GURU KASHI UNIVERSITY

Bachelor of Technology in Electrical Engineering

Session : 2023-2024

Department of Electrical Engineering

GRADUATE OUTCOME OF THE PROGRAMME

The programme focuses on electrical principles with their applications to design, analyze and troubleshoot electrical systems and components which help them to have strong analytical and problem-solving skills to identify and solve complex engineering problems in order to develop sustainable solutions in broader economic, societal and environmental contexts.

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PROGRAMME LEARNING OUTCOMES

After completing the programme the learner will be able to:

1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. Identify, formulate and analysis complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
5. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
6. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
7. Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
8. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Structure

Program: Bachelor of Technology in

Electrical Engineering

Semester: I						
Course Code	**Course Title**	**Type of Course**	**L**	**T**	**P**	**Credits**
BEE101	Basic Electrical Engineering	Core	3	0	0	3
BEE111	Engineering Physics	Core	3	1	0	4
BEE112	Engineering Mathematics – I	Core	3	1	0	4
BEE104	Engineering Graphics & Drawing	Skill based	1	0	4	3
BEE113	Engineering Physics Lab	Skill based	0	0	4	2
BEE106	Basic Electrical Engineering Lab	Skill based	0	0	4	2
BEE114	Fundamental of Computer and Information Technology	Value added	2	0	0	2
BEE115	Constitution of India	Value added	2	0	0	NC*
Total			**14**	**2**	**12**	**20**

Note:*-Non Credit (NC) Course Will be evaluated as Satisfactory/Unsatisfactory*

Semester: II						
Course Code	**Course Title**	**Type of Course**	**L**	**T**	**P**	**Credits**
BEE201	Engineering Chemistry	Core	3	0	0	3
BEE215	Engineering Mathematics–II	Core	3	1	0	4
BEE203	Programming for Problem Solving	Core	3	0	0	3
BEE204	Communication Skills	Skill based	3	0	0	3
BEE205	Manufacturing Practices	Skill based	1	0	4	3
BEE206	Engineering Chemistry Lab	Skill based	0	0	2	1
BEE207	Programming for Problem Solving Lab	Skill based	0	0	2	1
BEE208	Communication Skills Lab	Skill based	0	0	2	1
Value Added Course (Any one) For other disciplines also						
BEE216	Entrepreneurship Development	VAC	2	0	0	2
BEE209	Numerical Aptitude & Reasoning Ability					
BEE211	Stress Management					
Total			**15**	**1**	**10**	**21**

Semester: III						
Course Code	**Course Title**	**Type of Course**	**L**	**T**	**P**	**Credits**
BEE301	Electrical Circuit Analysis	Core	3	0	0	3
BEE302	Electrical Machines – I	Core	3	0	0	3
BEE303	Electrical and Electronic Measurements	Core	3	0	0	3
BEE305	Basic Electronics	Core	3	0	0	3
BEE313	Numerical Methods and Analysis	Core	3	0	0	3
BEE306	Basic Electronics Lab	Skill based	0	0	2	1
BEE307	Electrical and Electronic Measurements Lab	Skill based	0	0	2	1
BEE308	Electrical Machines – I Lab	Skill based	0	0	2	1
BEE314	Human Value & Ethics	Value added	3	0	0	3
BEE399	XXX	MOOC	-	-	-	2
	Total		**18**	**0**	**6**	**23**

Note: *-Institutional Training will be imparted in the Institute at the end of 2nd Semester for 6-weeks duration. However, this Subject is not applicable to LEET Students. S/US- Satisfactory /Unsatisfactory Semester for 6-weeks duration. However this Subject is not applicable to LEET Students

Semester: IV						
Course Code	**Course Title**	**Type of Course**	**L**	**T**	**P**	**Credits**
BEE401	Electrical Machines – II	Core	3	1	0	4
BEE402	Power Electronics	Core	3	1	0	4
BEE403	Digital Electronics	Core	3	0	0	3
BEE415	Electromagnetic Fields	Core	3	1	0	4
BEE405	Digital Electronics Lab	Skill based	0	0	2	1
BEE406	Electrical Machines – II Lab	Skill based	0	0	2	1
BEE407	Power Electronics Lab	Skill based	0	0	2	1
BEE416	Environmental Sciences	Value added	2	0	0	NC*
BEE417	Organizational Behavior	Value added	3	0	0	3
Total			**17**	**3**	**6**	**21**

Note:*- Non Credit (NC) Course Will be evaluated as Satisfactory/Unsatisfactory*

Semester: V						
Course Code	**Course Title**	**Type of Course**	**L**	**T**	**P**	**Credits**
BEE501	Power System -I (Apparatus and Modeling)	Core	3	1	0	4
BEE502	Control Systems	Core	3	1	0	4
BEE503	Microprocessors & its applications	Core	3	1	0	4
BEE505	Power System-I Lab	Skill based	0	0	2	1
BEE506	Control Systems Lab	Skill based	0	0	2	1
BEE507	Microprocessors & its applications Lab	Skill based	0	0	2	1
BEE512	Human Resourse Management	Value added	3	0	0	3
BEE599	xxx	MOOC	-	-	-	2
Total			**12**	**3**	**6**	**20**

Semester: VI						
Course Code	**Course Title**	**Type of Course**	**L**	**T**	**P**	**Credits**
BEE601	Power Systems-II (Operation and Control)	Core	3	1	0	4
BEE602	Programmable Logic Controllers	Core	3	1	0	4
BEE603	Generation of Electrical Power	Core	3	1	0	4
BEE605	Power Systems-II Lab	Skill based	0	0	2	1
BEE606	Programmable Logic Controllers Lab	Skill based	0	0	2	1
BEE616	Project-I	Skill based	0	0	4	2
Discipline Elective-I (Any one of the following)						
BEE617	Electrical Materials	Discipline Elective-I	3	0	0	3
BEE618	Mechanical Measurements					
BEE619	Electrical Estimation & Costing					
Discipline Elective-II (Any one of the following)						
BEE607	Electric Drives	Discipline Elective-II	3	0	0	3
BEE620	Electrical Safety and Standards					
BEE621	Electronic Devices & circuits					
	Total		**15**	**3**	**8**	**22**

Semester: VII						
Course Code	**Course Title**	**Type of Course**	**L**	**T**	**P**	**Credits**
BEE701	Computer Aided Power System Analysis	Core	3	0	0	3
BEE702	Power System Protection	Core	3	0	0	3
BEE707	High Voltage Engineering	Core	3	0	0	3
BEE708	Programming in MATLAB	Skill based	0	0	2	1
BEE709	Project-II	Skill based	0	0	4	2
BEE799	xxx	MOOC	-	-	-	2
Discipline Elective-III (Any one of the following)						
BEE710	Electric and Hybrid Vehicles	Discipline Elective-III	3	0	0	3
BEE711	EHVAC TRANSMISSION					
BEE712	Energy conservation and Practices					
Open Elective Course–I						
XXX	XXX	Open Elective-I	3	0	0	3
Total			**15**	**0**	**6**	**20**
Open Elective–I (Open Elective Course for other Departments)						
OEC081	Industrial Safety and Environment	Open Elective-I	3	0	0	3

Semester: VIII						
Course Code	**Course Title**	**Type of Course**	**L**	**T**	**P**	**Credits**
BEE802	Project-III	Skill based	0	0	10	5
Discipline Elective-IV (Any one of the following)						
BEE803	Utilization of Electrical Energy	Discipline Elective-IV	3	0	0	3
BEE804	HVDC Transmission Systems					
BEE805	Wind and Solar Energy					
Open Elective Course–II						
XXX	XXX	Open Elective-II	3	0	0	3
Open Elective Course–III						
XXX	XXX	Open Elective-III	3	0	0	3
Total			**9**	**0**	**10**	**14**
Open Elective Course–II (Open Elective Courses for other Departments based on individual interest)						
OEC082	Basics of Electrical Domestic Appliances	Open Elective-II	3	0	0	3
Open Elective Course–III (Open Elective Courses for other Departments based on individual interest)						
OEC083	Power Plant Engineering	Open Elective-III	3	0	0	3
Grand Total			**114**	**12**	**64**	**160**

Evaluation Criteria for Theory Courses

A. Continuous Assessment (25 Marks)

CA1 Surprise Test (Two best out of three) (10 Marks)

CA2 Assignment (10 Marks)

CA3 Term Paper / Quiz / Presentation (5 Marks)

B. Attendance (5 marks)

C. Mid Semester Test (30 Marks)

D. End Semester Exam (40 Marks)

Evaluation Criteria for Practical Courses

Performance of each practical-(10 Marks)

Report- (5 Marks)

Practical Viva – (5 Marks)

Total - (20 Marks) (Each Practical)

SEMESTER- I

Course Title: Basic Electrical Engineering

Course Code: BEE101

L	T	P	Credits
3	0	0	3

Total Hours: 45

Learning Outcomes: After completion of this course, the learner will be able to:

1. Understand the DC and AC electrical circuit elements with RLC.
2. Analysis of simple circuits with dc excitation. Superposition, The venin and Norton Theorems.
3. Use Single Phase AC Circuits and representation of alternating quantities and determining the power in these circuits.
4. Classify the different types of Electrical machines.

Course Content

UNIT I **15 Hours**

DC Circuits: Electrical circuit elements (R, L and C), voltage and current sources, Kirchhoff's current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems. Time-domain analysis of first-order RL and RC circuits.

UNIT II **10 Hours**

AC Circuits: Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three- phase balanced circuits, voltage and current relations in star and delta connections.

Transformers: Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.

UNIT III **10 Hours**

Electrical Machines: Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss components and efficiency, starting and speed control of induction motor. Single-phase induction motor, Construction, working, torque-speed characteristic and speed control of separately excited dc motor. Construction and working of synchronous generators.

UNIT IV **10 Hours**

Electrical Installations: Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries,

Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings

- *Kothari, D. P. and Nagrath, I. J. (2010). Basic Electrical Engineering. Tata McGraw Hill.*
- *Kulshreshtha, D. C. (2009). Basic Electrical Engineering. McGraw Hill.*
- *Bobrow, L. S. (2011). Fundamentals of Electrical Engineering. Oxford University Press.*
- *Hughes, E. (2010). Electrical and Electronics Technology. Pearson.*

Course Title: ENGINEERING PHYSICS

Course Code: BEE111

L	T	P	Credits
3	1	0	4

Total hours 60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Apply knowledge of electricity and magnetism to explain natural physical processes and related technological advances.
2. Use the knowledge regarding calculus along with physical principles to effectively solve problems encountered in everyday life, further study in science, and in the professional world.
3. Design experiments and acquires data in order to explore physical principles, effectively communicate results, and evaluate related scientific studies.
4. Assess the contributions of physics to our evolving understanding of global change and sustainability while placing the development of physics in its historical and cultural context.

Course Content

UNIT I **15 Hours**

Electrostatics: Calculation of electric field and electrostatic potential for a charge distribution; Divergence and curl of electrostatic field; Laplace's and Poisson's equations for electrostatic potential, Boundary conditions of electric field and electrostatic potential; method of images. Electrostatic field and potential of a dipole. Bound charges due to electric polarization; Electric displacement; boundary conditions on displacement; solving simple electrostatics problems in presence of dielectrics – Point charge at the center of a dielectric sphere, charge in front of a dielectric slab, dielectric slab and dielectric sphere in uniform electric field.

UNIT II **15 Hours**

Magneto statics: Bio-Savart law, Divergence and curl of static magnetic field; vector potential and calculating it for a given magnetic field using Stokes' theorem; vector potential and its solution for given current densities. Properties of magnetic materials: magnetic susceptibility and ferromagnetic, paramagnetic and diamagnetic materials.

Time Varying Field and Maxwell's Equation: Laws of Electromagnetic Induction, Self and Mutual induction, Concept of Displacement Current, Difference between Conduction Current and Displacement Current, Eddy Current, Maxwell's Equations, Derivation of Maxwell's Equations, Propagation of Electromagnetic

Waves in Free Space, Solution of propagation of Plane Electromagnetic Wave in free space.

UNIT III **15 Hours**

Semiconductors: Intrinsic and extrinsic semiconductors, Carrier generation and recombination, Carrier transport: diffusion and drift, p-n junction, Semiconductor materials of interest for optoelectronic devices.

Modern Physics: Particle properties of wave: Planck's hypothesis, Qualitative discussion of Photoelectric effect and Compton Effect. Wave properties of particle: De Broglie wave as mater waves, Heisenberg's uncertainty principle and its application. Quantum Mechanics: Interpretation of wave function, Schrödinger equation (time dependent and time independent), particle in a box,

UNIT IV **15 Hours**

Wave Optics: Interference due to division of wavefront, Young's double slit expt., Principle of Superposition, Interference from parallel thin films, Newton rings, Michelson interferometer. Diffraction: Fresnel Diffraction, Diffraction at a straight edge, Fraunhoffer diffraction due to N slits, Diffraction grating, dispersive and resolving power of Grating. Polarization**:** production of plane polarized light by different methods, Brewster and Malus Laws. Double refraction, Quarter & half wave plate, Nicol prism, specific rotation, Laurent's half shade polarimetry.

Laser: Introduction, principle of Laser, stimulated and spontaneous emission, Einstein's Coefficients, He-Ne Laser, Ruby Laser, Application of Lasers.

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

- *David J Griffths. (1999). Introduction to Electrodynamics. Prentice Hall.*
- *Walker, Jearl, David Halliday, and Robert Resnick. (2011). Fundamentals of Physics. Hoboken, N.J: Wiley.*
- *Saslow, W. (2008). Electricity, magnetism and light. e-book.*

Course Title: ENGINEERING MATHEMATICS–I

L	T	P	Credits

Course Code: BEE112

3	1	0	4

Total hours 60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Apply differential and integral calculus to notions of curvature and to improper integrals. Apart from some other applications they will have a basic understanding of Beta and Gamma functions.
2. Classify of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.
3. Illustrate the Tool of power series and Fourier series for learning advanced Engineering Mathematics.
4. Use of functions of several variables that is essential in most branches of engineering and tools of matrices and linear algebra in a comprehensive manner.

Course Content

UNIT I **16 Hours**

Calculus: Evaluates and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.

Rolle 's Theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; Indeterminate forms and Hospital's rule; Maxima and minima.

Advanced Calculus: Differentiation: Limit continuity and partial derivatives, directional derivatives, total derivative; Tangent plane and normal line; Maxima, minima and saddle points; Method of Lagrange multipliers; Gradient, curl and divergence.

Integration: Multiple Integration: double and triple integrals (Cartesian and polar), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes by (double integration) Center of mass and Gravity (constant and variable densities). Theorems of Green, Gauss and Stokes, orthogonal curvilinear coordinates, Simple applications involving cubes, sphere and rectangular parallelepipeds.

UNIT II **14 Hours**

Trigonometry: Hyperbolic and circular functions, logarithms of complex number resolving real and imaginary parts of a complex quantity, De Moivre's Theorem.

Theory of equations: Relation between roots and coefficients, reciprocal Equations, transformation of equations and diminishing the roots.

UNIT III **15 Hours**

Sequences and series: Convergence of sequence and series, tests for convergence; Power series, Taylor's series, series for exponential, trigonometric and logarithm functions; Fourier series: Half range sine and cosine series, Parseval's theorem.

UNIT IV **15 Hours**

Algebra: Vector Space, linear dependence of vectors, basis, dimension; Linear transformations (maps), range and kernel of a linear map, rank and nullity, Inverse of a linear transformation, rank- nullity theorem, composition of linear maps, Matrix associated with a linear map.

Eigen values, eigenvectors, symmetric, skew-symmetric, and orthogonal Matrices, Eigen bases, Diagonalization; Inner product spaces, Gram-Schmidt orthogonalization.

