Syllabus for

Applied Mathematics- III (EN/ET/EE/Mech)

Scheme (Theory: 4 hrs, Tutorial: 1hr.)

UNIT - I: LAPLACE TRANSFORM (15Hrs)

Definition, Properties, Evaluation of integrals by Laplace Transform, Inverse Laplace Transform and its Properties, Convolution theorem (statement only), Laplace Transform of Periodic Functions (statement only), Unit Step Function and Unit Impulse Function, Applications of Laplace Transform to solve Ordinary Differential Equations, Simultaneous Differential Equations, Integral Equations & Integro-Differential Equations.

UNIT – II: FOURIER SERIES & FOURIER TRANSFORM (08 Hrs)

Periodic functions and their Fourier Expansions, Even and Odd functions, Change of interval, Half Range Expansions.

Fourier Transform: Definition and Properties (excluding FFT), Fourier Integral Theorem, Relation with Laplace Transform, Applications of Fourier Transform to Solve Integral Equation.

UNIT – III: CALCULUS OF VARIATIONS(05 Hrs)

Functionals, Maxima and minima of functionals, Euler's equation(statement only), Functionals dependent on First & Second order derivatives, Isoperimetric Problems, Solution of Boundary Value problems by Rayleigh-Ritz method.

UNIT- IV: FUNCTIONS OF COMPLEX VARIABLE (12 Hrs)

Analytic function, Cauchy- Riemann Conditions, Harmonic Functions (excluding orthogonal system), Milne-Thomson Method, Cauchy Integral Theorem & Integral Formula (Statement only), Taylor's & Laurent's series (Statement only), Zeros and Singularities of Analytic function, Residue Theorem (Statement only), Contour integration (Evaluation of real definite integral around unit circle and semi-circle).

UNIT - V: PARTIAL DIFFERENTIAL EQUATIONS(08Hrs)

Partial Differential Equations of First Order First Degree i.e. Lagrange's form, Linear Homogeneous Equations of higher order with constant coefficients. Method of separations of variables, Simple Applications of Laplace Transform to solve Partial Differential Equations (One dimensional only).

UNIT –VI: MATRICES(12Hrs)

Linear and Orthogonal Transformations, Linear dependence of vectors, Characteristics equation, Eigen values and Eigen vectors, Statement and Verification of Cayley Hamilton Theorem [without proof], Reduction to Diagonal form, Reduction of Quadratic form to Canonical form by Orthogonal transformation, Sylvester's theorem [without proof], Solution of Second Order Linear Differential Equation with Constant Coefficients by Matrix method.

Text Books

1. Higher Engineering Mathematics by B.S. Grewal, 40th Edition, Khanna Publication
2. Advanced Engineering Mathematics by Erwin Kreysizig, 8th Edition, Wiley India
3. Applied Mathematics for Engineers & Physicist by L.R. Pipes and Harville,
4. Calculus of variation by Forrey

Reference Books

1. A Text Book of applied Mathematics, Volume II , by P.N. Wartikar & J.N. Wartikar, Poona Vidyarthi Griha Prakashan
2. Introductory methods of Numerical Analysis, by S.S. Sastry, PHI
3. Mathematics for Engineers by Chandrika Prasad
4. A text book of Engineering Mathematics by N. P. Bali & M. Goyal, Laxmi Publication.

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BEELE302T	**NON CONVENTIONAL ENERGY SOURCES**	**L = 4**	**T = 0**	**P = 0**	**Credits = 4**
Examination Scheme	College Assessment	University Examination		Total	Univ. Exam. Duration
	20	80		100	3 Hrs

Learning Objective	Learning Outcomes
• Students will introduce with various sources of Non-conventional energy such as solar wind, small hydro, ocean & wave energy.	A student will be able to • Learn fundamentals of solar radiation geometry, application of solar energy • Selection of sites for wind farm, different types of wind generators. • Understand the basic of small hydro, ocean & wave energy.

UNIT-I

Solar Radiation & its Measurement: Solar Constant, Solar radiation at earth's surface, solar radiation geometry, solar radiation measurement, estimation of average solar radiation, solar radiation on tilted surfaces.

UNIT -II

Solar Energy Collectors: Physical Principles of the conversion of solar radiation into heat,flat plate collectors, transitivity of cover systems, energy balance equation and collector efficiency, concentrating collectors, comparison of concentrating and flat plate collectors, selective absorber coatings.

Solar Energy Storage :

Solar Energy Storage system (Thermal, Electrical, Chemical, Mechanical), Solar ponds.

