Name of Author/s**	**Edition & Publisher**
A course in Electrical Power	Soni, Gupta and Bhatnagar	
Modern Electrical Traction	H. Pratap	
Art and Science of Utilization of Electrical Energy	H. Pratap	
Magnetic Control of Industrial motors	Heumann	
Industrial Electronics	Petru Zula	McGraw Hill
Industrial Electronics	Bhattacharya	
Basic course in Electrical Drives	S. K. Pillai	

BEELE604T	**POWER ELECTRONICS**	**L = 4**	**T = 1**	**P = 0**	**Credits = 5**
Examination Scheme	College Assessment	University Examination		Total	Univ. Exam. Duration
	20	80		100	3 Hrs

Learning Objectives	**Learning Outcomes**
To introduce students the basic theory of power semiconductor devices and their practical application in power electronics. To familiarize the operation principle of AC-DC, DC-DC, DC-AC conversion circuits andtheir applications. To provide the basis for further study of power electronics circuits and systems.	A student who successfully fulfills the course requirements will be able to • understand basic operation of various power semiconductor devices. • understand the basic principle of switching circuits. • analyze and design an AC/DC rectifier circuit. • analyze and design DC/DC converter circuits. • analyze DC/AC inverter circuit. • understand the role power electronics play in the improvement of energy usage efficiency and the development of renewable energy technologies.

Unit 1: SCR and Its characteristics: Gate characteristics, SCR turn off, ratings, series and parallel connections of SCRs, Protection of SCR gate circuit protection, over voltage and over current protection, snubber circuit design, commutation methods. 10 Hrs

Unit 2: Static controllable switches: Characteristic and working of MOSFET Gate turn off thyristor and insulated gate bipolar transistor, Triac, AC regulator, Uni-junction transistors, Triggering circuits and optocouplers. 8 Hrs

Unit 3: Line commutated converters: Working of single pulse converter, two pulse midpoint converter, three pulse midpoint converter and' 3 phase six pulse bridge converter, effect of source inductance in converters, effect of freewheeling diode. 8 Hrs

Unit 4: Single phase and three phase half controlled converters: Speed control of d.c. motors using line commutated converters. Power factor improvement methods, Cyclo-converters (single phase), dual converter. 8 Hrs

Unit 5: D.C. Choppers: Principles of step down chopper, step up chopper classification, impulse commutated and resonant pulse choppers. Multi phase choppers. Application of choppers, Inverters: Basic series resonant inverter, half bridge and full bridge series resonant inverters. 10 Hrs

Unit 6: Single phase and three phase bridge inverters, commutation and trigger-circuits for forced commutated thyristor inverters. Output voltage control, Harmonics in output voltage waveform, Harmonic attenuation by filters. Harmonic reduction by pulse width modulation techniques. Analysis for pulse width, modulation. Working of current source inverters few applications of inverters. 10 Hrs

Text Books		
Title of Book	**Name of Author/s**	**Edition & Publisher**
Power Electronics circuits Devices and Applications	M. H. Rashid	Prentice Hall India
Power Electronics	Ned Mohan, T.M. Undeland and W.P. Robbins	John Wiley and Sons,Inc
Thyristors and their Applications	G.K.Dubey and Doralda, Joshi and Sinha	New Age
Power Electronics	Khanchandani	Tata McGraw Hill
Power Electronics	P. C. Sen	
Reference Books		
Power Electronics	C.W. Lander	

BEELE604P	**POWER ELECTRONICS**	**L = 0**	**T = 0**	**P = 2**	**Credits = 1**
Examination Scheme	College Assessment	University Examination		Total	Univ. Exam. Duration
	25	25		50	Practical

EELE605T	**CONTROL SYSTEM - I**	**L = 4**	**T = 1**	**P = 0**	**Credits = 5**
Examination Scheme	College Assessment	University Examination		Total	Univ. Exam. Duration
	20	80		100	3 Hrs

Learning Objectives	**Learning Outcome**
• To impart knowledge of modeling and stability analysis of linear time-invariant system. • To understand the stability, time domain specifications and tools • To study frequency domain analysis of linear system An introduction to state space approach.	• Model the linear systems and study the control system components specifications through classical and state variable approach. • Understand the time response and time response specifications. • Analyze the absolute stability • Analyse the relative stability through root locus method • Frequency response tools like bode plot and nyquist plot • Understand the introductory concepts of state variable approach

UNIT-1

Introduction to need for automation and automatic control. Use of feedback, broad spectrum of system application. Mathematical modeling (Electrical & Electromechanical) differential Equation, Transfer functions, block diagram, signal flow graph. 10Hrs

UNIT-2

Effect of feedback on parameter variations, disturbance signal, Control system components electrical, electromechanical, their functional analysis and input output representation. Servomechanism. 8Hrs

UNIT-3:

Time response of system, standard inputs, first order and second order system, concept of gain and time constant. Steady state error, type of control system, approximate methods for higher order system, PD, PI, PID controllers. 8Hrs

UNIT-4:

Stability of control systems, condition of stability, characteristics equation, Routh Hurwitz criterion, special cases for determining relative stability.

Root location and its effect on time response, elementary idea of root locus, effect of addition of pole and zero on proximity of imaginary axis. 10 Hrs

UNIT-5:

Frequency response method of analyzing linear system, Polar, Nyquist and Bode plot, stability and accuracy analysis from frequency response, open loop and close loop frequency response, effect of variation of gain and addition of pole and zero on response plot, stability margin in frequency response. 10 Hrs

UNIT-6:

State variable methods of analysis, characteristics of system state. Choice of state variables, representation of vector matrix differential equation, standard form, relation between transfer function and state variables. 8 Hrs

BOOKS:-

Text Books		
Title of Book	**Name of Author/s**	**Edition & Publisher**
Modern control system Engineerring	K.Ogatta	Prentice Hall,India
Control System Analysis	Nagrath/Gopal	New age International
Automatic Control Systems	B.C. Kuo	Prentice Hall,India
Control System Engineering	S. K. Bhattacharya	Pearson
Reference Books		
Linear System Design	D' azzo and Houpis	McGraw Hill
Control Systems, Principles & Design	M. Gopal	TMH (Tata McGraw Hill)
Control Systems Engineering	Samarajit Ghosh	Pearson

Practical:

Based on above syllabus. At least two practical should be set using related software.

BEELE606P	**INDUSTRIAL VISITS & REPORT WRITING**	**L = 0**	**T = 0**	**P = 2**	**Credits = 2**
Examination Scheme	College Assessment	University Examination		Total	Univ. Exam. Duration
	50	0		50	

Expected work from each student in this practical :-

1) Power point presentation on visited industry

2) Report must contain:-

Single line diagram of the establishment

Electrical Installations available in the establishment

List of Loads available with ratings of equipments

Types of load (continuous, intermittent etc.)

Analysis of Energy Bill

Any problems identified / discussed

BEELE607T **FUNCTIONAL ENGLISH**

BEELE607T	**FUNCTIONAL ENGLISH**	**L = 2**	**T = 0**	**P = 0**	**Credits = 2**
Examination Scheme	College Assessment	University Examination		Total	Univ. Exam. Duration
	10	40		50	2 Hrs

Syllabus

Total Credits: 02

Teaching Scheme
Theory: 2 hrs per week
Duration of University Examination :2 hrs

Examination Scheme
T (University): 40 marks
T (Internal): 10 marks

Objective: At the end of the semester, students will have enough confidence to face competitive examinations (IELTES/ TOEFL/CAT/ MAT/ XAT/SNAP/GMAT/GATE etc.)to pursue masters degree. They will also acquire language skills required to write their Reviews/Projects/Reports. They will be able to organize their thoughts in English and hence face job interviews more confidently.