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

- *G.B. Thomas and R.L. Finney. (2002). Calculus and Analytic geometry. Pearson.*
- *Veerarajan T. (2008). Engineering Mathematics for first year. Tata McGraw-Hill, New Delhi.*
- *Ramana B.V. (2010). Higher Engineering Mathematics. Tata McGraw Hill New Delhi.*
- *N.P. Bali and Manish Goyal. (2010). A text book of Engineering Mathematics.Laxmi Publications.*
- *B.S. Grewal. (2000). Higher Engineering Mathematics. Khanna Publishers.*
- *V. Krishnamurthy, V.P. Mainra and J.L. Arora. (2005). An introduction to Linear Algebra. Affiliated East–West press.*
- *Erwin Kreyszig. (2006). Advanced Engineering Mathematics. John Wiley & Sons.*

Course Title: ENGINEERING GRAPHICS & DRAWING

Course Code: BEE104

L	T	P	Credits
1	0	4	3

Total hours 45

Learning Outcomes: After completion of this course, the learner will be able to:

1. Understand about engineering drawing applications and its importance in society.
2. Learn about the visual aspects of engineering design.
3. Discuss the engineering graphics standards.
4. Classify the concept of solid modeling techniques.

Course Content

UNIT I **9 Hours**

Introduction to Engineering Drawing covering, Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involutes; Scales – Plain, Diagonal and Vernier Scales;

Orthographic Projections covering, Principles of Orthographic Projections-Conventions - Projections of Points and lines inclined to both planes; Projections of planes inclined Planes - Auxiliary Planes;

UNIT II **12 Hours**

Projections of Regular Solids covering, those inclined to both the Planes- Auxiliary Views; Draw simple annotation, dimensioning and scale. Floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc. Sections and Sectional Views of Right Angular Solids covering, Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw the sectional orthographic views of geometrical solids, objects from industry and dwellings (foundation to slab only)

UNIT III **14 Hours**

Isometric Projections covering, Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions;

Overview of Computer Graphics covering, listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, shares, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids];

Customization& CAD Drawing consisting of set up of the drawing page and the printer, including scale settings, setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerance; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles;

UNIT IV **10 Hours**

Annotations, layering & other functions covering applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to Credits ate drawings, Credits ate, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen); Printing documents to paper using the print command; orthographic projection techniques; Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation, Computer-aided design (CAD) software modeling of parts and assemblies. Parametric and non-parametric solid, surface and wireframe models. Part editing and two-dimensional documentation of models. Planar projection theory including sketching of perspective, isometric, multi view, auxiliary, and section views. Spatial visualization exercises. Dimensioning guidelines, tolerance techniques; dimensioning and scale multi views of dwelling;
Demonstration of a simple team design project that illustrates Geometry and topology of engineered components: Creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; meshed topologies for engineering analysis and tool-path generation for component manufacture; geometric dimensioning and tolerance; Use of solid-modeling software for Credits eating associative models at the component and assembly levels; floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc. Applying color coding according to building drawing practice; Drawing sectional elevation showing foundation to ceiling; Introduction to Building Information Modeling (BIM).

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings

- *Gill, P.S. (2001). Engineering Drawing. S.K; Kataria and Sons, Ludhiana.*
- *Bhatt, N.D. (2012). Engineering Drawing. Charotar Book Stall, TulsiSadan, Anand.*
- *French, T.E. and Vierck. C.J. (1993). Graphic Science. McGraw-Hill, New York.*
- *Zozzora, F. (1958). Engineering Drawing. McGraw Hill, NewYork.*
- *(Corresponding set of) CAD Software Theory and User Manuals.*

Course Title: ENGINEERING PHYSICS LAB

Course Code: BEE113

L	T	P	Credits
0	0	4	2

Total hours 30

Learning Outcomes On successful completion of this course, the students would be able to:

1. Illustrate the working p-n junction diode.

2. Analyse and solve various engineering problems.
3. Understand principle, concept, working and application of new technology and comparison of results with theoretical calculations.
4. Design new instruments with practical knowledge.

Course Content

List of experiments **30 Hours**

1. To study the V-I characteristics of P-N junction.
2. To verify the logic gates.
3. To calculate the acceleration due to gravity "g" using simple pendulum.
4. To find the moment of inertia of flywheel.
5. To measure the diameter of a small spherical/cylindrical body using Vernier calipers/screw gauge.
6. To draw V-I characteristics of Zener diode and determine reverse breakdown voltage.
7. To study the controls and obtain a wave using Cathode Ray Oscilloscope.
8. To find the resolving power of the prism.
9. To determine the angle of the given prism.
10. To determine the refractive index of the material of a prism.
11. To understand the phenomenon Photoelectric effect as a whole.
12. To draw kinetic energy of photoelectrons as a function of frequency of incident radiation.
13. To determine the Planck's constant from kinetic energy versus frequency graph.
14. To plot a graph connecting photocurrent and applied potential.
15. To determine the stopping potential from the photocurrent versus applied potential graph.

Note: Students will perform any 7-8 experiments from the syllabus.

Course Title: BASIC ELECTRICAL ENGINEERING LAB

Course Code: BEE106

L	T	P	Credits
0	0	4	2

Total Hours: 30

Learning Outcomes: After completion of this course, the learner will be able to:

1. Analysis of Resistive Circuits and Solution of resistive circuits with independent sources.
2. Understand the Two Terminal Element Relationships for inductors and capacitors and analysis of magnetic circuits.

3. Analysis of Single-Phase AC Circuits, the representation of alternating quantities and determining the power in these circuits.
4. Compare different types of Electrical machines and classify different electrical measuring equipment's and understanding their principles

List of Experiments:

1. To study basic safety precautions. Introduction and use of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope. real-life resistors, capacitors and inductors.
2. To verify Ohm's law.
3. To verify Kirchhoff's voltage and current laws.
4. To verify Superposition Theorem.
5. To verify Thevenin Theorem.
6. To obtain the sinusoidal steady state response of R-L circuit – impedance calculation and verification. Observation of phase differences between current and voltage.
7. To obtain the sinusoidal steady state response of R-C circuit – impedance calculation and verification. Observation of phase differences between current and voltage.
8. To study resonance phenomenon in R-L-C series circuits.
9. To perform open circuit and short circuit test on a single-phase transformer and calculate the efficiency.
10. Demonstration of cut-out sections of machines: Induction machine (squirrel cage rotor and slip ring arrangement) and single-phase induction machines.
11. To connect, start and reverse the direction of rotation by change of phase-sequence of connections of three phase induction motor.
12. To connect, start and reverse the direction of rotation of single-phase induction motor.
13. To demonstrate working of DOL starter for three-phase induction motor.

Course Title: FUNDAMENTAL OF COMPUTER AND INFORMATION TECHNOLOGY
Course Code: BEE114

L	T	P	Credits
2	0	0	2

Total Hours: 30

Learning Outcomes: After completion of this course, the learner will be able to:

1. Understand the concept of input and output devices of Computers
2. Study to use the Internet safely, legally, and responsibly.
3. Discuss an operating system and its working, and solve common problems related to operating systems
4. Learn basic word processing, Spreadsheet and Presentation Graphics Software skills

Course Content

UNIT I **8 Hours**

Computer Hardware / Software: Definition, History, Generation, Characteristics, Types & Applications, Overview of a computer system:

Hardware/Software: Definition of Hardware**,** Input Unit: Keyboard, Mouse, Scanner etc.**,** CPU: Arithmetic Logic Unit (ALU), Control Unit (CU), Memory Unit

(MU)**,** Output Unit: Monitor, Printer etc.**,** Storage Devices: Primary &Auxiliary Memory (Floppy Disk, Hard Disk, Compact Disk, DVD, Flash Disk etc.)**,** Others: Network Card, Modem, Sound Card etc.

Software: Definition & types of Software, Programming Language, Live ware, Firmware and Cache Memory

UNIT II **7 Hours**

Setting & Protection: of Computer Room and Computer- Concept of Computer related threats (virus, worms, Trojan, phishing etc.) remedies and protection

File Management Basics: Physical structure of disk

UNIT III **7 Hours**

Concept of E-mail / Internet / Extranet, World Wide Web (WWW): Familiarity with internet browsers (e.g., Internet Explorer, Firefox, Opera, Safari, Google Chrome etc.), Introduction of IP address, subnet mask and default gateway, Introduction to Network Media, topology and protocol, Setting up Microsoft Network, Dial-Up Networking

UNIT IV **8 Hours**

Number System: Introduction to binary, octal, decimal and hexadecimal number system

Introduction to ASCII and Unicode standards

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

- *Rajaraman, V., & Adabala, N. (2014). Fundamentals of computers. PHI Learning Pvt. Ltd.*
- *Doja, M. N. (2005). Technology. Deep and Deep Publications.*
- *Bangia, R. (2008). Computer Fundamentals and Information Technology. Firewall Media.*

Course Title: CONSTITUTION OF INDIA

Course Code: BEE115

L	T	P	Credits
2	0	0	NC

Learning Outcomes: After completion of this course, the learner will be able to:

1. Knowledge and legal literacy and thereby to take up competitive examinations
2. Understand state and central policies, fundamental duties, Electoral Process, and special provisions
3. Analyze powers and functions of Municipalities, Panchayats and Co-operative Societies, and
4. Classify the engineering ethics and responsibilities of Engineer and an awareness about basic human rights in India

Course Content

Unit I **5 Hours**

Introduction to the Constitution of India, The Making of the Constitution and Salient features of the Constitution.

Preamble to the Indian Constitution Fundamental Rights & its limitations.

Unit II **10 Hours**

Directive Principles of State Policy & Relevance of Directive Principles State Policy Fundamental Duties.

Union Executives – President, Prime Minister Parliament Supreme Court of India.

State Executives – Governor Chief Minister, State Legislature High Court of State.

Electoral Process in India, Amendment Procedures, 42nd, 44th, 74th, 76th, 86th &91st Amendments.

Unit III **10 Hours**

Special Provision for SC & ST Special Provision for Women, Children & Backward Classes Emergency Provisions. Human Rights –Meaning and Definitions, Legislation Specific Themes in Human Rights- Working of National Human Rights Commission in India

Powers and functions of Municipalities, Panchayats and Co – Operative Societies.

Unit IV **5 Hours**

Scope & Aims of Engineering Ethics, Responsibility of Engineers Impediments to Responsibility.

Risks, Safety and liability of Engineers, Honesty, Integrity & Reliability in Engineering.

Suggested Readings:

- *Singh Mahendra, P. (2000). VN Shukla's Constitution of India. Eastern Book Company, Lucknow.*
- *Agrawal, P. K., & Gupta, V. (2023). The Constitution of India Bare Act with Short Notes-Useful for Competitive Examinations: Bestseller Book by Dr. PK Agrawal; Virag Gupta: The Constitution of India Bare Act with Short Notes-Useful for Competitive Examinations. Prabhat Prakashan.*

- *Ghosh, P. K. (1966). Constitution of India (Prabhat Prakashan): How it Has Been Framed. Prabhat Prakashan.*

SEMESTER-II

Course Title: ENGINEERING CHEMISTRY
Course Code: BEE201

L	T	P	Credits
3	0	0	3

Total Hours: 45

Learning Outcomes: After completion of this course, the learner will be able to:

1. Demonstrate Schrodinger equation, Particle in a box solution and their applications for conjugated molecules and Nano particles,
2. Evaluate band structure of solids and the role of doping on band structures.
3. Distinguish the ranges of Vibrational and rotational spectroscopy of diatomic molecules, Applications, Nuclear magnetic resonance and magnetic resonance imaging
4. Rationalize periodic properties such as ionization potential, electro-negativity, Oxidation states and electro-negativity.

Course Content

UNIT1 **15 Hours**

Atomic and molecular structure: Schrodinger equation, Particle in a box solution and their applications for conjugated molecules and Nanoparticles, Forms of the hydrogen atom wave functions and the plots of these functions to explore their spatial variations, Molecular orbitals of diatomic molecules and plots of the multicenter orbitals. Equations for atomic and molecular orbitals. Energy level diagrams of diatomic. Pi-molecular orbitals of butadiene and benzene and aromaticity. Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties. Band structure of solids and the role of doping on band structures.

UNIT II **10 Hours**

Spectroscopic techniques and applications: Principles of spectroscopy and selection rules, electronic spectroscopy, Fluorescence and its applications in medicine, Vibrational and rotational spectroscopy of diatomic molecules, Applications, Nuclear magnetic resonance and magnetic resonance imaging, surface characterization techniques, Diffraction and scattering.

Ionic, Dipolar and Vander Waals interactions, Equations of state of real gases and Critical phenomena. Potential energy surfaces of H3, H2F and HCN and trajectories on these surfaces.

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications. Acid base, oxidation reduction and solubility equilibriums, Water chemistry, Corrosion, Use of free energy considerations in metallurgy through Ellingham diagrams.

UNIT III **10 Hours**

Periodic properties: Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis. Isomerism in transitional metal compounds.

UNIT IV **10 Hours**

Organic reactions and synthesis of a drug molecule: Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule.

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

- *Mahan, B. H. (1987). University chemistry.*
- *Sienko, M. J. & Plane, R. A. Chemistry. (1979): Principles and Applications. New York: McGraw-Hill.*
- *Banwell, C. N. (1966). Fundamentals of Molecular Spectroscop. New York, McGraw-Hill.*
- *Tembe, B. L., Kamaluddin& Krishnan, (2008). M. S. Engineering Chemistry (NPTEL Web-book).*

Course Title: ENGINEERING MATHEMATICS –II
Course Code: BEE215

L	T	P	Credits
3	1	0	4

Total Hours: 60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Demonstrate the methods of forming and solving Ordinary differential equations and solve linear differential equations with constant and variable coefficients
2. Explain the concept of differential equation and classifies the differential equations with respect to their order and linearity.
3. Solve first-order ordinary and exact differential equations and converts separable and homogeneous equations to exact differential equations by integrating factors.
4. Apply the method of undetermined coefficients to solve the non-homogeneous linear differential equations with constant coefficients.

Course Content

UNIT I **14 Hours**

First order ordinary differential equations: Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

Ordinary differential equations of higher orders: Second order linear differential equations with variable coefficients, method of variation of parameters, Cauchy-Euler equation; Power series solutions; Legendre polynomials, Bessel functions of the first kind and their properties.

UNIT II **15 Hours**

Complex Variable – Differentiation: Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) and their properties; Conformal mappings, Mobius transformations and their properties.

UNIT III **15 Hours**

Complex Variable – Integration: Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula (without proof), Liouville's theorem and Maximum-Modulus theorem (without proof); Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine, Evaluation of certain improper integrals using the Bromwich contour.

UNIT IV **16 Hours**

Transform Calculus: Laplace Transform, Properties of Laplace Transform, Laplace transform of periodic functions.

Finding inverse Laplace transform by different methods, convolution theorem. Evaluation of Integrals by Laplace transform, solving ODEs and PDEs by Laplace Transform method, Fourier transforms.

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

- *Thomes, G.B.and Finney, R.L. (2010) Calculus and Analytic Geometry; Ninth Edition; Pearson Education*
- *Kreyszig, E. (1998) Advanced Engineering Mathematics; Eighth Edition, John Wiley and sons.*
- *Grewal, B.S. (1965) Higher Engineering Mathematics; Khanna Publishers, New Delhi.*
- *Babu Ram (2009) Advance Engineering Mathematics; First Edition; Pearson Education.*
- *Richard Courant and Fritz John (2012) Introduction to Calculus and Analysis, Volume II, V Springer Publica*

Course Title: PROGRAMMING FOR PROBLEM SOLVING
Course Code: BEE203

L	T	P	Credits
3	0	0	3

Total Hours: 45

Learning Outcomes: After completion of this course, the learner will be able to:

1. Design the algorithms to write programs.
2. Illustrate arrays, pointers and structures to formulate algorithms and programs
3. Apply programming to solve simple numerical method problems, namely rot finding of function, differentiation of function and simple integration
4. Implement conditional branching, iteration and recursion.