UNIT-III

Application of Solar Energy: Solar water heating, space heating, space cooling, solar thermal heat conversion, solar photovoltaic energy conversion, solar pumping, solar cooking, online grid connected solar photovoltaic generation system.

UNIT - IV

WIND ENERGY: Basic principles of wind energy conversion, wind energy conversion system, wind data & energy estimation, site selection consideration, basic components of wind energy conversion system (WECS), classification of WEC system, generating system, energy storage, application of wind energy.

UNIT-V

ENERGY from OCEANS: Ocean thermal electric conversation (OTEC), Claude & Anderson cycles, evaporators, Bio-fouling, Hybrid cycle, components of OTEC for power generation.

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Energy from Tides: Introduction, basic principles of Tidal power, components of Tidal Power Plants, operation methods of utilization of Tidal Energy; Estimation of Energy & Power in simple single basin Tidal system, Advantages & limitations of Tidal Power Generations, energy & power from wares, wave energy conversions devices.

UNIT- VI

OTHER NONCONVENTIONAI, ENERGY SOURCE: Brief Introduction to operating principles only): small scale hydro electric power generation, Energy from Bio –Mass, Geothermal Energy, MHD power generation, fuel cell etc.

Text Books		
Title of Book	**Name of Author/s**	**Edition & Publisher**
Non Conventional Energy Sources	G.D. Rai	Khanna publishers
Non Conventional Energy Resources	B. H. Khan	2nd , The McGraw Hill Companies
Energy Technology : Nonconventional, Renewable and Conventional	S. Rao & B. B. Parulekar	1st, Khanna Publisher
Solar Energy: Principles of thermal collection and storage	S. P. Sukhatme	2nd edition, Tata McGraw Hill Publishing Company Ltd.
Solar Photovoltaics : Fundamental, Technologies and Applications	Chetan Singh Solanki	PHI Learning Pvt. Ltd.

BEELE303T	**ELECTRICAL MEASUREMENT AND INSTRUMENTATION**	**L = 4**	**T = 1**	**P = 2**	**Credits = 6**
Examination Scheme	College Assessment	University Examination		Total	Univ. Exam. Duration
	20	80		100	3 Hrs

Learning Objective	Learning Outcomes
Students will learn the details of different electrical instrument used for electrical measurement and Instrumentation, different types of Bridges & different types of potentiometers, CT and PT, various transducers, analog to digital conversions, data acquisition.	• Student has understood the details of different electrical instrument used for electrical measurement And Instrumentation. • Students has understood the details of different Bridges used for measurement of R,L,C • Students have understood the details of different types of potentiometers and CT and PT. • The basic idea about transducer and Measurement of acceleration, velocity Measurement of angular velocity, Torque and Power measurement Torque meter. • the basic idea about Measurement of temperature using thermistor ,RTD and thermocouple and Two color pyrometers, Optical pyrometer.

Unit 1: Measurement of RLC Elements

Loading effect of instruments, Measurement of Resistance: classification, measurements by voltage drop method, Measurement of medium resistance :- Wheatstone Bridge. Low resistance: - Kelvin's Double Bridge. High resistance: - Ohmmeter, Megger & loss of charge method. Earth resistance: - Earth tester, Measurement of inductance using Maxwell's inductance-capacitance bridge, Measurement of Capacitance using Schering's & Hays bridge, LCR meter.

Unit 2: Analog Instruments :
Principle & operation of moving iron, PMMC and dynamometer type instruments.
Special Instruments : Power factor meter, frequency meter, synchronoscope.

Unit 3: Measurement of Power & Energy
True RMS Measurement, Principle of Measurement of active, reactive and apparent power in polyphase circuits. Measurement of Energy in single and polyphase circuits. General theory & extension of range using C.T. & P.T., errors in instrument transformers, applications of instrument transformers for metering.

Unit 4: Generalised instrumentation systems
Active and passive transducers, Digital and analogue mode of operation, Static and Dynamic characteristics and performance of instruments. combination of errors. Introduction to Data Acquisition Systems. Elementary Idea of Microprocessor based instrumentation.