Scope: The Curriculum designed is student –centered and it is guidance for their career

Course Structure

Unit 1. Functional Grammar: (4 hours**)**

Common errors, Transformation of Sentences, Phrases, Idioms & Proverbs.
[50 sentences of common errors, 50 examples of Transformation of Sentences, (5 each type), 50 noun/prepositional phrases, 50 idioms/proverbs]

Unit II. English for Competitive Exams & Interview Techniques: **(** 6 hours)

IPA (vowel & consonant phonemes), Word building (**English** words /phrases derived from other languages), Technical Jargons, Synonyms/Antonyms, Analogies, Give one word for, Types & Techniques of Interview

Assignment : [25 Words for teaching IPA, 25 words/phrases of foreign origin, 25 technical jargons, 25 words for Synonyms/ Antonyms, 25 words for Analogies, 50 examples of give one word for]

Unit III. Formal Correspondence (4 hours)

Business Letters, e-mail etiquettes [Orders, Complaints , Enquiries, Job applications and Resume Writing ,Writing Memorandum, Circulars, notices]

Unit IV. Analytical comprehension: (4 hours)
[Four fictional & four non-fictional unseen texts]

Unit V. Technical & Scientific Writing: (6 hours)
Features of Technical Writing, Writing Scientific Projects, Technical Report writing, Writing Manuals, Writing Project Proposals, Writing Research papers.
Assignment: (Any one project/review as assignment)

RECOMMENDED BOOKS

- **Reference Books:**

1. Effective technical Communication by Barun K. Mitra, Oxford University Press,
2. *Technical Communication-Principles and Practice* by Meenakshi Raman & Sharma, Oxford University Press, 2011, ISBN-13-978-0-19-806529-
3. *The Cambridge Encyclopedia of the English Language* by David Crystal , Cambridge University Press
4. *Contemporary Business Communication* by Scot Ober , Published by Biztantra,
5. *BCOM- A South-Asian Perspective* by C.Lehman, D. DuFrene & M. Sinha, Cenage Learning Pvt. Ltd.2012
6. *Business English*, by Dept of English, University of Delhi, Published by Dorling Kindersley (India), Pvt .Ltd.,2009, ISBN 978 81 317 2077 6
7. *How to Prepare a Research Proposal*: Guidelines for Funding and Dissertations in the Social and Behavioral Sciences by Krathwohl & R David
8. *Technical Writing- Process and Product* by Sharon J. Gerson & Steven M. Gerson, 3rd edition, Pearson Education Asia, 2000
9. *Developing Communication* skills by Krishna Mohan & Meera Banerjee

EVALUATION PATTERN:
Internal Examination: Weightage = 10 marks
Written Examination: 05 marks
Project Seminar : 05 marks

External Examination: Weightage = 40 marks

Question pattern for end semester examination

Unit No	Q. No	Question type	No. of Questions	Weightage
Unit 1	1(A) 1(B) 1(C)	objective objective objective	3 out of 5 3 out of 5 4 out of 6	3+3+4=10
Unit 2	2 (A) 2(B) 2(C)	objective objective subjective	3 out of 5 3 out of 5 1 (no choice)	3+3+4=10
Unit 3 & Unit4	3 (A) 3(B)	Subjective subjective	1 set (out of 2 sets) 1(no choice)	5 5
Unit 5	4(A) 4(B)	subjective subjective	1 out of 2 1 out of 2	5 5

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR
B.E. (Electrical Engineering)
SCHEME OF EXAMINATION

SEVENTH SEMESTER

S.N.	Sub Code	Subject	Board	Teaching Scheme				Credits	Examination Scheme			Min. Passing Marks	Paper Duration
				L	T	P	Total		College Assessment	Univ. Assessment	Total Marks		
1	BEELE701T	CONTROL SYSTEM-II	EE	4	1	0	5	5	20	80	100	40	3 Hours
2	BEELE702T	ELECTRICAL POWER SYSTEM –II	EE	4	1	0	5	5	20	80	100	40	3 Hours
3	BEELE703T	ELECTIVE –I	EE	3	1	0	4	4	20	80	100	40	3 Hours
4	BEELE704T	HIGH VOLTAGE ENGINEERING	EE	4	1	0	5	5	20	80	100	40	3 Hours
5	BEELE704P	HIGH VOLTAGE ENGINEERING	EE	0	0	2	2	1	25	25	50	25	
6	BEELE705T	ELECTRICAL INSTALLATION DESIGN	EE	4	1	0	5	5	20	80	100	40	3 Hours
7	BEELE705P	ELECTRICAL INSTALLATION DESIGN	EE	0	0	2	2	2	25	25	50	25	
8	BEELE706P	PROJECT SEMINAR	EE	0	0	3	3	3	50	0	50	25	
		Total		19	5	7	31	30			650		

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR
B.E. (Electrical Engineering)
SCHEME OF EXAMINATION

EIGHTH SEMESTER

S.N.	Sub Code	Subject	Board	Teaching Scheme				Credits	Examination Scheme			Min. Passing Marks	Paper Duration
				L	T	P	Total		College Assessment	Univ. Assessment	Total Marks		
1	BEELE801T	ELECTIVE- II	EE	3	1	0	4	4	20	80	100	40	3 Hours
2	BEELE802T	ELECTIVE- III	EE	3	1	0	4	4	20	80	100	40	3 Hours
3	BEELE803T	SWITCHGEAR & PROTECTION	EE	4	1	0	5	5	20	80	100	40	3 Hours
	BEELE803P	SWITCHGEAR & PROTECTION	EE	0	0	2	2	1	25	25	50	25	
4	BEELE804T	COMPUTER APPLICATIONS IN POWER SYSTEM	EE	4	1	0	5	5	20	80	100	40	3 Hours
	BEELE804P	COMPUTER APPLICATIONS IN POWER SYSTEM	EE	0	0	2	2	1	25	25	50	25	
5	BEELE805P	PROJECT	EE	0	0	6	6	6	75	75	150	75	
		Total		14	4	10	28	26			650		

S. No.	Elective-I	Elective-II	Elective - III
1	IT and Its Applications in Power System Control	Entrepreneurship Development	Bio-medical Engineering
2	Fuzzy Logic and Neural Networks	Digital Signal Processing	Advanced Microprocessor Peripherals
3	Flexible AC Transmission Systems	Power Quality	Power Semiconductor Based Electric Drives
4	Energy Management and Audit	EHV AC and HVDC Transmission	Electrical Distribution System

Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur

Absorption Scheme for the students of B. E. Electrical Engg. (Electronics & Power)

from <u>OLD semester</u> pattern to <u>NEW semester</u> pattern

VII Semester B. E. Electrical Engineering

Subject Code	Name of subject in Old semester pattern	Subject Code	Name of subject in New semester pattern
7S-EE-01	CONTROL SYSTEM-II (Th.)	BEELE701T	CONTROL SYSTEM-II
7S-EE-02	ELECTRICAL POWER –II (Th.)	BEELE702T	ELECTRICAL POWER SYST –II
7S-EE-03	ELECTIVE –I i) IT and Its Applications in Power System Control ii) Fuzzy Logic and Neural Networks iii) Flex A.C. Transmission Systems iv) Non conventional energy sources	BEELE703T	ELECTIVE –I i) IT and Its Applications in Power System Control ii) Fuzzy Logic and Neural Networks iii) Flex A.C. Transmission Systems iv) Energy Management and Audit
7S-EE-04	HIGH VOLTAGE ENGG. (Th.)	BEELE704T	HIGH VOLTAGE ENGG.
7S-EE-04	HIGH VOLTAGE ENGG (Pract.)	BEELE704P	HIGH VOLTAGE ENGG.
7S-EE-05	POWER ELECTRONICS (Th.)		----
	Power Electronics (Pract.)		----
7S-EE-06	PROJECT SEMINAR	BEELE706P	PROJECT SEMINAR
7S-EE-03	Electrical Installation Design (Elective-I) (Th.)	BEELE705T	ELECTRICAL INSTALLATION DESIGN*
		BEELE705P	ELECTRICAL INSTALLATION DESIGN *

***** The students who fail to clear any subject(s) of the VII semester (old pattern) by the last chance prescribed, shall be required to clear the respective equivalent subject of VII semester (new pattern) along with an additional subject marked with (*****).

Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur

Absorption Scheme for the students of B. E. Electrical Engg. (Electronics & Power)

from <u>OLD semester</u> pattern to <u>NEW semester</u> pattern

VIII Semester B. E. Electrical Engineering

Subject Code	Name of subject in Old semester pattern	Subject Code	Name of subject in New semester pattern
8S-EE-01	POWER SEMICONDUCTOR BASED DRIVES	BEELE802T	ELECTIVE- III i) Bio-medical Engineering ii) Advanced Microprocessor Peripherals iii) Power Semiconductor based Drives iv) Electrical Distribution System
8S-EE-02	ELECTIVE- II (Th.) i) EHV AC and HVDC Transmission ii) Entrepreneurship Development iii) Advanced Microprocessor Peripherals iv) Bio-medical Engineering v) Digital Signal Processing vi) Optimization Technique	BEELE801T	ELECTIVE – II i) Entrepreneurship Development ii) Digital Signal Processing iii) Power Quality iv) EHV AC and HVDC Transmission
8S-EE-03	SWITCHGEAR & PROTECTION (Th.)	BEELE803T	SWITCHGEAR & PROTECTION
8S-EE-03	SWITCHGEAR & PROTECTION (Pract.)	BEELE803P	SWITCHGEAR & PROTECTION
8S-EE-04	COMP.APPL.IN ELECTRICAL ENGG. (Th.)	BEELE804T	COMP.APPL.IN POWER SYSTEM
8S-EE-04	COMP.APPL.IN ELECTRICAL ENGG. (Pract.)	BEELE804P	COMP.APPL.IN POWER SYSTEM
8S-EE-05	PROJECT	BEELE805P	PROJECT

The students who fail to clear any subject(s) of the VIII semester (old pattern) by the last chance prescribed, shall be required to clear the respective equivalent subject of VIII semester (new pattern).