Course Content

UNIT I **15 Hours**

Introduction to Programming: Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.) - Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/Pseudo code with examples. From algorithms to programs; source code, variables (with data types) variables and memory Locations, Syntax and Logical Errors in compilation, object and executable code-

UNIT II **15 Hours**

Arithmetic expressions and precedence: Conditional Branching and Loops Writing and evaluation of conditionals and consequent branching

Iteration and loops

Arrays: Arrays (1-D, 2-D), Character arrays and Strings

Basic Algorithms: Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of Equations, notion of order of complexity through example programs (no formal definition requirement.

UNIT III **8 Hours**

Function: Functions (including using built in libraries), Parameter passing in functions, call by value, passing arrays to functions: idea of call by reference.

Recursion: Recursion as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort.

UNIT IV **7 Hours**

Structure: Structures, Defining structures and Array of Structures

Pointers: Idea of pointers, defining pointers, Use of Pointers in self-referential structures, notion of linked list (no implementation)

File handling (only if time is available, otherwise should be done as part of the lab.

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

- *Byron Gottfried, Schaum's (1995), Outline of Programming with C, McGraw-Hill.*
- *E. Balaguruswamy (2005) Programming in ANSI C, Tata McGraw-Hill.*

Course Title: COMMUNICATION SKILLS
Course Code: BEE204

L	T	P	Credits
3	0	0	3

Total Hours: 45

Learning Outcomes: After completion of this course, the learner will be able to:

1. Develop vocabulary and improve the accuracy in Grammar.
2. Apply the concepts of accurate English while writing and become equally ease at using good vocabulary and language skills.
3. Develop and Expand writing skills through Controlled and guided activities.
4. Compose articles and compositions in English.

Course Content

UNIT I **16 Hours**

Vocabulary Building: The concept of Word Formation, Root words from foreign languages and their use in English, Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives. Synonyms, antonyms, and standard abbreviations.

UNIT II **14 Hours**

Basic Writing Skills: Sentence Structures, use of phrases and clauses in sentences, Importance of proper punctuation, creating coherence, organizing principles of paragraphs in documents, Techniques for writing precisely.

UNIT III **8 Hours**

Identifying Common Errors in Writing: Subject-verb agreement, Noun-pronoun agreement, Misplaced modifiers, Articles, Prepositions, Redundancies, Cliché

UNIT IV **7 Hours**

Nature and Style of sensible Writing: Describing, Defining, Classifying, providing examples or evidence, writing introduction and conclusion

Writing Practices: Comprehension, Précis Writing, Essay Writing.

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings

- *Swan, Michael. (1995). Practical English. OUP.*
- *Wood, F.T. (2007). Remedial English Grammar. Macmillan.*
- *Zinsser, W. (2001). On Writing Well. Harper Resource Book.*
- *Lyons, L. H. &Heasly, B. (2006). Study Writing. Cambridge University Press.*
- *Kumar, S &Lata, P. (2011). Communication Skills. Oxford University Press.*
- *CIEFL, Hyderabad. Exercises in Spoken English. Parts. I-III. Oxford University Press.*

Course Title: MANUFACTURING PRACTICES
Course Code: BEE205

L	T	P	Credits
1	0	4	3

Total Hours: 45

Learning Outcomes: After completion of this course, the learner will be able to:

1. Apply the various manufacturing methods in different fields of engineering.
2. Use the different fabrication techniques
3. Learn about the practices in manufacturing of simple components using different materials.
4. Understand the advanced and latest manufacturing techniques being used in engineering industry

Course Content

UNIT I **8 Hours**

Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods.

UNIT II **6 Hours**

CNC machining, Additive manufacturing, Fitting operations & power tools

UNIT III **6 Hours**

Electrical & Electronics Carpentry, Plastic moulding, glass cutting

UNIT IV **10 Hours**

Metal casting, welding (arc welding & gas welding), brazing [More hours can be given to Welding for Civil Engineering students as they may have to deal with Steel structures fabrication and erection; 3D Printing is an evolving manufacturing technology and merits some lectures and hands-on training.]

Workshop Practice:

1. Machine shop - 10 hours
2. Fitting shop - 8 hours
3. Carpentry - 6 hours
4. Electrical & Electronics - 8 hours
5. Welding shop - 8 hours (Arc welding 4 hrs. + gas welding 4 hrs.)

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

- Raghuwanshi, B.S. (2009*). A Course in Workshop Technology, Vol 1 &II*. Dhanpat Rai & Sons.
- Jain, R.K. (2010*). Production Technology. Khanna* Publishers.
- Singh, S. (2003). *Manufacturing Practice*. S.K. Kataria & Sons.

Course Title: ENGINEERING CHEMISTRY LAB
Course Code: BEE206

L	T	P	Credits
0	0	2	1

Total Hours: 15

Learning Outcomes: After completion of this course, the learner will be able to:

1. Evaluate the estimate rate constants of reactions from concentration of reactants/products as a function of time.
2. Measure molecular/system properties such as surface tension, viscosity, conductance of solutions, redox potentials, chloride content of water, etc.
3. Apply the theoretical concepts for result analysis and interpret data obtained from experimentation.
4. Identify the compound using a combination of qualitative test and analytical methods.

Course Content

List of Experiments

1. Determination of surface tension and viscosity
2. Thin layer chromatography
3. Ion exchange column for removal of hardness of water
4. Determination of chloride content of water
5. Colligative properties using freezing point depression
6. Determination of the rate constant of a reaction
7. Determination of cell constant and conductance of solutions
8. Potentiometry - determination of redox potentials and emfs
9. Synthesis of a polymer/drug
10. Saponification/acid value of an oil
11. Chemical analysis of a salt
12. Lattice structures and packing of spheres
13. Models of potential energy surfaces
14. Chemical oscillations- Iodine clock reaction
15. Determination of the partition coefficient of a substance between two immiscible liquids.
16. Adsorption of acetic acid by charcoal
17. Use of the capillary viscosimeters to the demonstrate of the isoelectric point as the pH of minimum viscosity for gelatin sols and/or coagulation of the white part of egg.

Course Title: PROGRAMMING FOR PROBLEM SOLVING LAB
Course Code: BEE207

L	T	P	Credits
0	0	2	1

Total Hours: 15

Learning Outcomes: After completion of this course, the learner will be able to:

1. Create read and write to and from simple text files.
2. Identify and correct logical errors encountered at run time
3. Apply programming to solve simple numerical method problems, namely rot finding of function, differentiation of function and simple integration.
4. Represent data in arrays, strings and structures and manipulate them through a program

Course Content

1. Problem solving using computers
2. Familiarization with programming Environment
3. Variable types and type conversions
4. Simple computational problems using arithmetic expressions
5. Branching and logical expressions
6. Problems involving if-then-else structures
7. Loops, while and for loops
8. Iterative problems e.g., sum of series
9. 1D Arrays: searching, sorting
10. 1DArray manipulation
11. 2D arrays and Strings, memory structure
12. Matrix problems, String operations
13. Functions, call by value
14. Simple functions
15. Numerical methods (Root finding, numerical differentiation, numerical integration)
16. Numerical methods problems
17. Recursion, structure of recursive calls
18. Recursive functions
19. Pointers, structures and dynamic memory allocation
20. Pointers and structures
21. File handling
22. File operations

Suggested Readings

- *Byron Gottfried, Schaum's (1995), Outline of Programming with C, McGraw-Hill*
- *E. Balaguruswamy (2005) Programming in ANSI C, Tata McGraw-Hill.*

Course Title: COMMUNICATION SKILLS LAB
Course Code: BEE208

L	T	P	Credits
0	0	2	1

Total Hours: 15

Learning Outcomes: After completion of this course, the learner will be able to:

1. Illustrate the importance of pronunciation and apply the same day to day conversation.
2. Apply verbal and non-verbal communication techniques in the Professional Environment.
3. Develop coherence, cohesion and competence in Oral discourse.
4. Evaluate the interview process confidently.

Course Content

Oral Communication

(This unit involves interactive practice sessions in Language Lab)

- Listening Comprehension
- Pronunciation, Intonation, Stress and Rhythm
- Common Everyday Situations: Conversations and Dialogues
- Communication at Workplace
- Interviews
- Formal Presentations

Course Title: ENTREPRENEURSHIP DEVELOPMENT
Course Code: BEE216

L	T	P	Credits
1	0	0	1

Total Hours: 15

Learning Outcomes: After completion of this course, the learner will be able to:

1. Assess the commercial viability of new technologies, business opportunities and existing companies
2. Plan, organize, and execute a project or new venture with the goal of bringing new products and service to the market
3. Carry out scientific research in the field of entrepreneurship
4. Improved your interpersonal and collaborative skills

Course Content

UNIT I **10 Hours**

Introduction to Generic Skills: Importance of Generic Skill Development (GSD), Global and Local Scenario of GSD, Life Long Learning (LLL) and associated importance of GSD.

Managing Self: Knowing Self for Self-Development- Self-concept, personality, traits, multiple intelligence such as language intelligence, numerical intelligence, psychological intelligence etc., Managing Self – Physical- Personal grooming, Health, Hygiene, Time Management, Managing Self – Intellectual development -Information Search: Sources of information, Reading: Purpose of reading, different styles of reading, techniques of systematic reading, Note Taking: Importance of note taking, techniques of note taking, Writing: Writing a rough draft, review and final draft. Managing Self – Psychological, Stress, Emotions, Anxiety-concepts and significance, Techniques to manage the above.

UNIT II **5 Hours**

Managing in Team: Team - definition, hierarchy, team dynamics, Team related skills- sympathy, empathy, co-operation, concern, lead and negotiate, work well with people from culturally diverse background, Communication in group - conversation and listening skills.

UNIT III **5 Hours**

Task Management: Task Initiation, Task Planning, Task execution, Task close out, Exercises/case studies on task planning towards development of skills for task management

Problem Solving: Prerequisites of problem solving- meaningful learning, ability to apply knowledge in problem solving, Different approaches for problem solving. Steps followed in problem solving. Exercises/case studies on problem solving.

UNIT IV **10 Hours**

Entrepreneurship: Introduction, Concept/Meaning and its need, Competencies/qualities of an entrepreneur, Entrepreneurial Support System e.g., District Industry Centres (DICs), Commercial Banks, State Financial Corporations,

Small Industries Service Institute (SISIs), Small Industries Development Bank of India (SIDBI), National Bank of Agriculture and Rural Development (NABARD), National Small Industries Corporation (NSIC) and other relevant institutions/organizations at State/National level. Market Survey and Opportunity Identification (Business Planning)- How to start a small-scale industry, Procedures for registration of small-scale industry, List of items reserved for exclusive manufacture in small-scale industry, Assessment of demand and supply in potential areas of growth, understanding business opportunity, Considerations in product selection, Data collection for setting up small ventures. **Project Report Preparation-** Preliminary Project Report, Techno-Economic Feasibility Report, Exercises regarding "Project Report Writing" for small projects.

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

- *Khanka, S. S. (2006). Entrepreneurial development. S. Chand Publishing.*
- *Desai, V. (2009). Dynamics of entrepreneurial development and management (pp. 119-134). Himalaya Publishing House.*
- *Kennedy, A. (2015). Business development for dummies. John Wiley & Sons*

Course Title: NUMERICAL APTITUDE AND REASONING ABILITY
Course Code: BEE209

L	T	P	Credits
1	0	0	1

Total Hours: 15

Learning Outcomes: After completion of this course, the learner will be able to:

1. Understand the basic concepts of quantitative ability and logical reasoning Skills
2. Learn the basic concepts of Acquire satisfactory competency in use of reasoning
3. Solve campus placements aptitude papers covering Quantitative Ability, Logical Reasoning
4. Create the ability to appear in exams like CAT, CMAT, GATE, GRE, GATE, UPSC, GPSC etc.

Course Content

UNIT I **4 Hours**

Numerical problem: Percentages *(like profit & loss %, marks, shares etc.,)*, Time & Work, Speed & Distance problems, Fraction, Ratios, Average & Volume, Factoring *(LCM, HCF),* Mensuration formulas, Simple interest & Compound interest.

UNIT II **4 Hours**

Logical Reasoning: Statements & Assumption, Syllogism, Puzzles, Constraint-Based Reasoning, Proposition Testing, Course of Action, Assertion and Reason, Input Output Relations, Conclusion Estimation from Passages, Cause and Effect Reasoning, Theme Detection etc.

UNIT III **4 Hours**

Verbal Reasoning: Analogy, Series Completion, Blood Relations, Venn Diagrams, Sequential Output Tracing, Ranking & Time Sequence Test, Alphabet Test, Logical Sequence of Words, Inserting the Missing Character, Data Sufficiency, Arithmetical Reasoning Questions, Coding-Decoding, Puzzle Test, Eligibility Test, Situation Reaction Test, Assertion & Reason, etc.

UNIT IV **3 Hours**

Non-Verbal Reasoning: Mirror Images, Reverse Images, Spotting Embedded Figures, Figure Matrix, Paper Folding, Cubes & Dice, Construction of Squares & Triangles, Grouping of Identical Figures, Paper Cutting, Rule Detection, Dot Situation, Figure Formation & Analysis, Series, Classification, Analogy etc.

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

- *Aggarwal, R. S. (2012). Quantitative Aptitude for Competitive Examinations. S. Chand & Company Pvt Limited (Unit II, III).*
- *Experts, D. (2021). (Free Sample) NTA UGC NET Paper 1 Topic-wise 52 Solved Papers (2020 to 2004). Disha Publications.*

Course Title: STRESS MANAGEMENT
Course Code: BEE211

L	T	P	Credits
1	0	0	1

Total Hours: 15

Learning Outcomes: After completion of this course, the learner will be able to:

1. Identify the nature and causes of stress in organizations
2. Knowledge of stress prevention mechanism
3. Classify the strategies that help cope with stress
4. Apply stress management principles in order to achieve high levels of performance and adopt effective strategies, plans and techniques to deal with stress

Course Content

UNIT I **3 Hours**

Understanding Stress, Stress – concept, features, types of stress, Relation between Stressors and Stress, Potential Sources of Stress – Environmental, Organizational and Individual, Consequences of Stress – Physiological, Psychological and Behavioral Symptoms, Stress at work place – Meaning, Reasons

Impact of Stress on Performance, Work Stress Model, Burnout – Concept, Stress v/s Burnout

UNIT II **4 Hours**

Managing Stress – I, Pre-requisites of Stress-free Life, Anxiety - Meaning, Mechanisms to cope up with anxiety, Relaxation - Concept and Techniques Meditation-Concept, types, benefits, elements and ways to building skills

Benefits of meditation, Time Management - Meaning, Importance of Time Management, Approaches to Time Management, Stress Management - Concept, Benefits, Managing Stress at Individual level, Role of Organization in Managing Stress/ Stress Management Techniques

2.10 Approaches to Manage Stress - Action oriented, Emotion oriented, Acceptance oriented.

UNIT III **4 Hours**

Models of Stress Management – Transactional Model, Health Realization/ Innate Health Model, General Adaption Syndrome (GAS) - Concept, Stages, Measurement of Stress Reaction - The Physiological Response, The Cognitive Response, The Behavioral Response, Stress prevention mechanism - Stress management through mind control and purification theory and practice of yoga education, Stress management interventions: primary, secondary, tertiary.

Meditation – Meaning, Importance

UNIT IV **4 Hours**

Stress Management Leading to Success, Eustress – Concept, Factors affecting Eustress, Stress Management Therapy - Concept, Benefits, Stress Counseling – Concept, Value education for stress management, Stress and New Technology, Stress Audit Process, Assessment of Stress - Tools and Methods, Future of Stress Management.