Unit 5: Measurement of Force Torque, Velocity & Acceleration
Different types of load cells – strain gauge load cell, Different methods of torque measurement,– stroboscope. Accelerometers – LVDT, piezo-electric strain gauge and variable reluctance type accelerometers – mechanical type vibration instruments – seismic instrument as an accelerometer and vibrometer

Unit 6: Temperature, Pressure and Flow measurement
Bimetallic thermometers – Electrical methods of temperature measurement, Resistance Temperature Dedectors (RTD) and their characteristics, thermistor, Thermocouples, law of thermocouple, special techniques for measuring high temperature using thermocouples. Units of pressure, Bourdon type bellows, Diaphragms, Electrical methods, elastic elements with LVDT and strain gauges, capacitive type pressure gauge, piezo resistive pressure sensor, measurement of vacuum, McLeod gauge, thermal conductivity gauges, Ionization gauge,
Introduction to flow meters, types and principles, Orifice plate, Venturi tube. Different types of ultrasonic flow meters, pitot tube, electromagnetic flow meter, hot wire anemometer.

Text Books		
Title of Book	**Name of Author/s**	**Edition & Publisher**
Electronic Instrumentation & Measurement Technique	W.D. Cooper	Prentice Hall
Electrical & Electronics Measurements & Instrumentation	A. K. Sawhney	DHANPAT RAI & SONS, 5th REVISE
Instrumentation Devices & Systemes	Rangan	Tata McGraw Hill
Mechanical and Industrial Measurements	R.K.Jain	Khanna Publishers
Reference Books		
Measurement System Application and Design	E.O. Doeblin	McGraw Hill
Instrumentation for Engineering Measurements	Dalley Railey, Mc Connel	John Wiley & Sons
Electrical Instrumentation	H. S. Kalsi	TATA MCGRAW-HILL EDUCATION PVT. LTD.2nd revised

BEELE304T	**NETWORK ANALYSIS**	**L = 4**	**T = 1**	**P = 2**	**Credits = 6**
Examination Scheme	College Assessment	University Examination		Total	Univ. Exam. Duration
	20	80		100	3 Hrs

Learning Objective	**Learning Outcomes**
The course objective is to impart knowledge of • Behavior of basic circuit elements. • Fundamental concepts and methods used for analysis of dc, single-phase and three-phase circuits.	students should be able to: • Apply node and loop (mesh) analysis • Apply phasor analysis to AC circuits in sinusoidal steady state.

• various mathematical tools/transformations used in circuit analysis	• Use various network theorems for analysis and design of electric circuits. • Analyze periodic inputs to electric circuits using Fourier series and their response. • Compute initial and final conditions for current and voltage in first and second order circuits. • Determine the response of a circuit excited by a waveform composed of various step and ramp components. • Characterize two – port networks by z, y, t and h parameters.

UNIT –1

Voltage current sources, source transformation mosh basis equilibrium equation, matrix approach For complicated network containing independent sources and reactances.

UNIT-2

Nodal basis equilibrium equation matrix for electrical network containing independent sources And reactances, Duality

UNIT-3

NETWORK THEOREM: Superposition, Reciprocity, Thevenin's, Norton's, maximum power transfer, compensation, Tellegen's theorem as applied to A.C. & DC circuits.

UNIT-4

Laplace transform and properties, partial fractions, singularity functions, waveforms, synthesis. Analysis of RC, RL and RLC network with and without initial conditions with Laplace transforms, evaluation of initial condition.

UNIT-5

Transient behaviors concept of complex frequency, Driving points and transfer functions,poles, zeros Of transfer function, their properties.

UNIT-6

Two port network parameters and inter connections, study of series and parallel resonance in a.c. Three phase balanced and unbalanced circuit and power calculations.

Text Books		
Title of Book	**Name of Author/s**	**Edition & Publisher**
Network Analysis	Van Valkenburg	PEARSON EDUCATION 3rd,ed.
Linear Network Theory	Kelkar and Pandit	PRATIBHA PUBLICATION 39Ed.
Circuit and Network	A. Sudhakar and S.P. Shyam Mohan	TATA MCGRAW-HILL EDUCATION PVT. LTD. 2 REVISE
Reference Books		
Network and System	D.P. Roy choudhary	NEW AGE INTERNATIONAL PVT. LTD. 3re ed.
Electrical circuit	Del Toro	Prentice Hall
Electric Circuits & Network	K. Sureshkumar	Pearson Publication

BEELE305T	**ELECTRONIC DEVICES & CIRCUITS**	**L = 4**	**T = 1**	**P = 2**	**Credits = 6**
Examination Scheme	College Assessment	University Examination		Total	Univ. Exam. Duration
	20	80		100	3 Hrs

Learning Objective	Learning Outcomes
• The course objective is to impart knowledge of basic semiconductor devices, transistors, amplifiers, FET & MOSFETS. Students also learn digital circuits with Boolean Algebra, logic gates etc.	students will be able to understand • principle & working of basic semiconductor devices, transistors, amplifiers, FET & MOSFETS. • Conversion of numbers from one code to other code. • Logic gates and truth tables of digital circuits.