VII – SEM. ELECTRICAL ENGG.

BEELE701T - CONTROL SYSTEMS -II

Learning Objectives	Learning Outcomes
To impart knowledge of classical controller/compensator design for linear systems. To understand the theory and analyze non-linear system. To have idea about optimal and discrete time control system.	Students will be able to • Analyze the practical system for the desired specifications through classical and state variable approach. • Design the optimal control with and without constraints • Analyze non-linear and work with digital system and their further research.

UNIT - I

COMPENSATION: Need for compensation. Performance Analysis of Lead, Lag and Lag-lead Compensators in time & frequency domain, Bode Plots of Lead, Lag and Lag-lead Compensators. (Design of Compensator is not required).

UNIT-II

Solution of state equation: Review of state variable representations , diagonalization of state model ,eigen values and eigen vectors , generalized eigen vector, properties of state transition matrix (STM) , Computation of STM by Laplace transform, Cayley Hamilton theorem and Canonical transformation method. Solution of state equation.

UNIT-III

Design by state variable feedback: Controllability & observability. Kalman's test and Gilbert's test, duality, Design of State variable feedback. Effect of state feedback on controllability and observability.

UNIT-IV

Optimal Control System: Performance Index. Desirability of single P.I. Integral Square Error (ISE), Parseval's Theorem, parameter Optimization with & without constraints. Optimal control problem with T.F. approach for continuous time system only.

UNIT - V

Non Linear Control Systems: Types of non - linearities. jump resonance. Describing function analysis and its assumptions. Describing function of some common non- linearities. Singular points. Stability from nature of singular points. Limit cycles. Isocline method, Delta method.
(Construction of phase trajectories is not expected)

UN1T-VI

Sampled Data Control Systems: Representation SDCS. Sampler & Hold circuit. Shanon's Sampling theorem, Z-Transform. Inverse Z- Transform & solution of Differencial Equations. 'Z' & 'S' domain relationship. Stability by Bi-linear transformation & Jury's test. Controllability &. observability of Discrete time systems.

BOOKS :

Text Books		
Title of Book	**Name of Author/s**	**Edition & Publisher**
Control System Analysis	Nagrath & Gopal	New Age International
Linear Control System Analysis and Design	Constantine H. Houpis, Stuart N. Sheldon, John J. D'Azzo, Constantine H. Houpis, Stuart N. Sheldon	CRC Press
Digital Control and state variable methods	M. Gopal	The McGraw-Hill
Reference Books		
Modern Control Engineering	k. Ogata	Prentice Hall
Modern control system	M.Gopal	New Age International
Modern Control Engineering	D.Roy Choudhury	PHI Learning Private Limited, New Delhi

BEELE702T - ELECTRICAL POWER SYSTEM - II

Learning Objectives	Learning Outcomes
Students will understand the various aspects of electrical power systems such as stability, analysis of symmetrical components, various faults, economic scheduling and different methods of earthling.	A student will be able to • Understand the basics of power system. • Analyze and solve problems on symmetrical & unsymmetrical fault, stability. • Understand economy of operation and get familiar with types of grounding.

Unit 1: Symmetrical Component transformation: Three phase power in unbalanced circuit in terms of symmetrical component. Sequence impedances of Generator. Transformer Transmission line & Passive loads. Phase shift in Y/ delta three phase transformer (Yd1, Yd11 connection.).

Unit 2: **Symmetrical fault analysis:** Without & with pre fault load current . Selection of Circuit Breakers ratings, current limiting reactors.

Unit 3: **Unsymmetrical fault Analysis:** L-G, L-L-G, L-L, open conductors faults analysis using symmetrical components.

Unit 4: Stability of Power System- Steady state, Dynamic and Transient stability definition. Dynamics of synchronous machine, swmg equation, swing equation for machines swinging coherently and Non Coherently. Power angle equation. Steady state stability studies.

Transient stability studies: -

Swing curve. Equal Area criterion for transient stability. Application of equal area criterion for different disturbances. Solution of swing equation by point by point method. Methods of improving transient stability..

Unit 5: Economic operation of power system: Introduction, Distribution of load between units Within the plant Optimum generation scheduling considering transmission losses. Representation of transmission loss using loss formula coefficient. Derivation of loss formula co-efficient, simulation of co-ordination equation on digital computer.

Unit 6: i) Grounding of Neutral in power system.

ii) Shunt & series compensation-

Generalized equation, shunt reactor compensation of very long line with intermediate switching station, series capacitor compensation at line centre, shunt reactors at both ends and series capacitor in middle of line. Elementary idea of sub synchronous resonance problem arid counter measures.

Text Books		
Title of Book	**Name of Author/s**	**Edition & Publisher**
Elements of P.S. Analysis	William D. Stevenson	The McGraw-Hill Company
Modem power System analysis	Nagrath & Kothari	The McGraw-Hill Company
Power System Analysis	Wadhwa C.L	Tata McGraw-Hill Education
Reference Books		
Extra High Voltage AC. - Transmission Engineering	R D. Begamudre	New Age International

Note: - Unit 6 (ii) - Scope will be limited to the treatment given in recommended Book (4).

Elective- I BEELE703T (1)- I.T. & ITS APPLICATIONS IN POWER SYSTEM CONTROL

Learning Objectives	Learning Outcomes
Students will understand the various aspects of real time issues and communication required for automation. Student will also learn energy management and auditing.	A student will be able to • Understand the communication used for automation. • Understand the various aspects of energy auditing in industry • Do the networking of communication in industry with instrumentation and microprocessors.

UNIT# 1

Real-time issues on signal transmission and control; Communication systems for industrial automation; Data acquisition and Supervisory" control; Control of discrete manufacturing processes, Intelligent systems for monitoring, supervision and control; Case studies of industrial control systems.

UNIT # 2

Energy Auditing-Introduction, importance of Energy Audit basic terms of energy audit, Procedure for carrying energy audit, instruments used for energy audit such as power analyzer multipoint heat flow meter, lux meter, portable infrared radiation thermometer, thermocouple based temperature indicator.

Energy Conservation & Management-Need & importance of Energy Conservation & Management, payback period, return on investment (ROI),life cycle costs ,specific energy consumption. Calculation of Energy costs of specified products & simple systems. Analysis of selected energy intensive units like iron-steel, cement, petroleum refining etc.

UNIT # 3

Principles of multi-objective Energy management - with emphasis on conservation, User friendly software development on Windows 9x. UNIX Platforms for Energy Conservation &. Management Studies.

UNTT # 4

Serial data communication using RS232 and RS485 based system, distributed measurement system. IEEE488 protocol.

UNIT # 5

Local area networks - Common topologies. Medium access control-round-robin, reservation and contention based strategies. ALOHA protocol and its variants. CSMA and CSMA/CD protocols. Token-ring protocol. IEEE 802 standards for local area networks. High speed LANs - Fast and Gigabit Ethernet, FDDI. Wireless LANs. Internet Working- Repeaters, bridge routers *a*nd gateway S. TCP/IP protocol suite. TCP/IP sockets, client server computing. Name Service. Application protocols over TCP/IP. Network-Security.

UNIT # 6

Design of microprocessor based Instrumentation systems, design. interfacing circuits and data acquisition systems.

Text Books		
Title of Book	**Name of Author/s**	**Edition & Publisher**
Microprocessor & Interfacing	D.V Hall	Tata McGraw-Hill Education
LAN	Keiser	McGraw Hill
Reference Books		
Energy management	William T. Synder & Fredric W. symonds	
Energy management Handbook	W C Turker	

Elective- I BEELE703T (2)- FUZZY LOGIC & NEURAL NETWORK

Learning Objectives	Learning Outcomes
Students will understand the various aspects of fuzzy logic and neural network.	A student will be able to • Understand the fundamentals of fuzzy logic and ANN. • Learn different neural networks • Learn concepts of Associative memories and self organizing network.

UNIT –I: Introduction:

1. Fuzzy sets, Approximate reasoning Representing set of rules.
2. Fuzzy knowledge based.(FKBC)parameters. Introduction rule and data base inference engine, choice of fuzzyfication and & defuzzyfication processes.