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings

- *Heena T. Bhagtani. (2018). Stress Management. Himalaya Publishing House.*
- *Dutta, P. K, (2010). Stress Management. Himalaya Publishing House.*
- *Roy, S (2012). Managing Stress. Sterling Publication.*

SEMESTER- III

Course Title: ELECTRICAL CIRCUIT ANALYSIS
Course Code: BEE301

L	T	P	Credits
3	0	0	3

Total hours: 45

Learning Outcomes: After completion of this course, the learner will be able to:

1. Interpret the network theorems for the analysis of electrical circuits.
2. Evaluate the transient and steady-state response of electrical circuits.
3. Analyze circuits in the sinusoidal steady-state (single-phase and three-phase) and two port circuit behaviors.
4. Synthesize networks and filters to improve skills in network functions and two port network in electrical circuits

Course Content

UNIT-1 **10 Hours**

Basic Network Analysis

Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem, Reciprocity theorem, Compensation theorem. Analysis with dependent current and voltage sources. Node and Mesh Analysis. Concept of duality and dual networks. Solution of first and second order differential equations for series and parallel R-L, R-C, R-L-C circuits, initial and final conditions in network elements, forced and free response, time constants, steady state and transient state response.

UNIT-2 **10 Hours**

Electrical circuit and steady state analysis

Representation of sine function as rotating phasor, phasor diagrams, impedances and admittances, AC circuit analysis, effective or RMS values, average power and complex power. Three-phase circuits. Mutual coupled circuits, Dot convention in coupled circuits, Ideal Transformer. Analysis of electrical circuits using Laplace Transform for standard inputs, transformed network with initial conditions. Frequency response (magnitude and phase plots), series and parallel resonances.

UNIT-3 **10 Hours**

Network functions and two port network

Driving point impedance and admittance, natural response of a network, transfer impedance and admittance, concept of pole and zeros in a network function, Routh Hurwitz criterion of stability.

Two Port Networks: terminal pairs, relationship of two port variables, impedance parameters, admittance parameters, transmission parameters and hybrid parameters, interconnections of two port networks.

UNIT-4 **15 Hours**

Network Synthesis and Filters

Network synthesis techniques for 2-terminal network, Foster and Cauer forms.

Filters: Classification of filters, characteristics impedance and propagation constant of pure reactive network, ladder network, T-section, π-section, terminating half section, pass bands and stop bands, Design of constant-K, m-derived filters.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *Van Valkenburg, M. E. (2006). Network Analysis. Prentice Hall.*
- *Choudhury, D. Roy. (1998). Networks and Systems. New Age International Publication.*
- *Hayt W. H. and Kemmerly J. E. (2013). Engineering Circuit Analysis. McGraw Hill Education.*
- *Alexander C. K. and Sadiku, M. N. O. (2004). Electric Circuits. McGraw Hill Education.*

Course Title: ELECTRICAL MACHINES - I
Course Code: BEE302

L	T	P	Credits
3	0	0	3

Total hours: 45

Learning Outcomes: After completion of this course, the learner will be able to:

1. Interpret the concept of magnetic fields and magnetic circuits.
2. Analyze the response of the dc machine on the basis of Armature Reaction and commutation.
3. Analyze the concept of starters and speed control of dc motors and evaluate the performance of dc machine by performing Swinburne' and Hopkinson's test.
4. Evaluate the performance of single-phase transformer by performing open circuit test, short circuit test and Sumpner's test.

Course Content

UNIT-I **10 Hours**

Magnetic fields and magnetic circuits

Review of magnetic circuits - MMF, flux, reluctance, inductance; Visualization of magnetic fields produced by a bar magnet and a current carrying coil - through air and through a combination of iron and air; influence of highly permeable materials on the magnetic flux lines.

UNIT-II **15 Hours**

DC machines

Basic construction of a DC machine, magnetic structure - stator yoke, stator poles, pole-faces or shoes, air gap and armature core, visualization of magnetic field produced by the field winding excitation with armature winding open, air gap flux density distribution, flux per pole, induced EMF in an armature coil. Armature winding and commutation - Elementary armature coil and commutator, lap and wave windings, construction of commutator, linear commutation Derivation of back EMF equation, armature MMF wave, derivation of torque equation, armature reaction, air gap flux density distribution with armature reaction.

UNIT-III **10 Hours**

DC machine - motoring and generation

Armature circuit equation for motoring and generation, Types of field excitations - separately excited, shunt and series. Open circuit characteristic of separately excited DC generator, back EMF with armature reaction, voltage build-up in a shunt generator, critical field resistance and critical speed. V-I characteristics and torque-speed characteristics of separately excited, shunt and series motors. Speed control through armature voltage. Losses, load testing and back-to-back testing of DC machines

UNIT-IV **10 Hours**

Transformers

Principle, construction and operation of single-phase transformers, equivalent circuit, phasor diagram, voltage regulation, losses and efficiency, Testing - open circuit and short circuit tests, polarity test, back-to-back test, separation of hysteresis and eddy current losses, Three- phase transformer - construction, types of connection and their comparative features, Parallel operation of single-phase and three-phase transformers, Autotransformers - construction, principle, applications and comparison with two winding transformer, Magnetizing current, effect of nonlinear B-H curve of magnetic core material, harmonics in magnetization current, Phase conversion - Scott connection, three-phase to six-phase conversion, Tap-changing transformers - No-load and on-load tap-changing of transformers, Three-winding transformers. Cooling of transformers.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *Fitzgerald E. and Kingsley, C. (2013). Electric Machinery. New York, McGraw Hill Education.*
- *Clayton E. and Hancock, N. N. (2004). Performance and design of DC machines. CBS Publishers.*
- *Say, M. G. (2002). Performance and design of AC machines. CBS Publishers.*
- *Bimbhra, P. S. (2011). Electrical Machinery. Khanna Publishers.*

Course Title: ELECTRICAL AND ELECTRONIC MEASUREMENTS
Course Code: BEE303

L	T	P	Credits
3	1	0	3

Total hours: 45

Learning Outcomes: After completion of this course, the learner will be able to:

1. Acquire knowledge of the characteristics of measuring instruments and their classification.
2. Examine and reproduce in construction, working of measuring instruments and their proficient use.
3. Acquire knowledge various methods of electrical parameters measurement.
4. Demonstrate various instruments for the measurement of electrical quantities, Cathode Ray Oscilloscope (CRO) and recorders.

Course Content

UNIT-1 **10 Hours**

Introduction
Functional Elements of generalized measurement system, Characteristics of instruments, errors in measurements and their statistical analysis: Limiting errors, combination of quantities with errors, types of errors.

Basic Indicating Instruments
Classification of analog instruments, concept of deflecting, controlling and damping torque, control and damping system, construction and principle of moving iron and moving coil instruments, construction of ammeter and voltmeter, Principles of operation Permanent Magnet Moving Coil (PMMC) ohm meters and their types.

UNIT-II **15 Hours**

Measurement of Resistance
Wheat stone bridge, Kelvin double bridge, Carey-Foster Bridge, Measurement of Insulation resistance.

AC bridges:
General equation for bridge balance, Measurement of Inductance (L): Maxwell Inductance Bridge, Hay's Bridge, Measurement of Capacitance (C): De-Sauty's Bridge, Schering's bridge, Measurement of frequency (f) by and Wein's bridge.

UNIT-III **5 Hours**

Instrument Transformers
Theory and construction of Current Transformer (CT) and Potential Transformer (PT), ratio and phase angle errors and their minimization, Characteristics of CT's. & PT's., Testing of CT's & PT's.

UNIT-IV **15 Hours**

Cathode ray Oscilloscope (CRO) and Recorders
Construction and working of cathode ray tube (CRT), Block diagram of CRO, measurement of voltage and frequency with CRO, basic CRO circuit, measurement of voltage, current, phase, frequency, time period. Dual track oscilloscope, specification of a CRO and their significance, front panel controls. Study of various recorders

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *A.K. Sawhney and Puneet Sawhney, A course on electrical and electronic measurements and Instrumentation, Dhanpat Rai, 2012.*
- *J.B Gupta, A Course in Electronic and Electrical Measurements & Instrumentation, S K Kataria and Sons, 1996.*

Course Title: BASIC ELECTRONICS
Course Code: BEE305

L	T	P	Credits
3	0	0	3

Total hours: 45

Learning Outcomes: After completion of this course, the learner will be able to:

1. Demonstrate electronics component and equipments like C.R.O., Function Generator and power supplies.
2. Analyze the V-I characteristics of PN-Junction diode and determine static resistance and dynamic resistance.
3. Interpret the zener diode and study the characteristics of zener diode.
4. Design and plot the input and output characteristics of common emitter transistor and calculate its input and output resistance.

Course Content

UNIT-I **10 Hours**

Diodes and its Applications: Semiconductor Diode - Ideal versus Practical, Resistance Levels, Diode Equivalent Circuits, Load Line Analysis; Diode as a Switch, Diode as a Rectifier, Half Wave and Full Wave Rectifiers with and without Filters; Breakdown Mechanisms, Zener Diode – Operation and Applications; Opto-Electronic Devices – LEDs, Photo Diode and Applications; Silicon Controlled Rectifier (SCR) – Operation, Construction, Characteristics, Ratings, Applications.

UNIT-II **10 Hours**

Transistor Characteristics: Bipolar Junction Transistor (BJT) – Construction, Operation, Amplifying Action, Common Base, Common Emitter and Common Collector Configurations, Operating Point, Voltage Divider Bias Configuration; Field Effect Transistor (FET) – Construction, Characteristics of Junction FET, Depletion and Enhancement type Metal Oxide Semiconductor (MOS) FETs, Introduction to CMOS circuits;

UNIT-III **15 Hours**

Transistor Amplifiers and Oscillators: Classification, Small Signal Amplifiers – Basic Features, Common Emitter Amplifier, Coupling and Bypass Capacitors, Distortion, AC Equivalent Circuit; Feedback Amplifiers – Principle, Advantages of Negative Feedback, Topologies, Current Series and Voltage Series Feedback Amplifiers; Oscillators – Classification, RC Phase Shift, Wien Bridge, High

Frequency LC and Non-Sinusoidal type Oscillators;

UNIT-IV **10 Hours**

Operational Amplifiers and Applications: Introduction to Op-Amp, Differential Amplifier Configurations, CMRR, PSRR, Slew Rate; Block Diagram, Pin Configuration of 741 Op-Amp, Characteristics of Ideal Op-Amp, Concept of Virtual Ground;

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *David. A. Bell. (2003). Laboratory Manual for Electronic Devices and Circuits, Prentice Hall, India.*
- *L. Floyd and R. P. Jain (2009). Digital Fundamentals. Pearson Education.*
- *Paul B. Zbar, A.P. Malvino and M.A. Miller. (2009). Basic Electronics – A Text-Lab. Manual, TMH.*

Course Title: Numerical Methods and Analysis

Course Code: BEE313

L	T	P	Credits
3	0	0	3

Total hours: 45

Learning Outcomes: After completion of this course, the learner will be able to:

1. Analyze the errors, source of error and its effect on any numerical computations and also analysis the efficiency of any numerical algorithms.
2. Evaluate numerical solution of nonlinear equations using bisection, secant, newton, and fixed-point iteration methods.
3. Formulate system of linear equations numerically using direct and iterative methods and definite integrals and initial value problems numerically
4. Analyze the approximate the functions using interpolating polynomials.

Course Content

UNIT I **10 Hours**

Floating-Point Numbers: Floating-point representation, rounding, chopping, error analysis, conditioning and stability.

Non-Linear Equations: Bisection, secant, fixed-point iteration, Newton method for simple and multiple roots, their convergence analysis and order of convergence.

UNIT II **10 Hours**

Linear Systems and Eigen-Values: Gauss elimination method using pivoting strategies, LU decomposition, Gauss-Seidel and successive-over-relaxation (SOR) iteration methods and their convergence, ill and well-conditioned systems, Rayleigh's power method for eigen-values and eigen-vectors.

UNIT III **10 Hours**

Interpolation and Approximations: Finite differences, Newton's forward and backward interpolation, Lagrange and Newton's divided difference interpolation formulas with error analysis, least square approximations.

UNIT–IV **15 Hours**

Numerical Integration: Newton-Cotes quadrature formulae (Trapezoidal and Simpson's rules) and their error analysis, Gauss-Legendre quadrature formulae.

Differential Equations: Solution of initial value problems using Picard, Taylor series, Euler's and Runge-Kutta methods (up to fourth-order), system of first-order differential equations.

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

- *Gerald, C. F. (2004). Applied numerical analysis. Pearson Education India.*
- *Jain, M. K. (2003). Numerical methods for scientific and engineering computation. New Age International.*
- *Mathews, J. H. (1992). Numerical methods for mathematics, science and engineering (Vol. 10). Prentice-Hall International.*
- *Burden, R. L., Faires, J. D., & Burden, A. M. (2015). Numerical analysis. Cengage learning.*

Course Title: BASIC ELECTRONICS LABORATORY

Course Code: BEE306

L	T	P	Credits
0	0	2	1

Total hours: 15

Learning Outcomes:

After completion of this course, the learner will be able to::

1. Demonstrate electronics component and equipments like C.R.O., Function Generator and power supplies.
2. Analyze the V-I characteristics of PN-Junction diode and determine static resistance and dynamic resistance.
3. Interpret the Zener diode and study the characteristics of Zener diode.
4. Design and plot the input and output characteristics of common emitter transistor and calculate its input and output resistance.

Course Content **15 Hours**

Laboratory Sessions covering

1. To study the characteristics of V-I Characteristics of Silicon & Germanium PN Junction diodes
2. V-I Characteristics of Zener Diode
3. Characteristics of BJT in Common Emitter Configuration
4. Characteristics of JFET in Common Source Configuration
5. To study the characteristics of Half Wave Rectifier.
6. To study the characteristics of Full Wave Rectifier.
7. To study the characteristics of Half Wave and Full Wave Rectifier with Filter circuits.
8. Common Emitter BJT Amplifier
9. To study the characteristics of RC oscillators namely:
   i) Phase shift oscillators.
   ii) Wein bridge oscillators.
10. Implement a non-Inverting (NI) amplifier circuit using op-amp
11. Implement an inverting amplifier circuit using op-amp.
12. Performance evolution of a summing amplifier circuit.

Course Title: ELECTRICAL AND ELECTRONIC MEASUREMENTS LABORATORY
Course Code: BEE307

L	T	P	Credits
0	0	2	1

Total hours: 15

Learning Outcomes: After completion of this course, the learner will be able to:

1. Design and validate DC and AC bridges.
2. Interpret the characteristics of measuring instruments and their classification.
3. Acquire knowledge various methods of electrical parameters measurement.
4. Evaluate and demonstrate various instruments for the measurement of electrical quantities, Cathode Ray Oscilloscope (CRO) and recorders.

Course Content **15 Hours**

LIST OF EXPERIMENTS:

1. Measurement of resistance using Wheatstone bridge.
2. To measure the unknown Inductance in terms of capacitance and resistance by using Maxwell's Inductance Bridge.
3. To measure unknown Inductance using Hay's bridge.
4. To measure unknown capacitance of small capacitors by using Schering's bridge.
5. To measure unknown capacitance using De-Sauty's bridge.
6. Measurement of capacitance using Schering Bridge
7. To measure unknown frequency using Wein's frequency bridge.
8. To test the soil resistance using Meggar (Ohm meter).
9. To convert the Voltmeter into Ammeter using Potentiometer.
10. Determination of frequency and phase angle using CRO.

Course Title: ELECTRICAL MACHINES - I LABORATORY
Course Code: BEE308

L	T	P	Credits
0	0	2	1

Total hours: 15

Learning Outcomes: After completion of this course, the learner will be able to:

1. Interpret the basic concept of single and three-phase transformer/system connections.
2. Evaluation of equivalent circuit parameters, efficiency and voltage regulation by performing various tests on transformer.
3. Analyze parallel operation of transformers.
4. Analyze the performance characteristics of DC generators and performance of starters.