Unit 1: Theory of PN-junction diodes, operation and characteristics, Zener diodes and voltage regulators, Half and Full Wave Rectifiers, Filters, Ripple factor, Voltage doublers.

Unit 2: BJT, Theory of operation, characteristics, Biasing arrangements, Stability factor,Small signal analysis of CE, CB, CC amplifiers and their comparison, Power Transistors, Transistor as a switch.

Unit 3: Power amplifiers- classification as A,B, AB, C, Push pull amplifiers, Cross over distortion, Positive and Negative amplifiers- classification, feedback amplifiers, advantages and applications.

Unit 4: Oscillators- Barkhausen's criterion, RC and Crystal oscillators. Field effect transistors and MOSFETs- Principle of operation and characteristics, biasing arrangements.

Unit 5: Differential amplifier circuits and their stages, current source, biasing, level Shifting techniques, Common mode and differential mode gain, Impedance of different stages.

Unit 6: Boolean Identities, Binary, Gray, Octal, Hex & ASCII, Codes, Logic gates and their truth tables, De Morgan's Laws, Concept of Sum of Products and Product of Sums.

Text Books		
Title of Book	**Name of Author/s**	**Edition & Publisher**
Electronic Devices and Circuits	Millman and Halkias	McGraw Hill
Integrated Electronics	Millman and Halkias	McGraw Hill
Digital Integrated Electronics	H. Taub	McGraw Hill
Introduction to Operation Amplifiers	Wait	Tata McGraw Hill
Reference Books		

IV SEM. ELECTRICAL ENGINEERING

Applied Mathematics- IV (Electrical Engg.)

Scheme (Theory: 4 hrs, Tutorial :1 hr)

UNIT–I : MATHEMATICAL MODELING AND TRANSFER FUNCTION (12 Hrs)

Mathematical Modeling of physical systems and Differential equations (Mechanical systems, basic translational and rotational systems, basic R-L-C series and parallel circuits), Concept of transfer function, Transfer function for elementary R-L-C circuits, Elementary block diagram single input single output closed loop system and its reduction. Laplace transform of step, ramp & parabolic signals, Time response of first order systems and second order systems for unit step input, Concept of characteristic equation q(s) = 0 vs time response.

UNIT – II: Z-TRANSFORM (10Hrs)

Definition , Convergence of Z-transform and Properties, Inverse Z-transform by Partial Fraction Method, Residue Method (Inversion Integral Method) and Power Series Expansion, Convolution of two sequences. Solutions of Difference Equations with Constant Coefficients by Z- transform.

UNIT – III: FUZZY SETS AND FUZZY LOGIC(12 Hrs)

Fuzzy sets and systems, Crisp sets, Overview of Fuzzy logic and classical logic, Fuzzy compliment, fuzzy union and intersection and combinations of these Fuzzy sets operation, Crisp and Fuzzy relations.

UNIT – IV: NUMERICAL METHODS (08 Hrs)

Error Analysis, Solution of Algebraic and Transcendental Equations: Method of False position, Newton –Raphson method and their convergence, Solution of system of simultaneous linear equations: Gauss elimination method, Crout's method and Gauss-Seidel method

UNIT – V: NUMERICAL METHODS (08 Hrs)

Numerical solution of ordinary differential equations :Taylor's series method, Runge-Kutta 4^{th} order method, Euler's modified method. Milne's Predictor- Corrector method, Solution Of Second Order Differential Equations and Simultaneous Differential Equations by Runge- Kutta method.

UNIT – VI: THEORY OF PROBABILITY (10 Hrs)

Axioms of Probability, Conditional Probability, Baye's Rule, Random variables: Discrete and Continuous random variables, Probability function and Distribution function, Mathematical Expectation, Functions of random variable, Variance & Standard Deviation, Moments, Moment generating function, Measures of central tendency and Dispersion, Skewness and Kurtosis. Binomial distribution, Poisson distribution, Normal distribution.

Text Books

1. Control Systems Engineering by Nagrath & Gopal, New Age International Publishers.
2. Higher Engineering Mathematics by B.S. Grewal, 40th Edition, Khanna Publication.
3. Theory & Problems of Probability and Statistics by Murray R. Spiegel , Schaum Series, McGraw Hills.
4. Fuzzy Sets Uncertainty and Information by George, J. Klir and Tina A. Folger.