UNIT -II: Nonlinear Fuzzy Control

Introduction, Control problem, FKBC as nonlinear transfer element, types of' FKBC.

UNIT - Ill: Adaptive Fuzzy control

Introduction, design, and performance evaluation, main approach to design.

UNIT-IV:

I. Fundamental concept of ANN.

2. Model of artificial neural network (ANN), Learning & adaptation learning rules.

Feed forward network:

Classification Model, feature & decision regions; Minimum distance, Classification, perceptron, delta learning rules for multi-perceptron layer, Generalized learning rules, back propagation Algorithm, back propagation training, learning factors.

UNIT - V: Recurrent Networks

Mathematical foundation of discrete time & gradient type hope field networks, transient response & relaxation modeling.

UNIT-VI: Associative memories &, self organizing networks.

Basic concept & performance analysis of recurrent associative memory',' 'Bidirectional associative memory, Hamming net & MAXNET Unsupervised larning of clusters, counter propagation network, feature mapping self organizing feature maps, cluster discovery network (ART 1)

Text Books		
Title of Book	**Name of Author/s**	**Edition & Publisher**
Introduction of Artificial Neural Networks	Jacek M. Zurada	PWS Publishing Company
Neural Network & Fuzzy system	Bart Kosko	Prentice Hall,India
Neural Networks: Comprehensive Foundation	Simon Hayking	Macmillan , Canada Inc
Reference Books		
An Introduction to Fuzzy Control	Dimiter Driankov, Hans Hellendoorn, Michael Reinfrank	Springer,
Fuzzy sets: ncertainty & information	Klir & Folger	Prentice Hall,India
Digital Image Processing	Gonzalez	AWFC

Elective- I BEELE703T (3) FLEXIBLE AC TRANSMISSION SYSTEMS

Learning Objectives	Learning Outcomes
To understand the problems and constraints related with stability of large interconnected systems and to study their solutions using different FACTS controllers, shunt (SVC, STATCOM), series (TCSC, GCSC, SSSC), series-shunt (UPFC), series-series (IPFC) .	A student who successfully completes the course will be able to demonstrate the • Ability to understand and identify the problems and constraints with stability of large interconnected system. • Ability to understand different types of converters, regulators and compensators

Unit-I: FACTS CONCEPT AND GENERAL SYSTEM CONSIDERATION:
Transmission Interconnection, Flow of Power in an AC System, factors affecting the Loading Capability, Power Flow and Dynamic Stability Consideration of Transmission interconnection, relative importance of controllable. Parameters, FACTS Controller.

Unit-II: VOLTAGE-SOURCED AND CURRENT. SOURCED CONVERTERS:
Single phase three phase full wave bridge converters transformer connections for 12 pulse 24 and 48 pulse operation. Three level voltage source converter, Generalized Technique of Harmonic Elimination and Voltage Control, Basic pulse width modulation converter, basic concept of current source Converters, and comparison of current source converters with voltage Source converters.

Unit-3: **STATIC SHUNTS COMPENSATORS: SVC AND STATCOM:**
Objectives of shunt Compensation, midpoint voltage regulation voltage instability prevention, improvement of transient stability, Power oscillation damping, Methods of Controllable VAR Generation, Static Var Compensators SVC and STATCOM, Comparison Between STATCOM and SVC, Static Var System.

Unit-4: STATIC SERIES COMPENSATORS: GCS, TSSC, TCSC AND SSSC:
Objectives of series Compensation, improvement of transient stability, power oscillation damping, Variable Impedance Type Series Compensators, Switching Converter Type Series Compensators (only SSSC), External (System) Control for Series *Reactive* Compensators. Applications of SSSC in load flow and transient stability studies.

Unit-5: STATIC VOLTAGE AND PHASE ANGLE REGULATORS; TCVR AND TCPAR:
Objectives of Voltage and Phase Angle regulators, Approaches to Thyristor Controlled Voltage and Phase Angle Regulators (TCVR and TCPARs), Switching Converter-Based Voltage and Phase Angle regulator, Hybrid Phase Angle Regulators.

Unit-6: COMBINED COMPENSATORS (UPFC, IPFC) AND SPECIAL PURPOSE FACTS CONTROLLERS:
The Unified Power Flow Controller (UPFC}, operating principal v-I Characteristics UPFC_–_Principal of Operation-modes of operation-application**.** Interline Power Flow Controllers Generalized and Multifunctional FACTS Controllers, Sub synchronous Resonance, NGH-SSR Damping Scheme, Thyristor-Controlled Braking Resistor (TCBR).

BOOKS :

Text Books		
Title of Book	**Name of Author/s**	**Edition & Publisher**
Understanding FACTS	Narayan G. Hingorani and Laszlo Gyigyi	Standard Publishers
FACTS : Controllers in Power Transmission & Distribution	K. R. Padiyar	1st , New Age International
Flexible AC Transmission System (FACTS)	Edited by Yang Hua Song and Johns	IEEE Publishers
Reference Books		
HVDC and FACTS controllers – Applications of Static Converters in Power System	V.K.Sood	New Age International(P) Limited, Publishers, New Delhi,
Thyristor Based FACTS Controllers for Electrical Transmission System	R. Mohan Mathur, Rajiv K Verma	Wiley

Elective- I BEELE703T (4) ENERGY MANAGEMENT AND AUDIT

Learning Objectives	Learning Outcomes
To understand the need of energy audit and the mechanism through which it should be carry out and also to manage the electric and thermal energy.	A student will able to • Know Present energy scenario with need of energy audit and energy conservation. • Understand various aspects of energy audit such as planning, monitoring and implementation • Manage electric and thermal energy in the industry.

Unit 1: Basics of Energy Management and Conservation (10 Hrs)

Global and Indian energy scenario. Global environmental concerns, Climate Change, Concept of energy management, energy demand and supply, economic analysis; Carbon Trading & Carbon foot prints.

Energy Conservation: Basic concepts, Energy conservation in household, transportation, agricultural, service and industrial sectors; Lighting & HVAC systems in buildings.

Unit 2: Energy Audit (8 Hrs)

Definition, need, and 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 & energy substitution; Energy audit instruments; Energy Conservation Act; Duties and responsibilities of energy managers and auditors.

Unit 3: Material & Energy balance and Waste Heat Recovery (8 Hrs)

Facility as an energy system; Methods for preparing process flow; material and energy balance diagrams.
Cogeneration and waste heat recovery;

Unit 4: Energy Action Planning, Monitoring and Targeting: (8 Hrs)

Energy Action Planning : Key elements; Force field analysis; Energy policy purpose, perspective, contents, formulation, ratification; Organizing the management: location of energy management, top management support, managerial function, roles and responsibilities of energy manager, accountability; Motivation of employees: Information system-designing barriers, strategies; Marketing and communicating: Training and planning.

Monitoring and Targeting : Defining monitoring & targeting; Elements of monitoring & targeting; Data and information analysis; Techniques: energy consumption, production, cumulative sum of differences (CUSUM); Energy Service Companies; Energy management information systems; SCADA systems.

Unit 5: Electrical Energy Management: (8 Hrs)

Supply side: Methods to minimize supply-demand gap, renovation and modernization of power plants, reactive power management, Demand side management: conservation in motors, pumps and fan systems; energy efficient motors.

Unit 6: Thermal energy Management: (8 Hrs)

Energy conservation in boilers, steam turbines and Furnaces; Application of FBC, Heat exchangers and heat pumps.

Text Books		
Title of Book	**Name of Author/s**	**Edition & Publisher**
Handbook on Energy Audits and Management	Amit Kumar Tyagi	TERI
Energy Management Handbook	Wayne C. Turner	Wiley Inter Science Publication
Reference Books		
Principles of Energy Conservation	Archie, W Culp	McGraw Hill, 1991
Energy Management	P. O'Callaghan	McGraw - Hill Book Company, 1993
Handbook of Energy Engineering	Thuman A and Mehta D Paul	The Fairmount Press
Bureau of Energy Efficiency Study material for Energy Managers and Auditors Examination: Paper I to IV.		
Handbook of Energy Audit and Environment Management	Y.P. Abbi, Shashank Jain	TERI

BEELE 704 T- HIGH VOLTAGE ENGINEERING

Learning Objectives	Learning Outcomes
Student will learn the various concepts of high voltage engineering such as breakdown mechanism, lightning and switching overvoltage, travelling waves etc. Student will also learn measurement and calculation of high voltage and current using different tests.	Students has understood breakdown mechanism in solid liquid and gaseous medium lightening and switching over-voltages and insulation coordination different methods of generation and measurement of high voltage and currents in laboratory different methods of non destructive and High Voltage testing of apparatus.