Course Content **15 Hours**

Hands-on experiments related to the course contents

Note: A student to perform any 8-10 Experiments and make one minor working model project.

Suggested List of Experiments:

1. To perform the load test on a single phase transformer.
2. To perform open circuit and short circuit tests on a single phase transformer and hence draw the equivalent circuit, calculate the voltage regulation and efficiency.
3. To find the efficiency and voltage regulation of single phase transformer under different loading conditions.
4. To perform parallel operation of two single phase transformers.
5. To study the various connections of a three phase transformer.
6. To perform Scott connections on three phase transformer to get two phase supply.
7. To study the constructional details of DC machine and to draw sketches of different components.
8. To measure armature and field resistance of DC shunt generator and to obtain its open circuit characteristics.
9. To obtain load characteristics of DC
   (i) shunt
   (ii) series
   (iii) compound generator.
10. To draw speed-torque and torque-speed characteristics of DC shunt/series

/compound generator.

11. To study the three point and four-point DC motor starters.
12. To perform Swinburne's test (no load test) to determine various losses of DC shunt motor.

Course Title: Human Value & Ethics
Course Code: BEE314

L	T	P	Credits
3	0	0	3

Total hours: 45

Learning Outcomes: After completion of this course, the learner will be able to:
1. Compare value and ethics.
2. Develop the ability to face difficult situations in life boldly and resolve them confidently.
3. Implement the code of ethics in professional life and achieve harmony in life
5. Develop moral responsibility and mould themselves as good professionals

Course Content

UNIT-I **10 Hours**

Human Values: Morals, Values and Ethics - Integrity - Work Ethic - Service Learning - Civic Virtue - Respect for Others - Living Peacefully - caring - Sharing - Honesty - Courage - Valuing Time - Co-operation - Commitment - Empathy - Self-Confidence - Character – Spirituality.

UNIT-II **10 Hours**

Engineering Ethics: Senses of 'Engineering Ethics' - variety of moral issued - types of inquiry- moral dilemmas - moral autonomy - Kohlberg's theory - Gilligan's theory - consensus and controversy - Models of Professional Roles - theories about right action - Self-interest - customs and religion - uses of ethical theories.

UNIT-III **10 Hours**

Engineering as Social Experimentation: Engineering as experimentation - engineers as responsible experimenters - codes of ethics - a balanced outlook on law - the challenger case study.

UNIT-IV **15 Hours**

Safety, Responsibilities and Rights: Safety and risk - assessment of safety and risk - risk benefit analysis and reducing risk - the three-mile island and chernobyl case studies. Collegiality and loyalty - respect for authority - collective bargaining - confidentiality - conflicts of interest - occupational crime - professional rights - employee rights - Intellectual Property Rights (IPR) - discrimination.

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

- "Ethics in Engineering", Mike Martin and Roland Schinzinger, McGraw-Hill, New York, 1996.
- "Engineering Ethics", Govinda rajan M, Natarajan S, Senthil Kumar V. S, Prentice Hall of India, New Delhi,2004.

SEMESTER-IV

Course Title: ELECTRICAL MACHINES – II
Course Code: BEE401

L	T	P	Credits
3	1	0	4

Total hours: 60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Interpret the concepts of rotating magnetic fields.
2. Evaluate the operation of AC machines.
3. Analyze performance characteristics of AC machines.
4. Compare synchronous machines and asynchronous machines and interpret the equivalents circuits and phasor of induction machines.

Course Content

UNIT-I **10 Hours**

Fundamentals of AC machine windings

Physical arrangement of windings in stator and cylindrical rotor; slots for windings; single-turn coil - active portion and overhang; full-pitch coils, concentrated winding, distributed winding, winding axis, 3D visualization of the above winding types, Air-gap MMF distribution with fixed current through winding - concentrated and distributed, Sinusoidally distributed winding, winding distribution factor

UNIT-II **10 Hours**

Pulsating and revolving magnetic fields

Constant magnetic field, pulsating magnetic field - alternating current in windings with spatial displacement, Magnetic field produced by a single winding - fixed current and alternating current Pulsating fields produced by spatially displaced windings, Windings spatially shifted by 90 degrees, Addition of pulsating magnetic fields, three windings spatially shifted by 120 degrees (carrying three-phase balanced currents), revolving magnetic field.

UNIT-III **20 Hours**

Induction Machines

Concept of rotating magnetic field, Construction, Types (squirrel cage and slip-ring), Torque Slip Characteristics, Starting and maximum torque, power flow diagram, Equivalent circuit. Phasor diagram, Losses and efficiency. Effect of parameter variation on torque speed characteristics (variation of rotor and stator resistances, stator voltage, frequency). Methods of starting, braking and speed control for induction motors. Generator operation. Self-excitation. Doubly-fed induction machines.

Single phase induction motors: Constructional features, double revolving field theory, equivalent circuit, determination of parameters. Split-phase starting methods and applications.

UNIT-IV **20 Hours**

Synchronous machines

Constructional features, cylindrical rotor and salient pole synchronous machine - generated EMF, coil span and distribution factor, equivalent circuit and phasor diagram, armature reaction at different power factor loads, voltage regulation by synchronous impedance and zero power factor method, concept of short circuit ratio, Operating characteristics of synchronous machines, V- curves and inverter-V curves. Hunting. Salient pole machine - two reaction theory, analysis of phasor diagram, power angle characteristics. Parallel operation of alternators - synchronization and load division.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *Fitzgerald A. E. and Kingsley C. (2013) Electric Machinery Mc Graw Hill Education*
- *Alexander S. Langsdorf, (1955) Theory of A.C. Machines, Mc Graw Hill Education*

SEMESTER- IV

Course Title: POWER ELECTRONICS
Course Code: BEE402

L	T	P	Credits
3	1	0	4

Total hours: 60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Compare signal level and power level devices.
2. Analyse controlled rectifier circuits.
3. Evaluate the operation of DC-DC choppers.
4. Interpret Diode, Thyristor, MOSFET, IGBT and V-I characteristics.

Course Content

UNIT-I **10 Hours**

Power switching devices

Diode, Thyristor, MOSFET, IGBT: V-I characteristics; Firing circuit for thyristor; Voltage and current commutation of a thyristor; Gate drive circuits for MOSFET and IGBT.

UNIT-II **10 Hours**

Thyristor rectifiers

Single-phase half-wave and full-wave rectifiers, Single-phase full-bridge thyristor rectifier with R-load and highly inductive load; Three-phase full-bridge thyristor rectifier with R- load and highly inductive load; Input current wave shape and power factor.

UNIT-III **20 Hours**

DC-DC converter

Elementary chopper with an active switch and diode, concepts of duty ratio and average voltage, power circuit of a buck converter, analysis and waveforms at steady state, duty ratio control of output voltage. DC-DC boost converter: Power circuit of a boost converter, analysis and waveforms at steady state, relation between duty ratio and average output voltage.

UNIT-IV **20 Hours**

Voltage source inverter

Power circuit of single-phase voltage source inverter, switch states and instantaneous output voltage, square wave operation of the inverter, concept of average voltage over a switching cycle, bipolar sinusoidal modulation and unipolar sinusoidal modulation, modulation index and output voltage. Three-phase voltage source inverter: Power circuit of a three-phase voltage source inverter, switch states, instantaneous output voltages, average output voltages over a sub-cycle, three-phase sinusoidal modulation.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *Reddi S R. (2002) Fundamentals of Power Electronics, Narosa Publishing House Pvt. Ltd, New Delhi*
- *Mohammad H. (2005) Power Electronics, Circuits Devices and Applications Khanna Publishers, New Delhi*
- *Bhattacharya S.K. (1998), Industrial Electronics & Control New Age International Publications(P) Ltd, New Delhi.*

Course Title: DIGITAL ELECTRONICS
Course Code: BEE403

L	T	P	Credits
3	0	0	3

Total hours: 45

Learning Outcomes: After completion of this course, the learner will be able to:

1. Interpret the basic fundamental of digital system and logic families
2. Realize working of logic families and logic gates.
3. Design and implement Combinational and Sequential logic circuits
4. Compute the process of Analog to Digital conversion and Digital to Analog conversion.

Course Content

UNIT-I **5 Hours**

Fundamentals of Digital Systems and logic families

Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples of IC gates, number systems-binary, signed binary, octal hexadecimal number, binary arithmetic, one's and two's complements arithmetic, codes, error detecting and correcting codes, characteristics of digital lCs, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-state logic.

UNIT-II **15 Hours**

Combinational Digital Circuits

Standard representation for logic functions, K-map representation, simplification of logic functions using K-map, minimization of logical functions. Don't care conditions, Multiplexer, De-Multiplexer/Decoders, Adders, Subtractors, BCD arithmetic, carry look ahead adder, serial adder.

UNIT-III **10 Hours**

Sequential circuits and systems

A 1-bit memory, the circuit properties of Bi-stable latch, the clocked SR flip flop, J-K-T and D- types flip flops, applications of flip flops, shift registers, applications of shift registers, serial o parallel converter, parallel to serial converter, ring counter, sequence generator, ripple (Asynchronous) counters, synchronous counters, counters design using flip flops, special counter IC's, asynchronous sequential counters, applications of counters.

UNIT-IV **15 Hours**

A/D and D/A Converters

Digital to analog converters: weighted resistor/converter, R-2R Ladder D/A converter, specifications for D/A converters, examples of D/A converter ICs, sample and hold circuit, analog to digital converters: quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D converter, A/D converter using Voltage to frequency and voltage to time conversion, specifications of A/D converters, example of A/D converter ICs, concept of memories.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *Malvino, (1998) Digital principle and applications, (TMH)*
- *Jain, R. P. (2002) Modern digital electronics, (PHI)*
- *Mano, M.M. (2001) Digital Design. (PHI)*

Course Title: ELECTROMAGNETIC FIELDS
Course Code: BEE415

L	T	P	Credits
3	1	0	4

Total hours: 45

Learning Outcomes: After completion of this course, the learner will be able to:

1. Interpret the basic mathematical concepts related to electromagnetic vector fields.
2. Apply the principles of electrostatics to the solutions of problems relating to electric field and electric potential, boundary conditions and electric energy density.
3. Apply the principles of magneto statics to the solutions of problems relating to magnetic field and magnetic potential, boundary conditions and magnetic energy density.
4. Interpret the concepts related to Faraday‘s law, induced emf and Maxwell‘s equations.

Course Content

UNIT-I **10 Hours**

Review of Vector Calculus

Vector algebra-addition, subtraction, components of vectors, scalar and vector multiplications, triple products, three orthogonal coordinate systems (rectangular, cylindrical and spherical). Vector calculus- differentiation, partial differentiation, integration, vector operator, del, gradient, divergence and curl; integral theorems of vectors. Conversion of a vector from one coordinate system to another.

UNIT-II **10 Hours**

Static Electric Field

Coulomb’s law, Electric field intensity, Electrical field due to point charges. Line, Surface and Volume charge distributions. Gauss law and its applications. Absolute Electric potential, Potential difference, Calculation of potential differences for different configurations. Electric dipole, Electrostatic Energy and Energy density. Current and current density, Ohms Law in Point form, Continuity of current, Boundary conditions of perfect dielectric materials. Permittivity of dielectric materials, Capacitance, Capacitance of a two wire line, Poisson’s equation, Laplace’s equation, Solution of Laplace and Poisson’s equation, Application of Laplace’s and Poisson’s equations.

UNIT-III **10 Hours**

Magnetic Forces, and Inductance

Biot-Savart's law, Ampere's law of force, Ampere's circuital law, Faraday's law, Force on a moving charge, Force on a differential current element, Force between differential current elements, Magnetic boundary conditions, Magnetic circuits, calculations of inductances and mutual inductances for a solenoid and toroid.

UNIT-IV **15 Hours**

Maxwell's Equations in Time Varying Fields and Wave theory

Concept of displacement current and conduction current, Maxwell's equation-differential and integral form, Poynting's theorem, its significance and Poynting's vector, Boundary Conditions. Wave theory: Derivation of wave equation, uniform plane waves, Maxwell's equation in Phasor form, Wave equation in Phasor form, Plane waves in free space and in a homogenous material. Attenuation, phase and propagation constant, intrinsic impedance, Relation between E & H, wave equation for a conducting medium, Plane waves in lossy dielectrics, Propagation in good conductors, Skin effect.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

1. *Edward C. Jordan and Keith G. Balmain, (2003) Electromagnetic Waves and Radiation System, Prentice Hall of India. Pvt. Ltd.*
2. *Kraus/ Fleisch, (1999) Electromagnetics, Tata McGraw Hill.*
3. *Fraser, W. (2003) Telecommunications, CBS Publication and Distributor.*

Course Title: DIGITAL ELECTRONICS LABORATORY
Course Code: BEE405

L	T	P	Credits
0	0	2	1

Total hours: 15

Learning Outcomes: After completion of this course, the learner will be able to:

1. Demonstrate the basic electronic components and circuits.
2. Verify truth tables of TTL gates.
3. Design and fabrication and realization of all gates and basic circuits.
4. Design the truth tables and basic circuits and evaluate the basic electronics circuits.

Course Content

15 Hours

Hands-on experiments related to the course contents

Note: A student to perform any 8-10 Experiments and make one working minor project.

Suggested List of Experiments:

1. Verification of the truth tables of TTL gates viz; 7400 (NAND Gate), ,7408 (AND Gate),
2. Verification of the truth tables of TTL gates viz; 7432(OR Gate), 7402 (NOR Gate), 7486 (XOR Gate).
3. Verification of the truth tables of TTL gates viz; 7404 (NOT Gate), 7486 (XOR Gate).
4. Design and fabrication and realization of all gates using NAND/NOR gates.
5. Verification of truth table of Mutiplexer (74150)
6. Verification of truth table of Demultiplexer (74154)
7. Design and verification of truth tables of half-adder circuits using gates 7483 and 7486(controlled inverter).
8. Design and verification of truth tables of full-adder circuit using gates 7483 and 7486(controlled inverter).
9. Design and verification of truth tables of subtractor circuits using gates 7483 and 7486(controlled inverter).
10. To study the operation of Arithmetic Logic Unit IC 74181.
11. Design and test S-R flip-flop using NOR/NAND gates.
12. Verify the truth table of a JK flip flop using IC 7476,
13. Verify the truth table of a D flip flop using IC 7474 and study its operation in

the toggle and asynchronous mode.

Course Title: ELECTRICAL MACHINES-II LABORATORY
Course Code: BEE406

L	T	P	Credits
0	0	2	1

Total hours: 15

Learning Outcomes: After completion of this course, the learner will be able to:

1. Construct equivalent circuit's induction motors by routine tests.
2. Comprehend the requirement of starting and speed control methods of induction motors in the various applications of industry.
3. Construct equivalent circuits of synchronous generator and motor.
4. Apply knowledge to show utility of alternator, synchronous motors and synchronous condenser for various applications in power system.

Course Content

15 Hours

Hands-on experiments related to the course contents

Note: A student to perform any 8-10 Experiments and make one hardware/software based minor project.

Suggested List of Experiments:

1. To perform load-test on three-phase Induction motor and to plot torque versus speed characteristics.
2. To perform no-load and blocked–rotor tests on three-phase Induction motor to obtain equivalent circuit.
3. To study the speed control of three-phase Induction motor by Kramer's Concept.
4. To study the speed control of three-phase Induction motor by cascading of two induction motors, i.e. by feeding the slip power of one motor into the other motor.
5. To study star- delta starters physically and
   a) To draw electrical connection diagram
   b) To start the three-phase Induction motor using it.
   c) To reverse the direction of three-phase Induction motor
6. To start a three-phase slip –ring induction motor by inserting different levels of resistance in the rotor circuit and plot torque –speed characteristics.
7. To perform no-load and blocked–rotor test on single-phase Induction motor and to determine the parameters of equivalent circuit drawn on the basis of double revolving field theory.
8. To perform no load and short circuit. Test on three-phase alternator and draw open and short circuit characteristics.