Reference Books

1. Introductory methods of Numerical Analysis by S.S. Sastry, PHI.
2. Advanced Engineering Mathematics by Erwin Kreysizig, 8th Edition, Wiley India.
3. Neural Networks & Fuzzy Systems by Bart Kosko, PHI.
4. A text book of Engineering Mathematics by N. P. Bali & M. Goyal, Laxmi Publication.
5. Digital Signal Processing, by John Proakis and D.G. Manolakis, Pearson (for Z-Transform)

4S-EE-02T – ELEMENTS OF ELECTROMAGNETICS

BEELE402T	**ELEMENTS OF ELECTROMAGNETICS**	**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 become knowledgeable in static electric and magnetic fields. • To learn various laws of electromagnetic & electrostatic fields.	Students will be able to • Apply various laws in the analysis of electromagnetic systems. • Understand the physical basis for the functioning of circuit elements • Apply Electromagnetic boundary conditions. • Be familiar with the four Maxwell's equations used to study time varying electromagnetic or dynamic fields. • Understand the concept of uniform plane-wave propagation and electromagnetic power density flow in lossless medium.

UNIT-1: VECTOR ANALYSIS : Idea of vector & scalars, Vector Algebra, vector addition, vector subtraction, dot product, scalar product in Cartesian coordinates system, conversion of variables from Cartesian to cylindrical system and vice versa. Spherical co-ordinate system, transformation of Cartesian to spherical and vice versa.

UNIT-2:

Coulomb's law, Electrical field intensity and electric, flux density: Coulomb's law, electric field intensity, field of 'n' point charges, field due to continuous volume charge distribution, field of line charge, filed of sheet charges, concept of flux density.

UNIT-3:

Gauss's law, Energy and potential of charge system : Gauss's law, application of gauss law, divergence theorem, definition of potential difference and potential, potential of a point charges, potential field of system of charge, potential gradient, Energy density in Electrostatic field.

UNIT-4:

Conductors, Dielectric and Capacitance and poison's and Laplace Equations : current and current density, continuity of current, metallic conductors, conductor properties and Boundary conditions, Nature of Dielectric materials capacitance and capacitances, Capacitance of parallel plate capacitor, capacitance of two wire line, poisons and Laplace Equation.

UNIT-5:

The steady Magnetic Field and Magnetic forces: Biot Savarts law, Ampere's Circuital law, Strokes theorem, magnetic flux density, scalar and vector magnetic potentials, force on moving charge, force

between differential current elements nature of magnetic material. Magnetization and permeability, magnetic circuits, potential energy and forces on magnetic materials, Inductance and mutual inductance.

UNIT-6:

Maxwell's equations & boundary conditions. Elementary idea of Electromagnetic waves, uniform plane wave.

Text Books		
Title of Book	**Name of Author/s**	**Edition & Publisher**
Engineering Electromagnetics	W.H. Hayt	7th, Tata McGraw Hill Publication.
Schaum's Outline Series: Theory and Problems of Electromagnetics	Joseph A. Edminister	2nd, McGraw Hill Publication.
Principles of Electromagnetics	Matthew N.O.Sadiku	4th, Oxford University Press
Reference Books		
Applied Electromagnetic	Plonus	McGraw Hill Publication
Electromagnetics	Kraus	McGraw Hill Publication
Fundamentals of Electromagnetics with MATLAB	Karl E. Lonngren, Sava V. Savov, Randy J. Jost	PHI Learning Private Limited

BEELE403T	**DIGITAL AND LINEAR ELECTRONIC CIRCUITS**	**L = 3**	**T = 1**	**P = 2**	**Credits = 5**
Examination Scheme	College Assessment	University Examination		Total	Univ. Exam. Duration
	20	80		100	3 Hrs

Learning Objective	Learning Outcomes
To introduce the basics of logic families, multiplexers, Flip flops, timers. Students will introduce with operational amplifiers, Linear IC's and multivibrators used in digital electronics.	students will be able to understand • Basic fundamentals of logic gates, , Flip flops, timers. • Basic Operational amplifier circuits: • Simple linear circuit • Applications of Operational amplifier • Study of Linear ICS

Unit 1:

TTL, CMOS Logic Families, Combinational Logic concepts, Decoders, Encoders, Multiplexers, De-multiplexers, Code converters, Karanaugh map Principle.

Unit 2:

Introduction to Flip-flop, Latch, Concept of Clock, Overview of RAM, ROM, EPROM & EEPROM, Master slave Flip-flop and conversion of one type to another.

Unit 3:

Introduction to sequential circuits, Synchronous and Asynchronous Counters, Different module counters with reset/ clear facility, Adders, Subtractors, Concept of ALU.