Unit 1 : Breakdown mechanism in Di-electric : Ionization process; Townsend's criterion for B.D. Break down in electro-negative gases, Time-lag for B.D.; Streamer theory for B.D in gases, Paschen's law; B.D in non-uniform field. Corona discharges and introduction of corona post B.D. phenomenon and applications, Practical considerations in using gases for insulation purpose; vacuum insulation, Liquid as insulators, conduction and B.D. in pure and commercial liquids. Intrinsic, electromechanical &.thermal B.D., B.D. of solid di-electrics in practice; B.D. in composite dielectrics.

Unit 2: Lighting and switching over voltages; Mechanism of lightening, types of strokes, parameter and characteristics of lightening strokes, characteristics of switching surges; power frequency over voltages. control of O.V. due to switching. Protection of lines by ground wires, protection by lightning Arrester, gap type and sapless L.A.., selection of L.A. ratings, surge-absorbers.

Unit 3: Traveling waves and Insulation coordination; Traveling waves' on transmission lines, Classification of lines attenuation and distortion of traveling waves, reflection and transmission of waves, behavior of rectangular waves at transition points. Introduction to insulation coordination, associated terms, impulse waveform. Introduction to BIL Reduced BIL and SIL.

Unit 4: Generation of high voltage and. Currents: Generation of High D.C voltages by rectifiers, voltage doubler and multiplier, circuits (Derivations and expression 'not required), electrostatic machines, Generation of high AC voltages by Cascade transformers, Resonant transformers, generation high frequency AC high voltage. Generation of impulse voltages: Standard impulse wave shapes, analyses of model and commercial impulse generation circuits, wave shape contro1 Marx circuit, tripping and control of impulse generation, generation of switching surges generation of impulse current.

Unit 5: -Measurement of high voltage and current: Measurement of high AC and DC voltage by micro ammeter, generating voltmeter resistance and capacitance potential divider, series impedance voltmeter CVT, Magnetic type potential transformers, electrostatic voltmeter. Peak reading AC voltmeter. Sphere gap arrangement. Measurement of impulse voltage by' potential dividers and peak reading voltmeters. Measurement of High AC DC current; measurement of high frequency and impulse current by resistive shunt (Bifilar strip shunt only,)

Unit 6: Non destructive and high voltage testing of electrical apparatus; Non destructive testing Measurement of DC Resistivity, measurement of Dielectric constant and loss-factor *(low* and power frequency only), Schering bridge for high charging circuits, for high dissipation factor for three terminal measurement, transformer ratio arm bridges, partial discharge measurements by straight detectors & by balance detectors , calibration of detectors, discharge detection *in* power cables. High voltage testing. Testing of insulators, bushings, Isolators, circuit. breakers, cables, transformer, lightning arresters and power capacitors.

Text Books		
Title of Book	**Name of Author/s**	**Edition & Publisher**
High Voltage Engineering	M.S. Naidu and V Kamaraju	TMG
High Voltage Engineering	C.L.Wadhwa	New Age International
EHV AC Transmission	Begamudre	New Age international Publisher
Reference Books		
Advances In high Voltage Engineering	A.Haddat and D. Warne	IET

BEELE 705 T - ELECTRICAL INSTALLATION DESIGN

Learning Objectives	Learning Outcomes
The course will prepare students 1. The course will prepare students to understand methodology of load forecasting and assessment of electrical loads, types of electric loads and selection of apparatus for controlling electrical power. 2. The course will prepare students to design the distribution system for residential, commercial, industrial applications and utility distribution networks and illumination design 3. The course will prepare students to understand methods of installation, testing and commissioning of electrical apparatus and conductors. 4. The course will prepare the students to understand statutory requirements related to electrical design, safety and protection.	Upon the completion of this course, a. The students will understand concept of load forecasting, solve problems based on regression analysis. b. The students will be able to draw single line diagrams with specifications for electrical distribution networks for residential and commercial installations. c. The students will be able to draw single line diagrams with specifications for distribution networks, motor and power control centers for industrial installations and design reactive power compensation. d. The students will be able to understand construction, types and selection of PVC/ XLPE cables and overhead conductors e. Students shall be able to design 11kV and 33 kV substations for utility and industrial installations and specify the ratings and specifications of apparatus used f. Students shall be able to understand procedure for receipt, storage, testing and commissioning of transformers along with its accessories viz OTI, WTI, Silica Gel Breather, MOG, Buchholz relay etc g. Students will be able to determine fault level at various locations in radial networks and be able to find rating and location of series reactors h. Students will understand the relevant provisions of IE rules for low medium and high voltage installations i. Students will be able to understand provisions for system and equipment earthings as per IS 3043

Unit 1:

Electrical load assessment: **(4H)**

Concept of electrical load, categories of load, types of loads, connected load, demand factor, Maximum demand, diversity factor, load factor, power factor, TOD Tariff, Industrial Electric Bills.

Cables, conductors & bus-bars: **(4H)**

Construction, selection, installation, testing of LT/ HT cables, overload & short circuit ratings, rating factors; Overhead line conductors, copper and aluminium busbars.

Unit 2:

Switching & protection devices: **(5H)**

Types, specifications; selections of isolators, switches, switch fuse units, MCB, ELCB, MCCB,ACB, VCB, SF6 breakers, dropout/ horn gap fuses, AB switches, contactors for voltages upto 33 kV. Various types of protective releases for above circuit breakers.

Symmetrical Short Circuit Calculations: **(4H)**

Determining symmetrical short circuit currents at various locations for selecting proper circuit breaker rating & determining value of series reactors for limiting short circuit current. Overcurrent protection with two phase fault & one ground fault relays.

Unit 3:

Electric supply to Induction Motors in industries: **(5H)**

Types of motors, SLD and working of DOL/ Star-Delta/ Autotransformer starters; types, specifications, selection of power contactors, Overload relays, short circuit protective devices.

Reactive power management in industries: **(4H)**

Reactive power compensation in industries using static capacitors, use of Power Triangle, Calculating payback period for capacitor investment due to reduced system currents.

Unit 4:

Transformers: **(4H)**
Specifications, ratings, selection, installation, testing & commissioning.
Substations: **(4H)**
11kV & 33 kV, indoor/ outdoor substations, plan/ elevations, Earthing Arrangement

Unit 5:
Design of Industrial Electrical Installations: **(8H)**
Preparing load list, assessing various factors associated with loads, selection of transformer, design of PCC & MCC, selection of all the associated electrical apparatus, busbars, cables, switchgear, protective devices, earthing system, testing, commissioning.
Unit 6:
Earthing (IS 3043): **(4H)**
Necessity of earthing, concept of system & equipment earthing, definitions of various terms, types of earthing, earth tester and measurement of earth resistance.
IE Rules: **(4H)**
Important IE Rules applicable to residential, commercial & industrial installations.

Text Books		
Title of Book	**Name of Author/s**	**Edition & Publisher**
Electric Power Distribution system	A.S.Pabla,	Tata McGraw-Hill
Course in Electrical Power	P. V. Gupta, M. L. Soni, U. S. Bhatnagar	Dhampat Rai and Sons., 1987
Electrical Substation Engineering & Practice	S. Rao	Kanna Tech. Publ., 1992
Reference Books		
Design of Electrical Installations	V. K. Jain, Er. V.K. Jain & Er. Amitabh Bajaj	Laxmi Publications Pvt Limited, 01-Jan-1993
Electrical Engineering Handbook	C. L. Wadhwa	
Indian Electricity Regulation 1956		

BEECE 705 P – ELECTRICAL INSTALLATION DESIGN (PRACTICAL)

A. Visit for Comprehensive study of existing electrical installation:
Student should visit a residential/ commercial or industrial facility, preferably with its own transformer substation and:

1. Understand the processes in which the electricity is used and characterize the processes viz lighting, heating, cooling, air-conditioning, ventilation, pumping and other industry specific applications like mixing, pulverizing, machining, welding etc.
2. Prepare a list of all the loads demanding electric supply and assess "connected load"
3. Get the copies of at least six previous electric bills and determine the "demand factor", "load factor""power factor" etc.
4. Study the tariff structure and note various costs, taxes and duties. Understand TOD tariff. Note the sanctioned load, contract demand etc.
5. Note how the establishment receives electric supply (overhead/ underground), its voltage level (HT/LT, single phase two wire/ three phase three wire, three-phase four wire etc. Note the specifications of incoming conductor/ cable.
6. Note the type of energy meter used by electricity board (analogue/ digital, single/ three phase, directly connected/ CT operated, HT metering cubical)
7. Draw the power flow diagram of the electrical installation including transformers, stand- by DG supply
8. Convert the power flow diagram into single line diagram (SLD). Identify different components of Power Control Center (PCC) and Motor Control Center (MCC). Specify the current rating and specifications of various HT/LT switchgear and control- gear.