9. To find voltage regulation of an alternator by zero power factor (ZPF.) method.
10. To study effect of variation of field current upon the stator current and power factor with synchronous motor running at no load and draw Voltage and inverted Voltage curves of motor.
11. Parallel operation of three phase alternators using
    (i) Dark lamp method (ii) Two-Bright and one dark lamp method
12. To study synchroscope physically and parallel operation of three-phase alternators using synchroscope.
13. Starting of synchronous motors using:
    (i) Auxiliary motor (ii) Using Damper windings

Course Title: POWER ELECTRONICS LABORATORY
Course Code: BEE407

L	T	P	Credits
0	0	2	1

Total hours: 15

Learning Outcomes: After completion of this course, the learner will be able to:

1. Interpret the properties and characteristics of thyristors.
2. Classify the types of waveforms of inverter and chopper circuits.
3. Analyze speed and direction control of single phase and three phase electric motors using ac and dc drive.
4. Evaluate the effect of free-wheeling diode on pf with RL load and check the performance of a choppers, and inverter.

Hands-on experiments related to the course contents.

Note: A student to perform any 8-10 Experiments and make one hardware/software based minor project.

Suggested List of Experiments:

1. To plot V-I characteristics and study the effect of gate triggering on turning on of SCR.
2. To study the effect of free-wheeling diode on power factor for single phase half-wave rectifier with R-L load.
3. To plot waveforms for output voltage and current, for single phase full-wave, fully controlled bridge rectifier, for resistive and resistive cum inductive loads.
4. Study of the microprocessor-based firing control of a bridge converter.
5. To study three phase fully controlled bridge converter and plot waveforms of output voltage, for different firing angles.
6. To study Jones chopper or any chopper circuit to check the performance.
7. Thyristorised speed control of a D.C. Motor.
8. Speed Control of induction motor using thyristors.
9. Study of series inverter circuit and to check its performance.
10. To check the performance of a McMurray half-bridge inverter.

Course Title: ENVIRONMENTAL SCIENCES
Course Code: BEE416

L	T	P	Credits
2	0	0	NC

Total hours: 30

Learning Outcomes: After completion of this course, the learner will be able to:

1. Identify environmental problems arising due to engineering and technological activities and the science behind those problems.
2. Estimate the population - economic growth, energy requirement and demand
3. Analyze material balance for different environmental systems.
4. Realize the importance of ecosystem and biodiversity for maintaining ecological balance. Identify the major pollutants and abatement devices for environmental management and sustainable development

Course Content

UNIT-I **5 Hours**

Introduction: Definition and scope and importance of multidisciplinary nature of environment. Need for public awareness.

Natural Resources: Natural Resources and associated problems, use and over exploitation, case studies of forest resources and water resources.

UNIT-II **10 Hours**

Ecosystems: Concept of Ecosystem, Structure, interrelationship, producers, consumers and decomposers, ecological pyramids-biodiversity and importance. Hot spots of biodiversity.

Environmental Pollution: Definition, Causes, effects and control measures of air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, nuclear hazards. Solid waste Management: Causes, effects and control measure of urban and industrial wastes. Role of an individual in prevention of pollution. Pollution case studies. Disaster Management: Floods, earthquake, cyclone and landslides.

UNIT-III **10 Hours**

Social Issues and the Environment from Unsustainable to Sustainable development, urban problems related to energy, Water conservation, rain water harvesting, watershed management. Resettlement and rehabilitation 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.

UNIT-IV **5 Hours**

Human Population and the Environment, Population growth, variation among nations. Population explosion – Family Welfare Programme. 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.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *Goyal, A. (2020) Environmental Studies. Notion Press, New Delhi.*
- *Kaur, N & Goyal, A. (2014) Disaster Management. PBS Education, Jalandhar.*
- *Agarwal, K. C.(1998) Environment Biology, Nidi Publ. Ltd. Bikaner.*
- *Jadhav, H & Bhosale, V.M. (2001) Environment Protection and Laws. Himalaya Pub House, Delhi*
- *Rao M. N. & Datta A.K.(1997) Waste Water Treatment. Oxford & IBH Publ. Co. Pvt. Ltd.*

Course Title: ORGANIZATIONAL BEHAVIOUR
Course Code: BEE417

L	T	P	Credits
3	0	0	3

Total hours: 45

Learning Outcomes: After completion of this course, the learner will be able to:

1. Comprehend the usability goals and user experience goals for designing an interactive product.
2. Identify suitable methods for evaluating interactive technologies.
3. Analyze the suitable methods for establishing requirements.
4. Interpret the conceptual, practical, and ethical issues involved in evaluation.

Course Content

UNIT I **12 Hours**

Organizational Behavior: What managers do, Definition of OB, contributing disciplines to OB, challenges and opportunities for OB. Foundations of Individual behavior- biographical characteristics, ability, and learning. Values, Attitudes, Personality and Emotions, Perception

UNIT II **12 Hours**

Motivation: Concept, Theories of Maslow, Herzberg, McClelland, Porter & Lawler Model, Application of Motivation Concept. Job Satisfaction Foundations of Group

Behaviour: Group formation, development and structure, Group Processes, Group Decision- making Techniques, Work Teams.

UNIT III **11Hours**

Interpersonal Skill-Transactional analysis, Life Positions, Johari Window. Leadership: Concept, theories, styles and their application. Power and Politics in Organization

UNIT IV **10 Hours**

Conflict Management, Stress Management, Crisis Management, Organizational Change & Development, Innovation, Creating a learning Organization, Organizational Culture, Organizational Effectiveness.

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *Nelson, Debra L and James C Quick, "Organisational Behavior", Thomson Learning*
- *Pareek, Udai, "Understanding Organisational Behaviour", Oxford University Press, New Delhi*
- *Robbins, S.P., "Organisational Behaviour", Prentice Hall of India, New Delhi*
- *Hellgiegel, D & J.W. Slocum, "Organisational Behaviour", Thomson Learning*
- *Mcschane, "Organization Behaviour", TMH, New Delhi*
- *Luthans, Fred, "Organisational Behaviour", Mc Graw Hill, New York*
- *New Storm and Keith Davis, "Organization Behaviour", TMH, New Delhi*

SEMESTER- V

Course Title: POWER SYSTEM -I (APPARATUS AND MODELLING)
Course Code: BEE501

L	T	P	Credits
3	1	0	4

Total hours: 60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Interpret the basic concepts of power systems.
2. Classify the various power system components.
3. Evaluate fault currents for different types of faults.
4. Comprehend the generation of over-voltages and insulation coordination.

Course Content

UNIT-1 **15 Hours**

Basic Concepts

Evolution of Power Systems and Present-Day Scenario. Structure of a power system: Bulk Power Grids and Micro-grids.

Generation: Conventional and Renewable Energy Sources. Distributed Energy Resources. Energy Storage. Transmission and Distribution Systems: Line diagrams, transmission and distribution voltage levels and topologies (meshed and radial systems). Synchronous Grids and Asynchronous (DC) interconnections. Review of Three-phase systems. Analysis of simple three-phase circuits. Power Transfer in AC circuits and Reactive Power.

UNIT-II **15 Hours**

Power System Components

Conductor Materials; ACSR, hollow and bundle conductor. Different types of tower, Stringing of conductor, spacing, sag, clearance from ground, overhead line insulator, concept of string efficiency. Choice & variation of frequency & voltage. Benefits of double circuit lines.

Parameters and performance of transmission lines

Introduction to Line Parameters, Resistance of Transmission Line, inductance of single phase two wire line, concept of G.M.D, Transposition of power lines, Effect of earth on capacitance of conductors. Representation of short Transmission Line, medium length line, long length line, Diagram of Power Flow through transmission lines, ABCD constants.

UNIT-III **15 Hours**

Circle Diagram, Line Compensation and underground cables

Receiving end circle diagram for long transmission line based on ABCD constants. Power loci, Surge impedance loading, Reactive power requirement of system series and shunt compensation, synchronous phase modifiers, rating of phase modifiers. Types of Cables based upon voltage & current rating, dielectric stress, capacitance of cable.

UNIT-IV **15 Hours**

Introduction to DC Transmission

DC Transmission Systems: Line-Commutated Converters (LCC) and Voltage Source Converters (VSC) based dc link, Real Power Flow control in a dc link. Comparison of ac and dc transmission. Solar PV systems: I-V and P-V characteristics of PV panels, power electronic interface of PV to the grid. Wind Energy Systems: Power curve of wind turbine. Fixed and variable speed turbines.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *Elgerd O.L. (2001) Electrical Energy System Theory - An introduction, (TMH)*
- *Stevenson Jr W.D. (1999) Elements of Power System Analysis, TMH*
- *Wadhwa C.L. (2000) Course in Electrical Power, New Age Int.(P)Ltd.*
- *Nagrath and Kothari. (2003) Power System Analysis, (TMH)*
- *Gupta, B.R. (2001) Power System Analysis & Design, Wheeler Publishing.*

Course Title: CONTROL SYSTEMS
Course Code: BEE502

L	T	P	Credits
3	1	0	4

Total hours: 60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Interpret the modelling of linear-time-invariant systems using transfer function and state-space representations.
2. Analyze electromechanical systems by mathematical modelling.
3. Evaluate the Transient and Steady State behavior of systems using standard test signals.
4. Analyze linear and non-linear systems for steady state errors, absolute stability and relative stability.

Course Content

UNIT-I **15 Hours**

Introduction to control problem

Industrial control examples. Control hardware and their models. Transfer function models of linear time-invariant systems.

Feedback Control: Open-Loop and Closed-loop systems. Benefits of Feedback. Block diagram algebra.

UNIT-II **15 Hours**

Time Response Analysis

Standard test signals. Time response of first and second order systems for standard test inputs. Application of initial and final value theorem. Design specifications for second-order systems based on the time-response.

Concept of Stability. Routh-Hurwitz Criteria. Relative Stability analysis. Root-Locus technique. Construction of Root-loci.

UNIT-III **15 Hours**

Frequency-response analysis

Relationship between time and frequency response, Polar plots, Bode plots. Nyquist stability criterion. Relative stability using Nyquist criterion – gain and phase margin. Closed-loop frequency response.

Introduction to Controller Design

Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness of control systems. Root-loci method of feedback

controller design. Design specifications in frequency-domain. Frequency-domain methods of design.

UNIT-IV **15 Hours**

State variable Analysis

Concepts of state variables. State space model. Diagonalization of State Matrix. Solution of state equations. Eigenvalues and Stability Analysis. Concept of controllability and observability. Pole-placement by state feedback. Discrete-time systems. Difference Equations. State-space models of linear discrete-time systems. Stability of linear discrete-time systems.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *Ogata, K. (1999) Modern Control Engg. Prentice Hall, New Delhi.*
- *Gibsen, J.F. (2007) Control System Components, Mc Graw Hill.*
- *Kuo, B.C. (1998) Automatic Control System, Prentice Hall.*
- *Nagrath, I. J. (2004) Control System Engineering, Wiley Eastern Ltd., New Delhi.*

Course Title: MICROPROCESSORS AND ITS APPLICATIONS
Course Code: BEE503

L	T	P	Credits
3	1	0	4

Total hours: 60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Comprehend the 8085 and 8086 Microprocessors.
2. Write the assembly language programming.
3. Perform interfacing design of peripherals like 8253, 8279, 8251 etc.
4. Develop systems using different microprocessors.

Course Content

UNIT-I **10 Hours**

Fundamentals of Microprocessors:

Digital Computers: General architecture and brief description of elements, programming system, Buses and CPU Timings. Microprocessor and Microprocessor Development Systems: Evolution of Microprocessor, memory, data transfer schemes, architecture advancements of microprocessors, typical microprocessor development system, higher lever languages.

UNIT-II **20 Hours**

The 8085 Architecture

Microprocessor architecture and its operations, Pin configuration, internal architecture. Timing & Signals: control and status, interrupt: ALU, machine cycles, Instruction format, op-codes, mnemonics, number of bytes,

Instruction Set of 8085: Addressing Modes: Register addressing, direct addressing; register indirect addressing, immediate addressing, and implicit addressing. **Instruction Classification**: Data transfer, arithmetic operations, logical operations, branching operation, machine control; Writing assembly Language programs, Assembler directives.

UNIT-III **15 Hours**

The 8086 Architecture

8086 Microprocessors: Architecture: Architecture of INTEL 8086 (Bus Interface Unit, Execution unit), register organization, memory addressing, memory segmentation, Operating Modes Instruction Set of 8086 Addressing Modes: Instruction format: Discussion on instruction Set: Groups: data transfer,

arithmetic, logic string, branch control transfer, processor control. Interrupts: Hardware and software interrupts.

UNIT-IV **15 Hours**

Peripheral memory and I/O Interfacing

Interfacing devices, Interfacing of Memory, Programmed I/O, Interrupt Driven I/O, memory I/O, 8253/8254 Programmable timer/counter. 8259 programmable Interrupt Controller, 8251- USART.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *A. K. Ray & K M Bhurchandi. (2000) Advanced Microprocessor and peripherals. McGraw Hill.*
- *Ramesh. S. Gaonkar, (2000) Microprocessor Architecture, Programming and applications with the 8085, Pen Ram International Publishing*
- *B. Ram. (2001) Fundamentals of Microprocessors and Microcomputers, Dhanpat Rai Publications.*
- *Muhopadhyay A. H. (1998) Microprocessor Based Laboratory Experiments and Projects, Wheeler Publishing.*

Course Title: POWER SYSTEM - I LAB
Course Code: BEE505

L	T	P	Credits
0	0	2	1

Total hours: 15

Learning Outcomes: After completion of this course, the learner will be able to:

1. Identify with the concepts of power systems.
2. Classify the various power system components.
3. Evaluate fault currents for different types of faults.
4. Comprehend the generation of over-voltages and insulation coordination.

Course Content **15 Hours**

Hands-on experiments related to the course contents.

Visits to power system installations (generation stations, EHV substations etc.) are Exposure to fault analysis and Electro- magnetic transient program (EMTP) and Numerical Relays are suggested.

Suggested List of Experiments:

Hardware Based:

1. To measure negative sequence and zero sequence reactance of Synchronous Machines.
2. Fault analysis for line-to-line (L-L), Line-to-Ground (L-G) and double line to ground fault.
3. To study the performance of a transmission line and compute its ABCD parameters.
4. To study the earth resistance using three spikes.
5. Plot the time current characteristics of over current relay
6. Power measurement by using CTs and PTs
7. Earthing of different equipment/Main Distribution Board and Energy Meter Box
8. To study operation of oil testing set.

Course Title: CONTROL SYSTEMS LAB
Course Code: BEE506

L	T	P	Credits
0	0	2	1

Total Hours: 15

Learning Outcomes: After completion of this course, the learner will be able to:

1. Interpret the modelling of linear-time-invariant systems using transfer function and state-space representations.
2. Analyze the electromechanical systems by mathematical modelling.
3. Determine the Transient and Steady State behavior of systems using standard test signals.
4. Compare and analyze linear and non-linear systems for steady state errors, absolute stability and relative stability.

Course Content **15 Hours**

Note: A student to perform any 8-10 Experiments.

Suggested List of Experiments:

1. To study the characteristics of potentiometers and to use 2- potentiometers as an error detector in a control system.
2. To study the synchro Transmitter-Receiver set and to use it as an error detector
3. To study the Speed – Torque characteristics of an AC Servo Motor and to explore its applications.
4. To study the Speed – Torque characteristics of an DC Servo Motor and explore its applications.
5. To study the variations of time lag by changing the time constant using control engineering trainer
6. To simulate a third order differential equations using an analog computer and calculate time response specifications
7. To obtain the transfer function of a D.C. motor – D.C. Generator set using Transfer Function Trainer
8. To study the speed control of an A.C. Servo Motor using a closed loop and an open loop systems

(i) To study the operation of a position sensor and study the conversion of position in to corresponding voltage

(ii) To study PI control action and show its usefulness for minimizing steady state error of time response.