Unit 4:

Basics of Operational Amplifiers, Ideal and non-ideal OPAMPs, Inverting & non-inverting OPAMPs, Integrators, Differentiators, Summer and Averaging circuits, Instrumentation amplifiers, Grounding & Shielding Problems in opamps

Unit 5:

Precision rectifiers, Constant Current & Constant Voltage sources, Introduction to Active filters, Butterworth 2nd order filter – Design & operation, Clipping, clamping and comparator circuits, Sample & Hold circuits, A/D & D/A converters, Phase locked loops.

Unit 6:
Study of Linear ICs : LM 741, LM 555, LM 339, LM 723, LM 78xx & 79xx series, Astable, monostable and bistable multivibrators using IC LM 555.

Text Books		
Title of Book	**Name of Author/s**	**Edition & Publisher**
Digital Integrated Electronics	Herbert Taub	McGraw Hill
Introduction to Operation Amplifiers	Wait	Tata McGraw Hill
Operational Amplifiers- Design and applications	Tobey Grahame-Huelsman	TMH
Reference Books		
Operational Amplifiers and applications	R. Gaikwad	
Linear ICs Manual I, II, III	National Semiconductors	

BEELE404T	**ELECTRICAL MACHINES-I**	**L = 4**	**T = 1**	**P = 2**	**Credits = 6**
Examination Scheme	College Assessment	University Examination		Total	Univ. Exam. Duration
	20	80		100	3 Hrs

Learning Objective	**Learning Outcomes**
Student will learn • The basic principle of transfer of electrical power, operation, construction of 3-phase transformers, their classification, connections and phasor diagrams. • The basic principle, construction, operation, performance characteristics, steady state analysis and applications of electrical motors and induction generator.	The student will be able to understand • Principle, construction, connections, vector grouping, operation and testing of 3-phase transformer • conversion of 3-phasse supply to 2-phase supply, parallel operation of 3-ph. Transformers. • Principle, armature and field construction, types, operation characteristics, armature reaction, commutation, methods to improve commutation in dc generators. • Principle, types, voltage build up, performance characteristics, torque evaluation in dc motors • Principle, construction, types, torque development, performance characteristics, tests to determine performance indices & parameters of equivalent circuit of 3-phase and double cage induction motors, methods of starting, speed control and braking of induction motors. • Revolving and cross field theories, operation, characteristics, types, equivalent circuit & tests.

UNIT-1

SINGLE PHASE TRANSFORMER :- Transformer phasor diagram, equivalent circuit diagram. Transformer equivalent circuit parameter calculation using O.C. & S.C. test. Polarity test and parallel operation of single phase transformer.

3-PHASE TRANSFORMER: principle and operation of three phase transformer and, O.C. & S.C. test on three phase transformer, determination of equivalent circuit parameters, Regulation, Efficiency, Magnetizing current and harmonics, winding identifications, various connections with vector group.

UNIT-2

Three phase to two conversion, parallel operation of three phase transformer, methods of cooling, back to back test, maintenance of transformer, insulation of transformer.

UNIT-3

D.C. MACHNIES: - Basis principle & operation, Armature reaction & commutation, Compensating winding, interpoles. Type of excitation. Characteristics of shunt series & compound motor and generator speed control of d.c. shunt & series motor, constant horse power & constant torque drive of d.c. motor.

UNIT-4

THREE PHASE INDCTION MOTOR: - Types of induction motor and production of torque. Torque-slip characteristics, No load blocked rotor test, circle diagram, losses, efficiency, double cage motor, operating characteristics & influence of machine parameter on the performance of motor. Induction motor as a induction generator.

UNIT-5

Starting of 3 phase I.M. speed control of I.M. by pole changing, frequency control, rotor resistance by varying supply voltage, braking regenerative braking, plugging, dynamic braking Crawling & cogging.

UNIT-6

SINGLE PHASE I.M.: - Double field revolving and cross field theory split phase motor shaded pole motor, equivalent circuit, Torque-slip characteristics.

Text Books		
Title of Book	**Name of Author/s**	**Edition & Publisher**
Electrical Machines	P.K. Mukherjee & S. Chakraborty	Dhanpat Rai Publication (P) Ltd.
Electrical Machines	I. J. Nagrath & Dr. D.P. Kothari	3rd, Tata McGraw Hill
Electrical Machines	P. S. Bhimbra	Tata McGraw Hill
Reference Books		
Performance & Design of A.C. M/C	M.G. Say	CBS PUBLISHERS AND DISTRIBUTORS PVT. LTD. 3rd ed. Rev.