9. Identify various protections against earth leakage, overloads and short circuits.
10. Note in details the Earthing System, types, material used and quantity of earth electrodes etc.
11. Note reactive power management system, types and rating of capacitors, manual/ automatic control of PF improvement capacitors, Location of capacitors in system.
12. Submit the report for assessment.

B) Understanding the operating principle, construction and internal parts of electrical apparatus/ equipments:

Power and Control contactors: power contacts, control contacts, fixed/ moving contacts, magnetic circuit, copper shading band in AC contactors, operating coil, arc chutes; dismantling & assembly of contactors.Capacitor Duty Contactors.Rating & Specifications.

Switchgear: Re-wirable/ HRC main switches (Switch fuse, fuse switch units), MCB/ MCCB (Thermal/ magnetic release), Overload relays. Identifying difference between switch and circuit breakers. Single vs double break arrangement of contacts.

Transformer accessories: Buchholz Relay, Oil temperature Indicator (OTI), Winding Temperature Indicator (WTI), magnetic Oil Level Gauge, Silica Gel Breather.

C) Performing Routine Tests:

1. OC/ SC test on 5 kVA, Three –phase, delta- star transformer.Megger Test.
2. Turns ratio, magnetic Balance Test; Megger Test on three phase transformer.
3. Megger and Continuity test for HT/ LT cables.

C) Assembling and testing of DOL and Automatic Star Delta Starters.

D) Simulation for 3-phase short circuit current in distribution system using software like e-tap.

E) Common HT equipments: construction, operation, specifications, ratings of 11 kV AB Switch, Drop Out/ Horn Gap fuse, Distribution/ station class lightening arrestors.

F) Earthing system: Study of various types of Earth electrodes (rod/pipe/plate), maintenance free earth electrodes, Measurement of Earth electrode resistance and measurement of soil resistivity.

G) Some practicals based on illumination.

H)Preparing a list of reputed national/ global manufacturers in Electrical systems, their product range.

VIII – SEM. ELECTRICAL ENGG.

Elective II BEELE 801 T (1) - ENTREPRENEURSHIP DEVELOPMENT

Learning Objectives	Learning Outcomes
Student will learn how to become an entrepreneur. Various role an entrepreneur has to play such as market surveyour, project manager, planner, Operational incharge etc.	Students has understood • How to carry out market survey, demand forecasting etc. • How to calculate economic feasibility, preparation of project report, project planning, implementation schedule etc. • How to do performance analysis, environmental and societal impact.

UNIT - I

Need analysis, market survey, characteristics of market, sample survey, demand forecasting secondary data, accuracy, and confidence level, uncertainty.

UNIT- II

Technical feasibility: Process selection, level of automation, plant capacity, acquiring technology, appropriate technology plant location, Equipment selection & procurement, Govt. policies.

UNIT - III

Economic feasibility: Cost of project working capital analysis, fixed cost, means of finance, estimation of sales and production price analysis, breakeven point, projected cash flow statements, projected balance sheet, projected profit and loss statement, projected cash projected cash flow, rate of return, discounted payback period, cost benefit analysis , return after taxes.

UNIT - IV

Project Planning & Control: CPM, PERT. Optimum project duration, resource allocation, updating.

UNIT V:

Project report: Preparation of project report, risk analysis, sensitivity analysis, methods of raising capital.

UNIT VI:

Project review:

Initial review, performance analysis, ratio analysis, sickness, project revival, environmental & social aspects.

Text Books		
Title of Book	**Name of Author/s**	**Edition & Publisher**
Engineering Economy	H.G. Thuesen. W.J. Fabricky, G.J. Thuersen	Prentice Hall of India Pvt. Ltd
CPM & PERT	Shrinath	East West publisher
Reference Books		
Projects	P.K Joy	Mc Millan
Projects	Prasanna Chandra	Tata Mc Graw Hill Publishing Company Ltd

ELECTIVE-II BEELE 801 T (2) -DIGITAL SIGNAL PROCESSING

Learning Objectives	Learning Outcomes
Student will learn discrete time signals and systems with representation in different ways. They will also learn how to do the analysis using Fourier and Z-transform.	Students has understood • Discrete time signals and system. • Use of Fourier and z-transform in analysis of discrete signals. • Various filter design techniques use for discrete variables and discrete Fourier transform

UNIT–1: Discrete time signals & systems; Discrete time signals, Discrete time systems, Classification of discrete time systems: Linearity, causality, stability, static dynamic, Time Invariance Time variance. Linear convolution, circular convolution, cross correlation, Autocorrelation. Sampling theorem & sampling process, Reconstruction of sampled data.

UNIT- II: Frequency domain representation of discrete time signals and systems, Fourier transform (DTFT) of discrete time signals, properties of discrete time Fourier transform,

UNIT - III: The Z - transform: Definition. Properties of the region of convergence for the Z- transformer, Z - transform properties, Inverse Z - transform using contour integration, partial fraction expansion, power series methods, Parseval's theorem, unilateral Z – transform.

UNIT – IV: Transform analysis of LTI system & structures for discrete - time system: Frequency response of LTI system, relationship between magnitude & phase, all pass system, minimum phase system, linear system with generalized linear phase.

Block diagram representation & signal flow graph representation of linear constant Coefficient difference equations, basic structures for IIR systems, transposed forms, basic network structures for FIR systems, lattice structures.

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UNIT - V: Filter design techniques: Design of discrete time IIR filters from continuous time filters.
Frequency transformations of low pass IIR filters, Design of FIR filters by windowing, FIR filter design by Kaiser Window method. Frequency sampling method.

UNIT-VI: Discrete Fourier Transform: Discrete Fourier series, properties of discrete Fourier series, discrete Fourier transform, properties of DFT, circular convolution using discrete Fourier transform. Decimation in time FFT algorithm, decimation in frequency FFT, FFT of long sequences using overlap add & overlap save method.

Text Books		
Title of Book	**Name of Author/s**	**Edition & Publisher**
Discrete time signal processing	Alan V. Oppenheim, Ronald W. Schafer & Buch	2nd, Pearson
Digital Signal Processing - A Computer based approach	Sanjit K. Mitra	McGraw-Hill Education, 2011
Reference Books		
Digital signal processing Theory & application	Prows end Manolakis	3rd, PHI Ltd.
Digital signal processing, principles, algorithm and applications	John G. Prokis	PHI Ltd.

Elective- II **BEELE 801T (3) POWER QUALITY**

Learning Objectives	Learning Outcomes
Students will know the various power quality issues such as voltage sag, swell, flickers etc. with a waveform distortion. They will also learn how to monitor, assess and mitigate these issues.	Students will be able to understand • Power quality standards for voltage sag, swell, distortions, flickers etc. • Approach for power quality monitoring, assessment and mitigation. • State variable model and harmonic estimation.

Unit I: Introduction: Importance of power quality, terms and definitions of power quality as per IEEE std. 1159. such as transients, short and long duration voltage variations, interruptions, short and long voltage fluctuations, imbalance, flickers and transients. Symptoms of poor power quality. Definitions and terminology of grounding. Purpose of groundings. Good grounding practices and problems due to poor grounding. **(8 Hrs)**

Unit II: Flickers & transient voltages: RMS voltage variations in power system and voltage regulation per unit system, complex power. Principles of voltage regulation. Basic power flow and voltage drop. Various devices used for voltage regulation and impact of reactive power management. Various causes of voltage flicker and their effects. Short term and long term flickers. Various means to reduce flickers. Transient over voltages, sources, impulsive transients, switching transients, Effect of surge impedance and line termination, control of transient voltages. **(10 Hrs)**

Unit III: Voltage sag, swells and interruptions: Definitions of voltage sag and interruptions. Voltage sags versus interruptions. Economic impact of voltage sag. Major causes and consequences of voltage sags. Voltage sag characteristics. Voltage sag assessment. Influence of fault location and fault level on voltage sag. Areas of vulnerability. Assessment of equipment sensitivity to voltage sags. Voltage sag *limits for computer equipment, CBEMA, ITIC, SEMI F 42 curves. Representation of the results of voltage sags analysis. Voltage sag indices. Mitigation measures for voltage sags, such as UPS, DVR, SMEs, CVT etc., utility solutions and end user solutions. **(8Hrs)**