9. To measure Force / Displacement using Strain Gauge in a wheat stone bridge

10. To design a Lag compensator and test its performance characteristics.
11. To design a Lead-compensator and test its performance characteristics.
12. To design a Lead-Lag compensator and test its performance characteristics.

Course Title: MICROPROCESSORS & ITS APPLICATIONS LAB
Course Code: BEE507

L	T	P	Credits
0	0	2	1

Total hours: 15

Learning Outcomes: After completion of this course, the learner will be able to:

1. Interpret the 8085 and 8086 Microprocessors.
2. Prepare assembly language programmes.
3. Perform the interfacing design of peripherals like 8255, 8253, 8279, 8251 etc.
4. Develop systems using different microprocessors.

Course Content **15 Hours**

Suggested List of Experiments:

1. To study 8085 based microprocessor system
2. To study Pentium Processor
3. To develop and run a program for finding out the largest number from a given set of numbers.
4. To develop and run a program for finding out the smallest number from a given set of numbers.
5. To develop and run a program for arranging in ascending order of a set of numbers
6. To develop and run a program for arranging in descending order of a set of numbers
7. To perform multiplication of given numbers
8. To perform division of given numbers
9. To perform conversion of temperature from 0 F to 0 C and vice-versa
10. To perform 2's compliment of a given number
11. To perform floating point mathematical operations (addition, subtraction, multiplication and division)
12. To obtain interfacing of RAM chip to 8085 based system
13. To obtain interfacing of keyboard controller, 8279
14. To obtain interfacing of PPI, 8255
15. To obtain interfacing of USART, 8251
16. To perform microprocessor-based stepper motor operation through 8085 kit
17. To perform microprocessor-based traffic light control

Course Title: HUMAN RESOURCE MANAGEMENT
Course Code: BEE512

L	T	P	Credits
3	0	0	3

Total hours: 45

Learning Outcomes: After completion of this course, the learner will be able to:

1. Interpret the concept of human resource management and its relevance in organizations.
2. Develop necessary skill set for application of various HR issues.
3. Develop better Personnel Management skills.
4. Integrate the knowledge of HR concepts to take correct decisions.

Course Content

UNIT-I **10 Hours**

Introduction: Meaning, scope, objectives and importance of Human Resource Management, Personnel Management, its functions, policies & roles, Organizing the Human Resource Management department in the organization, Human Resource Management practices in India, HR audit.

Procurement and Placement: Need for Human Resource Planning; Process of Human Resource Planning; Methods of Recruitment; Psychological tests and interviewing, Meaning and Importance of Placement and Induction, Employment Exchanges (Compulsory Notification of vacancies) Act 1959, The Contract Labor (Regulation & Abolition) Act 1970.

UNIT-II **10 Hours**

Training & Development: Principles of Training and Development; Difference between Training and Development; Promotion: Promotion-Merit v/s seniority wise; Performance Appraisal, Career Development & Planning.

Job analysis & Design: Job Analysis and its Principle: Job Specification & Job Description, Difference between Job Specification Job Description
Job Satisfaction: Meaning, objectives and importance Job satisfaction.

UNIT-III **10 Hours**

Motivation: Factors affecting motivation, Motivation Theory, Maslow's Motivation Theory, Hertzberg Hygiene Theory, Workers ' Participation in the organization, Quality of work life.

Bonus and Incentives: Meaning, objectives and importance of Bonus and Incentives.

The Wage Act and Compensation Function: Basic concepts in wage administration, company's wage policy, Issues in wage administration, Payment of Wages Act-1936, Minimum Wages Act-1961.

UNIT-IV **15 Hours**

Integration and Human Relation: Meaning, objectives and importance of Integration in industry.

Human Relations and Industrial Relations; Difference between Human. Relations and Industrial Relations, Factors required for good Human Relation Policy in Industry;

Employees Grievances: Employee Employer relationship Causes and Effects of Industrial disputes, Administration of Discipline, Absenteeism, Labor Turnover, changing face of the Indian work force and their environment, Importance of collective Bargaining; Role of trade unions in maintaining cordial Industrial Relations.

Welfare of Employees: Welfare of Employees and its Importance; Fringe & retirement terminal benefits, administration of welfare amenities, Meaning and Importance of Employee Safety, Accidents-Causes & their Prevention, Safety Previsions under the Factories Act 1948, Social security, Family Pension Scheme, ESI act 1948, Future challenges for Human Resource Management.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- T. N. Chhabra. (2000) Human Resource Management. Dhanpat Rai & Co.
- Lowin B. Flippo. (2005) Principles of personnel Management. Mc Graw Hill.
- R.C. Saxena. Labour Problems and social welfare. K. Math & Co.
- A Minappa and M. S. Saiyada. Personnel Management. Mc Graw Hill.
- C.B. Mamoria. Personnel Management. Himalaya Publishing House, Bombay.
- T.N. Bhagotiwal. Economics of Labour and Industrial Relations. Sahitya Bhawan Agra.

SEMESTER- VI

Course Title: POWER SYSTEMS - II (Operation and Control)
Course Code: BEE601

L	T	P	Credits
3	1	0	4

Total hours: 60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Develop small scale model of alternator, excitation and governing systems.
2. Decide the scheduling of thermal units and hydro-thermal units for overall economy.
3. Design and apply control for frequency and voltage of power system represented by multi area
4. Compute the factors affecting power system security and voltage stability.

Course Content

UNIT-I **10 Hours**

Economic Operation of Power Systems: Fuel consumption, Characteristics of thermal unit, Incremental fuel rate and their approximation, Minimum and maximum power generation limits.

UNIT-II **15 Hours**

Economic Dispatch: Economic dispatch problem with and without transmission line losses, Unit Commitment, methods for their solutions. Hydrothermal Co-ordination: Hydro-scheduling, Plant models, Scheduling problems, Hydro-thermal scheduling problems and its approach.

UNIT-III **15 Hours**

Power System Control: Ideas of load frequency and voltage control, Reactive power control, Block diagrams of P-f and Q-V controllers, ALFC control, Static and dynamic performance characteristics of ALFC and AVR controllers, Excitation systems model, concept of area and Tie-line operations.

UNIT-IV **20 Hours**

Power System Security: Factors affecting security, Contingency analysis, Network sensitivity, correcting the generation dispatch by using sensitivity method and linear programming. Small Scale Stability Analysis: d-q model of generator, State space representation, Eigen value and participation factor analysis.

Voltage Stability: Basic concepts, Voltage collapse, P-V and Q-V curves, Impact of load, Static and dynamic analysis of voltage stability, Prevention of voltage collapse.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *Rao, S. (2001). Testing, Commissioning, Operation and Maintenance of Electrical Equipment by Khanna Technical Publication. New Delhi*
- *Wadhwa, C.L. (1996) Electrical Power Systems. Wiley Eastern Ltd. New Delhi*
- *Uppal, S.L. (2003). Electrical Power. Dr. Khanna Publications. Delhi.*
- *A.J. Wood, B.F. Woolenberg (2013). Power Generation Operation and Control. John Wiley and Sons.*
- *Chakrabarty Abhijit (2006). Power System Analysis, Operation and Control. PHI Learning, New Delhi.*

Course Title: PROGRAMMABLE LOGIC CONTROLLERS
Course Code: BEE602

L	T	P	Credits
3	1	0	4

Total hours: 60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Analyze the major components of PLC.
2. Interpret the operation of PLC modules.
3. Execute the PLC programming with different conditions.
4. Establish communication and networking with PLC.

Course Content

UNIT-I **10 Hours**

Introduction to PLC

Introduction, relative merits over hard-wired logic and relay. PLC based design of power converters, PLC based control of DC and AC Drives Process Control, Advantages, Applications Building blocks of PLC, Functions of various blocks, concept of PLC.

UNIT-II **10 Hours**

Working of PLC

Basic operation and principles of PLC Architectural details processor Memory structures, I/O structure Programming terminal, power supply

UNIT-III **20 Hours**

Instruction Set Basic instructions like latch, master control, self-holding relays. Timer instruction like retentive timers, resetting of timers. Counter instructions like up counter, down counter, resetting of counters. Sequencers, output sequencers, input sequencers, time driven, and event driven sequencers, masking etc. Comparison instructions like equal, not equal, greater, greater than equal, less than, less than equal, mask equal limit etc.

UNIT-IV **20 Hours**

Ladder Diagram Programming

Programming based on basic instructions, timer, counter, sequencer, and comparison instructions using ladder program.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *Otter, J.D. (2000). Programmable Logic Controller. P.H. International, Inc, USA*
- *Dunning, G. (1999). Introduction to PLCs. McGraw Hill.*

Course Title: GENERATION OF ELECTRICAL POWER
Course Code: BEE603

L	T	P	Credits
3	1	0	4

Total hours: 60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Interpret the India's power scenario, power system structure and related agencies.
2. Select the methods and size of plant generating power for overall economy.
3. Decide the tariff structure for different type of users.
4. Comprehend the Energy and environment, Air pollution, Aquatic impacts, nuclear plant and hydro plant impacts.

Course Content

UNIT-I **10 Hours**

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

UNIT-II **10 Hours**

Loads and Load curves: Maximum demand, Group diversity factor, Peak diversity factor, Types of load, chronological load curves, load-duration Curve, mass curves, load factor, capacity factor, utilization factor, base load and peak load plants, load forecasting.

Power Plant Economics: Capital cost of plants, annual fixed cost, operating costs and effect of load factor on cost of energy, depreciation.

UNIT-3 **20 Hours**

Tariffs and power factor improvement: Objectives of tariff making, different types of tariff for domestic, commercial, agricultural and Industrial loads. Need for p.f. improvement, p.f. improvement using capacitors, determination of economic p.f.

Selection of plant: Plant location, plant size, no. and size of units in plants, economic comparison of alternatives, annual cost, rate of return, present worth and capitalized cost methods.

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

UNIT-IV **20 Hours**

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

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

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

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *Gupta, B. R. (2000). Generation of Electric Energy. S. Chand & Co. Delhi.*
- *Dom, K. (1998) Power Plant Engineering S. Chand & Co. Delhi.*

Course Title: POWER SYSTEMS-II LAB
Course Code: BEE605

L	T	P	Credits
0	0	2	1

Total hours: 15

Learning Outcomes: After completion of this course, the learner will be able to:

1. Interpret various abnormal conditions that could occur in power system
2. Design various protective devices in power system for protecting equipment and personnel.
3. Classify the various types of existing circuit breakers, their design and constructional details.
4. Comprehend the various conventional relays, their design and latest developments.

Course Content

15 Hours

Laboratory Work:

1. Simulation of thermal scheduling with and without losses
2. Unit commitment by dynamic programming
3. Simulation of hydro-thermal scheduling by gradient method
4. Stability analysis of single area frequency control
5. Bias control of two area system and AVR.

Course Title: PROGRAMMABLE LOGIC CONTROLLERS LAB
Course Code: BEE606

L	T	P	Credits
0	0	2	1

Total Hours: 15

Learning Outcomes: After completion of this course, the learner will be able to:

1. Perform different types of PLC programming schemes.
2. Implement ladder diagrams for process control.
3. Evaluate and use PLCs for different applications.
4. Correlate PLCs with drives in achieving required control.

Course Content

LIST OF PRACTICALS

1. Familiarization with the working of PLC.
2. Components/Sub-Components of a PLC, learning functions of different modules of PLC System.
3. Introduction to step 5 programming language, ladder diagram concepts, instruction list syntax.
4. Basic logic operations, AND, OR, NOT functions.
5. Logic control systems with time response as applied to clamping operation.
6. Sequence control system e.g. In lifting a dense for packaging and counting.
7. Wiring, entering and testing programs wiring a hand-held programmer for the following operations: - Ladder Logic, Timers, Counters, Sequencers
8. Wiring, entering and testing programs using computers for the following operations: Ladder logic, timers, counters, sequencers
9. Assembly language programming.
10. Write a program for LCD interface.
11. Write a program for A/D converter, result on LCD.
12. Write a program for D/A converter, showing the result on LCD.
13. Write a program for serial data transmission from kit to PC.
14. Development of a small working programs using PLC.

Course Title: PROJECT-1
Course Code: BEE616

L	T	P	Credits
0	0	4	2

Total Hours: 30

Learning Outcomes: After completion of this course, the learner will be able to:
1. Apply the theoretical and practical knowledge gained so far, by taking up the study in the form of a project work.

2. Provide a good initiation for the students in R&D work.

The aim of the Project work to enable the student to take up an investigative study in the broad field of Electrical Engineering, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis or two/three students in a group, under the guidance of a supervisor.

Course Content

The assignment to normally include:

1. Survey and study of published literature on the assigned topic;
2. Working out a preliminary Approach to the Problem relating to the assigned topic.
3. Conducting preliminary Analysis/Modelling/Simulation/Experiment/Design/Feasibility;
4. Preparing a Written Report on the Study conducted for presentation to the Department
5. Final Seminar, as oral Presentation before a departmental committee.

Course Title: ELECTRICAL MATERIALS
Course Code: BEE617

L	T	P	Credits
3	0	0	3

Total hours: 45

Learning Outcomes: After completion of this course, the learner will be able to:

1. Evaluation the fundamental concepts of materials into conducting, semi conducting and insulating materials
2. Apply preliminary cost estimating techniques to prepare building cost plans.
3. Use estimating techniques to build unit prices.
4. Analyse price conforming tenders with available information. Develop and apply appropriate cost planning bidding strategies that are ethically appropriate.

Course Content

UNIT-I **13 Hours**

Classification
Classifications of materials into conducting, semi conducting and insulating materials through a brief reference to their atomic structure and energy bands.

Conducting Material
Introduction, Resistance and factors affecting it such as alloying and temperature etc. Classification of conducting material as low resistivity and high resistivity materials, Low resistance materials;

Copper: General properties as conductor: Resistivity, temperature coefficient, density, mechanical properties of hard-drawn and annealed copper, corrosion, contact resistance. Applications in the field of electrical engineering;

Aluminium: General properties as conductor: Resistivity, temperature coefficient, density, mechanical properties of hard and annealed aluminium, solder ability, contact resistance. Applications in the field of electrical engineering;

Steel: General properties as conductor: Resistivity, corrosion, temperature coefficient, density, mechanical properties, solderability, Applications in the field of electrical engineering. Introduction to bundle conductors and its applications. Low resistivity copper alloys: Brass, Bronze (cadmium and Beryllium), their practical applications with reasons for the same. Applications of special metals e.g. Silver, Gold, and Platinum etc. High resistivity materials and their applications e.g.,

manganin, constantan, Nichrome, mercury, platinum, carbon and tungsten. Superconductors and their applications.

UNIT-II **10 Hours**

Review of Semi-conducting Materials Semi-conductors and their properties, Materials used for electronic components like resistors, capacitors, diodes, transistors and inductors etc.

Insulating materials; General Properties:
Electrical Properties: Volume resistivity, surface resistance, dielectric loss, dielectric strength (breakdown voltage) dielectric constant

Physical Properties: Hygroscopicity, tensile and compressive strength, abrasive resistance, brittleness.

Thermal Properties: Heat resistance, classification according to permissible temperature rise. Effect of overloading on the life of an electrical appliance, increase in rating with the use of insulating materials having higher thermal stability, Thermal conductivity, Electro-thermal breakdown in solid dielectrics

Chemical Properties: Solubility, chemical resistance, weatherability, Mechanical properties, mechanical structure, tensile structure

UNIT-III **7 Hours**

Insulating Materials and their applications:
Plastics: Definition and classification.