BEELE405T	**COMPUTER PROGRAMMING**	**L = 4**	**T = 1**	**P = 2**	**Credits = 6**
Examination Scheme	College Assessment	University Examination		Total	Univ. Exam. Duration
	20	80		100	3 Hrs

Learning Objective	**Learning Outcomes**
The student will learn the concept of programming and topics using C & C++ language and apply it in the field of engineering and technology. Similarly student will know about the Matrix operation and use of graphic tools for representation.	The student on completion has understood • General information of computers and operating systems • Structure of "C" program, Data types, Storage class, variables, expressions and Operators • Use of arrays and sorting techniques • Pointers and structures. • Basics of strings and arrays • C++ concepts • Matrix operation using programming. • Use of graphic tools for presentation.

Unit-I: Structure of 'C' program, Data types, Variables, Input/output statements, Storage class, operators, Program control statements, Concept of function & Recursion.

Unit-II: Arrays, Searching (Linear & Binary), Sorting (Bubble & Selection).

Unit III: Structure(Arrays of Structures, Copying elements of one structure into another, Nested Structure, Structure Pointer)Pointer, File Handling(File open, close, read , write, Copy).

Unit IV: Introduction to C++ concepts.

Unit-V: Introduction to MATLAB Programming
Import/export data, Program and run simple scripts (M-files), Use graphics tools to display data, Conditional Statements (If-else, if-elseif), and Iterative statements (While, For loop).

Unit -VI: Matrix operation (Transpose, determinant, Inverse), Plotting of graphs (Basic plot, generating waveforms) using Matlab Programming. Manipulating text (Writing to a text file, Reading from a text file, Randomising and sorting a list, Searching a list), Programming using MATLAB functions.

Text Books		
Title of Book	**Name of Author/s**	**Edition & Publisher**
A text book on Programming languages C& C++	Kakade & Deshpande	DREAMTECH PRESS 2nd. Ed.
Pascal & C Programming	Venugopal	TATA MCGRAW-HILL EDUCATION PVT. LTD.
Let us C	Y. Kanetkar	8th BPB PUBLICATIONS
Computer Programming in C	Balguru Swami	
Reference Books		
C Programming languages	B.W. Kernighan and D.M. Ritchie	2nd EDITION PEARSON EDUCATION
METLAB-A Practical introduction to programming problem Solving	Stormy Attaway	Elsevier
Mastering METLAB 7	Duane Hansselman Bruce Littlefield	Pearson

BEELE406T	**ENVIRONMENTAL STUDIES**	**L = 3**	**T = 0**	**P = 0**	**Credits = 0**
Examination Scheme	College Assessment	University Examination		Total	Univ. Exam. Duration
	20	80		100	3 Hrs

Learning Objective	**Learning Outcomes**
• Student will be able to learn the natural sources available. • Students will also learn about ecosystem, biodiversity, pollution. • Student will also learn the effect on environment on social aspects and Human population.	The student on completion of course will understood the • Ecosystem • Environmental issues related with social and human population. • Biodiversity and its conversion

Unit 1 : Multidisciplinary nature of environmental studies

Definition, scope and importance (2 lectures)
Need for public awareness.
III

Unit 2 : Natural Resources :

Renewable and non-renewable resources :

Natural resources and associated problems.
a) Forest resources : Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people.
b) Water resources : Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.

c) Mineral resources : Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
d) Food resources : World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.
e) Energy resources : Growing energy needs, renewable and non renewable, energy sources, use of alternate energy sources. Case studies.
f) Land resources : Land as a resource, land degradation, man induced landslides, soil erosion and desertification. Role of an individual in conservation of natural resources. Equitable use of resoureces for sustainable lifestyles. (8 lectures)

Unit 3 : Ecosystems

• Concept of an ecosystem.
• Structure and function of an ecosystem.
• Producers, consumers and decomposers.
• Energy flow in the ecosystem.
• Ecological succession.
• Food chains, food webs and ecological pyramids.
• Introduction, types, characteristic features, structure and function of the following ecosystem :-
a. Forest ecosystem
b. Grassland ecosystem
c. Desert ecosystem
d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) (6 lectures)

Unit 4 : Biodiversity and its conservation

• Introduction – Definition : genetic, species and ecosystem diversity.
• Biogeographical classification of India
• Value of biodiversity : consumptive use, productive use, social, ethical, aesthetic and option values
• Biodiversity at global, National and local levels.
• Inida as a mega-diversity nation
V
• Hot-sports of biodiversity.
• Threats to biodiversity : habitat loss, poaching of wildlife, man-wildlife conflicts.
• Endangered and endemic species of India
• Conservation of biodiversity : In-situ and Ex-situ conservation of biodiversity. (8 lectures)