Unit IV: Waveform Distortion: Definition of harmonics, inter-harmonics, sub-harmonics. Causes and effect of harmonics. Voltage versus current distortion. Overview of Fourier analysis. Harmonic indices. A.C. quantities under non-sinusoidal conditions. Triplen harmonics, characteristics and non characteristics harmonics. Harmonics series and parallel resonances. Consequences of harmonic resonance. Principles for controlling harmonics. Reducing harmonic currents in loads. K-rated transformer. Harmonic study procedure. Computer tools for harmonic analysis. Locating sources of harmonics. Harmonic filtering, passive and active filters. Modifying the system frequency response. IEEE Harmonic standard519-1992. **(10Hrs)**

Unit V: Power quality monitoring Need of power quality monitoring and approaches followed in power quality monitoring. Power quality monitoring objectives and requirements. Initial site survey. Power quality Instrumentation. Selection of power quality monitors, selection of monitoring location and period. System wide and discrete power quality monitoring. Setting thresholds on monitors, data collection and analysis. Selection of transducers. Harmonic monitoring, Transient monitoring, event recording and flicker monitoring. **(6Hrs)**

UNIT VI: Power Quality Assessment & Mitigation Power Quality assessment, Power quality indices and standards for assessment disturbances, waveform distortion, voltage and current unbalances. Power assessment under waveform distortion conditions. Power quality state estimation, State variable model, observability analysis, capabilities of harmonic state estimation. Test systems. Mitigation techniques at different environments. (**8 Hrs**)

Text Books		
Title of Book	**Name of Author/s**	**Edition & Publisher**
Understanding power quality problems, voltage sag and interruptions	M. H. J. Bollen	IEEE press, 2000, series on power engineering
Electrical power system quality	R.C. Dugan, M.F. McGranghan, S. Santoso, H. Wayne Beaty	2nd, McGraw Hill Pub.
Reference Books		
Power system quality assessment	J. Arrillaga, M.R. Watson, S. Chan	John Wiley and sons
Electric power quality	G. J. Heydt	
Power system harmonics: Computer modeling and analysis	Enriques Acha, Manuel Madrigal	John wiley and sons ltd
Power System Harmonics	J. Arrillaga & N. Watson	
IEEE std 519-1992/ IEEE std 1159 IEEE recommended practices and requirements for harmonics control in electrical power system		

ELECTIVE-II BEELE 801T (4) - EHV AC & HVDC TRANSMISSION

Learning Objectives	Learning Outcomes
Students will understand various aspects of Transmission systems, power flow controls for EHVAC and HVDC transmission lines,design parameters of filters and Layout of HVDC power plant	On Successful Completion of the course the Student will be able to demonstrate the knowledge of : • Power handling capacity of different Transmission systems • Electrostatic and electromagnetic fields and corona in EHVAC lines • Voltage control and current control systems for power flow controls in HVDC system. • The knowledge of design parameters of AC filters as well as DC filters and Reactive power compensation • Overall knowledge about the HVDC system such as MTDC, protection and substation layout of HVDC power plant.

Unit 1: (i) Power Handling capacities of EHV AC transmission lines. (ii) Voltage, gradients; Electric field of point charge sphere gap, line-charge, single and three phase line bundled conductors. Maxwell's potential coefficients, Mangoldt formula.

Unit 2: (i) Electrostatic and electromagnetic fields of EHV line electric shock and Threshold current capacitance of long object; calculation of electrostatic field of AC. Lines (3-phase single and double circuit lines only) Effect of high electrostatic field, measurement *of* electrostatic field, induced voltages in insulated ground wires, electromagnetic interference (ii) Corona types, critical disruptive voltages; factor affecting corona, methods for reducing corona power loss, corona current wave form charge voltage diagram audible noise and radio interference.

Unit 3: (i) Comparison of EHVAC and HVDC systems. (ii) Conversion from AC to DC. Rectifiers, converter conversion from DC to AC, Invertors. (iii) Kinds of DC link. (iv) Earth electrode and earth returns; Introduction & objectives, location and configuration, resistance of electrodes, means of reducing earth electrode resistance, trouble caused by earth current and remedies. (v) Multi terminal HVDC system: Introduction, 2 pole transmission, MTDC system with series and paral1el connected converters, advantages OF parallel connected converters, and applications, configurations and types.

Unit 4:- (1) Power flow control in HVDC system: Constant current. Constant voltage, constant ignition and excitation angle control, control characteristics. (ii) Parallel operation of AC and DC links (Synchronous and Asynchronous links)

Unit 5:-(i) Harmonic Filters: Introduction, Filters, Surge capacitor and damping circuit, shunt filters, senes filters, AC filters, design of AC. filters and turned filters, double frequency and damped filters cost consideration. Rating AND harmonics on D.C. Side of converter, D.C. Harmonic filters. (ii) Reactive power compensation: Reactive power requirements of HVDC convertors, substations, effect of Delay angle and extinction angle on reactive power.

Unit 6: (1) HVDC circuit breakers Introduction, construction, principle, switching energy interruption of DC current application of MRTB. Types of HVDC C.B. capability and characteristics of HVDC circuit breakers (ii) HVDC substation protection against short circuit: Introduction, fault Clearing, protective zones, protection symbols, HVDC line pole protections (fault clearing and re-energizing), (iii) HVDC sub-station protection against over voltage, difference between Insulation coordination of AC and DC systems, fundamentals of switching over voltages, Over Voltages on A.C sides, and on D.C side surge- Arrestors protection scheme. Insulation coordination and protection margin.

Text Books		
Title of Book	**Name of Author/s**	**Edition & Publisher**
EHV AC and HVDC Transmission Engineering and practice	Sunil S. Rao	Khanna, publications
Electrical Power Systems	C.L. Wadhwa	2nd Edition New Age International
Reference Books		
EHV AC Transmission	Rakosh Das Begamudre	New Age International

ELECTIVE-III BEELE 802 T (1) - BIOMEDICAL ENGINEERING

Learning Objectives	Learning Outcomes
Students will understand the human body physiology with subsystem. Different methods of monitoring system of human body parameters and different control methods used.	On Successful Completion of the course the Student will be able to understand : • Physiology of human body with subsystem. • Different parameter measurement and monitoring using different devices • Control of body functioning using electronic devices.

UNIT - 1: Introduction: Human body physiology and subsystems, Biochemistry, Measurement of Electrical activities of human body.

UNIT - 2: Electrocardiography, Electro-encephalography, electromyography, Electroretinography, Principles specifications and interpretation of records.

UNIT -3: Measurement of no electrical quantity in human body, Measurement of blood flow respiration rate and depth heart rate.

UNIT- 4: ESR blood pressure, temperature PH impedance of various parts GSR mobility of internal organs.

UN1T-5: Control of body functioning: Stimulator for muscle and nervous system cardiac pacemaker.

UNIT- 6: Blood pump respiration controller myo electric control of paralyzed muscles.

Text Books		
Title of Book	**Name of Author/s**	**Edition & Publisher**
Biomedical Instrument	Cromwell.	Prentice Hall of India, New Delhi
Biomedical Engineering System		McGraw Hill
Biomedical Instrumentation & Measurement	Carr & Brown	Pearson
Medical Instrumentation	John. G. Webster	John Wiley
Reference Books		
Bioelectric Phenomena	Robert Blensev	McGraw Hill
Introduction to Biomedical electronics	Edwand J. Bukstein	Sane and Co. Inc

ELECTIVE-III
BEELE 802 T (2) - ADVANCED MICROPROCESSORS AND PERIPHERALS

Learning Objectives	Learning Outcomes
Students will understand various aspects of microprocessor and its peripherals	On Successful Completion of the course the Student will be able to understand : • Microprocessor and microcontrollers with its architecture. • Interfacing of microprocessor and microcontroller with its peripherals • Concept of virtual memory and DoS structure

Unit 1: Introduction to 16 bit microprocessors. 8086/8088 CPU architecture, Memory organization and interfacing.

Addressing modes, Instruction Set, examples Pseudo op-codes with ASM.86. ..

Unit 2: Interfacing of peripherals 8255 and 8253 with 8086. Architecture, operation and interfacing of 8251, 8257 with 8085 and. 8086/8088.

Unit 3: Architecture, operation and interfacing of 8259; with 8279 with 8085 and 8086/8088.

Unit 4: Multiprocessor system bus, 8087 coprocessor with architecture and instruction set, organization of PCXT / AT mother board.

Unit 5: Introduction to 80286, 386, 486 architecture. Concepts of Cache, associated/virtual memory. DOS structure.

Unit 6: Architecture of 8097 microcontrol1er, its important features, interface with parallel and serial I/O (Instruction set not included.)