Unit 5 : Environmental Pollution

Definition
• Cause, effects and control measures of :-
a. Air pollution
b. Water pollution
c. Soil pollution
d. Marine pollution
e. Noise pollution
f. Thermal pollution
g. Nuclear hazards
• Solid waste Management : Causes, effects and control measures of urban and industrial wastes.
• Role of an individual in prevention of pollution.
• Pollution case studies.
• Diaster management : floods, earthquake, cyclone and landslides. (8 lectures)

VI

Unit 6 : Social Issues and the Environment

• From Unsustainable to Sustainable development
• Urban problems related to energy
• Water conservation, rain water harvesting, watershed management
• Resettlement and rahabilitation of people; its problems and concerns. Case Studies
• Environmental ethics : Issues and possible solutions.
• Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies.
• Wasteland reclamation.
• Consumerism and waste products.
• Environment Protection Act.
• Air (Prevention and Control of Pollution) Act.
• Water (Prevention and control of Pollution) Act
• Wildlife Protection Act
• Forest Conservation Act
• Issues involved in enforcement of environmental legislation.
• Public awareness. (7 lectures)

Unit 7 : Human Population and the Environment

• Population growth, variation among nations.
• Population explosion – Family Welfare Programme.

VII

• Environment and human health.
• Human Rights.
• Value Education.
• HIV/AIDS.
• Women and Child Welfare.
• Role of Information Technology in Environment and human health.
• Case Studies. (6 lectures)

Unit 8 : Field work

• Visit to a local area to document environmental assetsriver/ forest/grassland/hill/mountain
• Visit to a local polluted site-Urban/Rural/Industrial/Agricultural
• Study of common plants, insects, birds.
• Study of simple ecosystems-pond, river, hill slopes, etc. (Field work Equal to 5 lecture hours)

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

THIRD 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	BEELE301T	APPLIED MATHEMATICS-III	ASH	4	1	0	5	5	20	80	100	40	3 Hours
2	BEELE302T	NON CONVENTIONAL ENERGY SOURCES	EE	4	0	0	4	4	20	80	100	40	3 Hours
3	BEELE303T	ELECTRICAL MEASUREMENT AND INSTRUMENTATION	EE	4	1	0	5	5	20	80	100	40	3 Hours
4	BEELE303P	ELECTRICAL MEASUREMENT AND INSTRUMENTATION	EE	0	0	2	2	1	25	25	50	25	
5	BEELE304T	NETWORK ANALYSIS	EE	4	1	0	5	5	20	80	100	40	3 Hours
6	BEELE304P	NETWORK ANALYSIS	EE	0	0	2	2	1	25	25	50	25	
7	BEELE305T	ELECTRONIC DEVICES & CIRCUITS	EN	4	1	0	5	5	20	80	100	40	3 Hours
8	BEELE305P	ELECTRONIC DEVICES & CIRCUITS	EN	0	0	2	2	1	25	25	50	25	
		Total		20	4	6	30	27			650		

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B.E. (Electrical Engineering)
SCHEME OF EXAMINATION

FOURTH 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	BEELE401T	APPLIED MATHEMATICS - IV	ASH	4	1	0	5	5	20	80	100	40	3 Hours
2	BEELE402T	ELEMENTS OF ELECTROMAGNETICS	EE	4	1	0	5	5	20	80	100	40	3 Hours
3	BEELE403T	DIGITAL AND LINEAR ELECTRONIC CIRCUITS	EN	3	1	0	4	4	20	80	100	40	3 Hours
4	BEELE403P	DIGITAL AND LINEAR ELECTRONIC CIRCUITS	EN	0	0	2	2	1	25	25	50	25	
5	BEELE404T	ELECTRICAL MACHINES-I	EE	4	1	0	5	5	20	80	100	40	3 Hours
6	BEELE404P	ELECTRICAL MACHINES-I	EE	0	0	2	2	1	25	25	50	25	
7	BEELE405T	COMPUTER PROGRAMMING	EE	4	1	0	5	5	20	80	100	40	3 Hours
8	BEELE405P	COMPUTER PROGRAMMING	EE	0	0	2	2	1	25	25	50	25	
9	BEELE406T	ENVIRONMENTAL STUDIES	ASH	3	0	0	3	0	75 + 25		Grades		
		Total		22	5	6	33	27			650		

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		

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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