Text Books		
Title of Book	**Name of Author/s**	**Edition & Publisher**
Programming and interfacing of 8086/808,8	D. V.Ha11	McGraw Hill
Programming and Interfacing 8086	Leu and Gibson	PHI
Reference Books		
Intel Reference Manuals for i) Microprocessor and ii) microcontrollers		
80286/80386 Assembly Language	Murary	Tata McGraw Hill
80386 Assembly Language	Femamdez	T.M.H.

ELECTIVE-III
BEELE 802 T (3) -POWER SEMICONDUCTOR BASED DRIVES

Learning Objectives	Learning Outcomes
• To study the converter and Chopper control of DC drives. • To study the semiconductor based control of Induction and Synchronous motors. • To learn the basics of Switched reluctance motor and Brushless DC motor. • To Study the non conventional and renewable energy based drives.	The student will be able to :- • work with confidence on the various drives used in the Industry. • The students can carry research on the newer Switched Reluctance motor and Brushless DC motor. • Understands the traction drives with ac and dc motors.

Unit 1: Dynamics of electric drives and control of electric drives,

Unit 2: D.C. motor drives: Controlled rectifier fed d.c. drives, single phase and three phase rectifier control of d.c. separately excited motor. Dual converter control of D.C separately excited motor. Power factor, supply harmonics and ripple in motor current. Chopper controlled dc drives of separately excited dc motor, chopper control of series motor, source current harmonics.

Unit 3: Induction motor drives: Stator voltage control, variable frequency control using
voltage source invertors, and current sources invertors. Concept of scalar control of 3-ph Induction Motor, Basic philosophy of vector control of 3-ph I.M. their advantages and list of applications.

Basic idea of energy conservation in fan and pump type loads using scalar controlled induction motor drives.(Numericals excluded)

Unit 4: Synchronous Motor Drive ; Starting Braking of synchronous motor, variable frequency control self controlled synchronous motor drive employing load commutated thyristor inverter or cycloconverter, starting of large synchronous motors.

Unit 5: Brushless de motor, stepper motor, switched reluctance motor drives and eddy current drives. introduction to solar and battery powered drives. Energy conservation in electric drives.

Unit 6: Traction drives: Conventional dc and ac traction drives, semiconductors converter controlled Drives, 25KV AC traction using semiconductor converter controlled dc motor. DC traction using semiconductor, chopper controlled dc motors, polyphase AC motors for traction drives.

BOOKS:

Text Books		
Title of Book	**Name of Author/s**	**Edition & Publisher**
Fundamentals of Electric drives	G. K. Dubey	CRC Press
Modern Electric Traction	H. Partab	Pritam Surat, 1973
Power Electronics and drives	B. K. Bose	Pearson
Reference Books		
Electric drives concepts and applications	Vedam Subrahmanyam	McGraw-Hill, 1996

ELECTIVE-III BEELE 802 T (4) ELECTRICAL DISTRIBUTION SYSTEM

Learning Objectives	Learning Outcomes
Student will able to learn various aspects of distribution system including distribution automation.	The student will be able to :- • Calculate different distribution factors, • Understand classification of load, types of load curves. • Control of voltage and reactive power in distribution system • Understand distribution automation • Understand distribution substation layout with associated equipments.

UNIT-1: Introduction to Distribution systems, Explanation of basic terms like demand factor, utilization factor, load factor, plant factor, diversity factor, coincidence factor, contribution factor and loss factor-Relationship between the load factor and loss factor - Classification of loads , Changes in load curve due to loads.

UNIT-2: Feeders: Radial and loop types, engineering considerations for voltage levels and loading, causes of unbalance and unequal drops.

UNIT-3 : System analysis : Voltage drop and power loss calculations, manual methods of solution of radial networks, three-phase & non-three-phase primary lines load flow and symmetrical component applications.

UNIT-4: Voltage control : Equipment for voltage control, effect of series capacitors, effect of AVB/AVR, line drop calculations and compensations, Reactive power requirements, economic consideration & best location.

UNIT-5 : Introduction to Distribution Automation, Data acquisition system and decentralized control, data acquisition and protection considerations of control panel(Specific reference to MCCB, HRC), earthing.

UNIT-6: Substation :- Equipment, layouts, theoretical consideration for fault calculations.

Text Books		
Title of Book	**Name of Author/s**	**Edition & Publisher**
Electrical Power Distribution System	Kamaraju	Tata-McGraw Hill Publications
Electric Power Distribution	A. S. Pabla	Tata Mc Graw-Hill Publishing Company
Reference Books		
Electric Power Distribution Automation	M. K. Khedkar & G. M. Dhole	University Science Press

BEELE 803 T -SWITCH GEAR AND PROTECTION

Learning Objectives	Learning Outcomes
Students will understand • The theory and applications of the main components used in power system protection. • The protection systems used for electric machines, transformers, bus bars, transmission lines. • The theory, construction, and applications of main types of circuit breakers. • to design the feasible protection systems needed for each main part of a power system	Students has understood • Theory & application of main components used in power system protection. • Protection systems used for electric machines, transformers, bus bars, transmission lines. • Theory, construction, and applications of main types of circuit breakers. • Design the protection systems needed for each main part of a power system.

Unit 1:- General philosophy of Protective Relaying: Protective zones, primary protection, Back up protection Remote and Local Back up selectivity.

Unit 2:- Medium voltage Line Protection: Over current relaying, directional- over current relay.

Unit 3: High Voltage Line Protection: Distance relays, carrier distance Schemes. Unit carrier schemes.

Unit 4: Equipment Protection: Principles of differential relaying, protection of generator, transformers and bus Bars by differential relaying and other relays. Protection of Induction Motors against overloads, short circuits. thermal relays, miniature circuit breakers.

Unit 5: - Introduction static relays *:* Comparison of static and electro mechanical relays, two input amplitude and phase comparator and their duality. Generation of various distance relay characteristics using above comparators.

Unit 6: Switchgear: Circuit breakers. Arc interruption theory, recovery and Restricting voltages, RRRV, breaking of inductive and capacitive currents, C.B, ratings, different media of arc interruption, overview of oll circuit breakers, construction and operation of Air blast, SF6 and vacuum breakers.

Books:

Text Books		
Title of Book	**Name of Author/s**	**Edition & Publisher**
Switchgear and Protection	Sunil S Rao	Khanna Publishers, 1992
Power System *Protection* and *Switchgear*	B. Ravindranath, M. Chander	New Age International
Power System Protection and switchgear	B.Ram	Tata McGraw Hill
Reference Books		
The art and science of protective relaying	C. Russell Mason	Wiley, 1956
Protective Relaying, Vol. I & II	Warrington	Springer

BEELE 804 T - COMPUTER APPLICATIONS IN POWER SYSTEM.

Learning Objectives	Learning Outcomes
This subject exposes students to the mathematical foundational concepts that are necessary in the field of electrical engineering such as a) Load flow. b) Short Circuit studies. c) Transient Stability Studies.	On successful completion of this course, students will be able to • Determine Bus Impedance & Admittance matrix (required for Load flow & Short circuit Studies) by graphically, Inspection & building algorithm. • Load flow study of a power system by Newton-Raphson & Gauss-Seidal Iterative Method. • Short circuit studies. • Transient stability by using Eulers, Modified Eulers & RK-4th order differential method.

Unit 1: Incidence & Network Matrices: Graph incidence Matrices, Primitive network, formation of network matrices by Singular transformations.

Unit 2: Algorithm for formation of Bus Impedance and Bus Admittance matrix' for system without mutual coupling.

Unit 3: Three phase Networks: Three phase balance network elements with balanced and unbalanced excitation, incidence and network matrices *for* three phase element. Algorithm for formation of three phase bus impedance matrices without mutual coupling. .

Unit 4: Load Flow Studies: Power system load flow equations, solution Technique; Gauss Seidel Newton Raphson and fast decoupled technique with and without voltage control buses. Representation of tap changing and phase shifting transformers, Elementary load flow programs.

Unit 5: Short circuit studies: Three phase network short circuit calculations using bus impendence matrix for balance and unbalanced faults. Computer programme for short circuit studies on simple system.

Unit 6: Transient Stability studies: Modelling of synchronous machine. power system network for transient stability studies, Numerical, solution of swing equation by modified Euler and Runge Kutta 4th order method. Elementary computer programme for the transient stability study.

BOOKS:

Text Books		
Title of Book	**Name of Author/s**	**Edition & Publisher**
Computer method in power system analysis	Stagg and E1e Abid	McGraw Hill
Elements of power system analysis	William D. Stevenson	Mcgraw-Hill Book Comp., 1982
Computer Analysis of Power system	R N Dhar	
Reference Books		
Electric Energy System Theory and introduction	Ole Elegard	Tata McGraw-Hill, 1983