Thermosetting materials: Phenol-formaldehyde resins (i.e. Bakelite) amino resins (urea- formaldehyde and Malamine-formaldehyde), epoxy resins - their important properties and applications.

Thermo-plastic materials: Polyvinyl chloride (PVC), polyethylene, silicon, their important properties and applications.

UNIT-IV **15 Hours**

Magnetic Materials:

Introduction - ferromagnetic materials, permeability, B-H curve, magnetic saturation, hysteresis loop including coercive force and residual magnetism, concept of eddy current and hysteresis loss, curie temperature, magneto-striction effect.

Soft Magnetic Materials: Alloyed steels with silicon: High silicon, alloy steel for transformers, low silicon alloy steel for electric rotating machines
Cold rolled grain-oriented steels for transformer, non-oriented steels for rotating machine Nickel-iron alloys Soft Ferrites

Hard magnetic materials: Tungsten steel, chrome steel, hard ferrites and cobalt steel, their applications

Special Materials: Thermocouple, bimetals, leads soldering and fuses material, mention their applications. Introduction of various engineering materials necessary for fabrication of electrical machines such as motors, generators, transformers etc

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- Electrical Engineering Materials Adrianus J Dekker, Phi Learning Publishers.
- Electrical Properties of Materials, 8th Edition by Solymar, L, Oxford University Press New Delhi.
- Introduction to Electrical Engineering Materials 4th Edn. 2004 Edition by Indulkar C, S. Chand & Company Ltd-New Delhi.
- Electrical and Electronic Engineering Materials by SK Bhattacharya, Khanna Publishers, New Delhi.

Course Title: MECHANICAL MEASUREMENTS
Course Code: BEE618

L	T	P	Credits
3	0	0	3

Total hours: 45

Learning Outcomes: After completion of this course, the learner will be able to:

1. Comprehend the terms of the measurements, and understand the principle of operation of an instrument
2. Interpret the characteristics of measuring instruments.
3. Use the methods of measurement for various physical quantities.
4. Apply the principles of miscellaneous measurements for humidity, density.

Course Content

UNIT-I **15 Hours**

Introduction

Measurement-definition-methods of measurement-Significance-Terms applicable to measuring instruments: Precision and Accuracy, Sensitivity and Repeatability, Range, Threshold, Hysteresis, calibration -Errors in Measurements-Systematic and Random error. Measuring instruments- Factors in selecting the measuring instruments

Pressure Measurements

Defining concept of atmospheric, absolute, vacuum, and gauge pressure; Units of pressure.

Manometers: Principle; types.
Elastic type: Bourdon tube; types, materials, construction; Metallic Diaphragm elements, construction; Capsule type; Bellows type
Electric methods of pressure measurements: Strain gauge pressure measurement, capacitance pressure measurement, potentiometric pressure measurements, optical pressure measurement
Special Pressure Measurement Techniques: Piston type pressure measurement; Pressure sensitive wire transducer, Dead Weight Piston Gauges.

UNIT-II **15 Hours**

Flow Measurement

Mechanical Flow Meters:
Orifice Flow Meter: Principle of operation; types of orifice plates; machining methods of orifice; material for orifice; position of tapes in orifice; Orifice Plate selection and designing. Venturi Tubes: Classical (long form) Venturi; Short form Venturi; Types

of Venturi Tubes; Installation, Flow Nozzle: Flange type flow nozzle; Design of flow nozzle; applications

Electrical Flow Meters:

Electromagnetic Flow Meter: Principle; Excitation schemes (AC, DC, and Dual Frequency). Ultrasonic Flow Meter: Principle; Types of Ultrasonic Flow Meters; Construction; Doppler Flow Meters; Applications.

UNIT-III **5 Hours**

Level Measurements

Float Type Level Indications: Float level switch, Level measurement using float – rope method, float operated spring loaded level switch, magnetic float device. Level Measurement by Electrical Methods.

UNIT-IV **10 Hours**

Temperature Measurement

Thermistors: Theory; materials; types; and applications, Thermocouples: Theory; materials; types; and applications, Resistance Temperature Detector (RTD): Temperature coefficient of resistivity of various metals; metals used in RTD; Platinum Resistance Thermometers. Radiation Thermometers: Theory of black body radiation; realization of black body radiation.

Miscellaneous Measurements

Humidity measurement– construction, working of hair hygrometer. Density measurement- Measurement of density using hydrometer.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *A. K. Sawhney and Puneet Sawhney, "Mechanical Measurement and Instrumentation and Control", 12th Edition, Dhanpat Rai & Co, 2009.*
- *Instrument Engineers' Handbook: Process Measurement and Analysis B. G. Liptak.*
- *Measurement Systems: Application and Design E. D. Doeblin, - Mc Graw Hill Publication.*
- *Industrial Instrumentation K. Krishnaswamy and S. Vijayachitra - New Age International Publications.*

Course Title: ELECTRICAL ESTIMATION & COSTING
Course Code: BEE619

L	T	P	Credits
3	0	0	3

Total hours: 45

Learning Outcomes: After completion of this course, the learner will be able to:

1. Interpret the basic principles of estimating and costing.
2. Use the preliminary cost estimating techniques to prepare building cost plans.
3. Apply estimating techniques to build unit prices.
4. Develop and apply appropriate cost planning bidding strategies that are ethically appropriate.

Course Content

UNIT-I **10 Hours**

Introduction

Purpose of estimating and costing, preformed for making estimates, preparation of materials schedule, costing, price list, tender document, net price list, market survey, overhead charges, labour charges, electrical point method and fixed percentage method, contingency, profit, purchase system, enquiries, comparative statements, orders for supply, payment of bills. Tenders – its constituents, finalization, specimen tender.

UNIT-II **10 Hours**

Estimating and Costing:

Domestic installations:

Standard practice as per IS and IE rules. Planning of circuits, sub-circuits and position of different accessories, electrical layout, preparing estimates including cost as per schedule rate pattern and actual market rate (single storey and multi-storey buildings having similar electrical load)

UNIT-III **10 Hours**

Estimating and Costing:

Industrial installations: relevant IE rules and IS standard practices, planning, designing and estimation of installation for single phase motors of different ratings, electrical circuit diagram, starters, preparation of list of materials, estimating and costing exercises on workshop with singe-phase, 3-phase motor load and the light load (3-phase supply system)

UNIT-IV **15 Hours**

Service line connections: estimate for domestic and Industrial loads (over-head and underground connections) from pole to energy meter

Estimating the material required for:

Transmission and distribution lines (overhead and underground): Planning and designing of lines with different fixtures, earthing etc. based on unit cost calculations

Substation: Types of substations, substation schemes and components, estimate of 11/0.4 KV pole mounted substation up to 200 KVA rating, earthing of substations, Key Diagram of 66 KV/11KV Substation.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *Gupta, J.B. (2000). Electrical Installation, Estimating and Costing. SK Kataria and Sons, New Delhi*
- *Bhattacharya, S.K. (1998). Estimating and Costing. Tata McGraw Hill, New Delhi*
- *Singh, Surjeet. (1999). Estimating and Costing. Dhanpat Rai & Co. New Delhi*

Course Title: ELECTRIC DRIVES
Course Code: BEE607

L	T	P	Credits
3	0	0	3

Total hours: 45

Learning Outcomes: After completion of this course, the learner will be able to:

1. Interpret the basic concept of dynamics of Electric Drives.
2. Analyze the multi-quadrant operations of dc and motors.
3. Evaluate the motor rating for duty cycles.
4. Recognize the various drive mechanisms and methods for energy conservation.

Course Content

UNIT-I **10 Hours**

Definitions, Dynamics of Electric Drives: Concept of electric drive and its classifications, Types of loads, Four-quadrant drive, and dependence of load torque on various factors, Dynamics of motor-load combination, Steady state stability of an electric drive system. Load Equalization

UNIT-II **10 Hours**

Drive Features of Importance: Multi-quadrant operations of DC and AC motors. Energy relations during starting and braking.

Static Control of Motors: Contactors and relays for electric drives. Control circuits for automatic starters of DC and AC motors including definite time accelerating type.

UNIT-III **10 Hours**

Estimation of Motors Rating: Types of duty cycles, Calculation of motor rating for duty cycles, Use of load diagrams.

UNIT-IV **15 Hours**

Semiconductor Controlled Drives: Control of DC drives fed through single-phase and three-phase semi converter and full-converter phase-controlled configurations. Their analysis, Regeneration and braking through static power converters, Control of three phase induction motors by stator voltage and frequency control for speeds below and above synchronous speed. Static Rotor resistance control, Static Kramer and Scherbius drives.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *Pillai, S.K. (2000) A First Course On Electrical Drives, New Age Publications.*

Course Title: ELECTRICAL SAFETY AND STANDARDS
Course Code: BEE620

L	T	P	Credits
3	0	0	3

Total hours: 45

Learning Outcomes: After completion of this course, the learner will be able to:

1. Interpret the objectives and precautions of Electrical Safety, effects of Shocks and their Prevention.
2. Summarize the Safety aspects during Installation of Plant and Equipment.
3. Comprehend the electrical safety in residential, commercial and agricultural installations.
4. Tabulate the various Electrical Safety in Hazardous Areas, Equipment Earthing and System Neutral Earthing.

Course Contents

UNIT-I **10 Hours**

Introduction To Electrical Safety, Shocks and Their Prevention
Terms and definitions, objectives of safety and security measures, Hazards associated with electric current, and voltage, who is exposed, principles of electrical safety, Approaches to prevent Accidents. Primary and secondary electrical shocks, possibilities of getting electrical shock and its severity, medical analysis of electric shocks and its effects, shocks due to flash/ Spark over's, prevention of shocks, safety precautions against contact shocks, flash shocks, burns, residential buildings and shops.

UNIT-II **15 Hours**

Safety during Installation of Plant and Equipment
Introduction, preliminary preparations, preconditions for start of installation work, risks during installation of electrical plant and equipment, safety aspects during installation, field quality and safety during erection, personal protective equipment for erection personnel, installation of a large oil immersed power transformer, installation of outdoor switchyard equipment, safety during installation of electrical rotating machines, drying out and insulation resistance measurement of rotating machines.

UNIT-III **10 Hours**

Electrical Safety in Residential, Commercial and Agricultural Installations

Wiring and fitting – Domestic appliances – water tap giving shock – shock from wet wall – fan firing shock – multi-storied building – Temporary installations –

Agricultural pump installation – Do's and Don'ts for safety in the use of domestic electrical appliances.

UNIT-IV **10 Hours**

Equipment Earthing and System Neutral Earthing

Introduction, Distinction between system grounding and equipment Grounding, Equipment Earthing, Functional Requirement of earthing system, description of an earthing system, neutral grounding (System Grounding), Types of Grounding, Methods of Earthing Generators Neutrals.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *Pradeep Chaturvedi, "Energy management policy, planning and utilization", Concept Publishing company, New Delhi, 1997.*
- *S. Rao, Prof. H.L. Saluja, "Electrical safety, fire safety Engineering and safety management", Khanna Publishers. New Delhi, 1988*
- *Webster J. G and Albert M.Cook, Clinical Engg, Principles and Practices, Prentice Hall Inc., Engle wood Cliffs, New Jersy, 1979.*
- *Karen Parsley, Karen Parsley Philomena Corrigan Quality improvement in Healthcare, 2nd edition, Nelson Thrones Pub, 2002.*
- *Sharon Myers Patient Safety and Hospital Accreditation – A Model for Ensuring Success Springer Publishers 2012 7. Joseph F Dyro Clinical Engineering Handbook Elsevier Publishers, 2004.*

Course Title: ELECTRONIC DEVICES & CIRCUITS
Course Code: BEE621

L	T	P	Credits
3	0	0	3

Total hours: 45

Learning Outcomes: After completion of this course, the learner will be able to:

1. Interpret the PN junction diode –structure, operation and V-I characteristics
2. Recognize the structure of basic electronic devices.
3. Enumerate the active and passive circuit elements.
4. Comprehend the operation and applications of transistor like BJT and FET.

Course Content

UNIT-I **10 Hours**

PN Junction Devices

PN junction diode –structure, operation and V-I characteristics, diffusion and transition capacitance. Rectifiers – Half Wave and Full Wave Rectifier,– Display devices- LED, Laser diodes, Zener diode characteristics- Zener Reverse characteristics – Zener as regulator.

UNIT-II **15 Hours**

Transistors and Thyristors

BJT, JFET, MOSFET- structure, operation, characteristics and Biasing UJT, Thyristors and IGBT Structure and characteristics.

Amplifiers

BJT small signal model – Analysis of CE, CB, CC amplifiers- Gain and frequency response –MOSFET small signal model– Analysis of CS and Source follower – Gain and frequency response- High frequency analysis.

UNIT-III **10 Hours**

Multistage Amplifiers and Differential Amplifier

Cascade amplifier, Differential amplifier – Common mode and Difference mode analysis FET input stages – Single tuned amplifiers – Gain and frequency response Neutralization methods, power amplifiers –Types (Qualitative analysis).

UNIT-IV **10 Hours**

Feedback Amplifiers and Oscillators

Advantages of negative feedback – voltage / current, series, Shunt feedback – positive feedback Condition for oscillations, phase shift – Wien bridge, Hartley, Colpitts and Crystal oscillators.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *Millman, J and Halkias, (1998) Integrated Electronics, TMH.*
- *Ryder, J. D. (2003) Electronic Fundamentals & Application, PHI.*
- *Boylestad R.L. (1997) Electronic Devices and Circuit Theory, VIII Edition, Pearson Education.*
- *Sedra & Smith. (2000) Microelectronic Circuits, V Edition, Oxford University Press.*
- *Millman and Taub. (2004) Pulse digital and switching waveforms, Mc Graw Hill, USA*

SEMESTER- VII

Course Title: COMPUTER AIDED POWER SYSTEM ANALYSIS
Course Code: BEE701

L	T	P	Credits
3	1	0	4

Total hours: 60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Appreciate the computer applications in the analysis of power systems.
2. Comprehend the solution methods and techniques used in power system studies.
3. Evaluate the behavior of power system under faulty conditions.
4. Analyze critically the solution methods used in power system studies.

Course Content

UNIT-I **15 Hours**

SYSTEM MODELLING:

System modeling of synchronous machines, transformers, loads etc, per unit impedance, single line diagram of electrical networks, single phase impedance diagrams corresponding to single line diagram. Formation of impedance and admittance matrices for the electrical networks.

UNIT-II **10 Hours**

LOAD FLOW STUDIES:

Data for the load flow studies, Swing Bus, Formulation of simultaneous equations, Iterative solutions by the Gauss-Seidal Method & by Newton Raphson Method.

UNIT-III **20 Hours**

FAULT ANALYSIS:

Transients on transmission line, short circuit of synchronous machine, selection of circuit breakers, Algorithm for short circuit studies, Symmetrical Component transformation, construction of sequence networks of power systems. Symmetrical Analysis of Unsymmetrical LG, LL, LLG faults using symmetrical components.

UNIT-IV **15 Hours**

POWER SYSTEM STABILITY:

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

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *Elgerd, O. I. (1999). Electric Energy Systems Theory. TMH*
- *Nagrath, I. J. Kothari, D.P. (1998). Modern Power System Analysis. TMH*
- *Stevenson, W.D. (2001). Elements of Power System Analysis. McGraw Hill*
- *G. L. Kusic (1989) Computer Aided Power System Analysis, PHI.*
- *John J. Grainger, William D. Stevenson, Jr., Power System Analysis, Tata McGraw-Hill Series in Electrical and Computer Engineering.*
- *M. A. Pai (2005) Computer Techniques in Power Systems Analysis, Tata McGraw-Hill, Second edition.*

Course Title: POWER SYSTEM PROTECTION
Course Code: BEE702

L	T	P	Credits
3	0	0	3

Total hours: 45

Learning Outcomes: After completion of this course, the learner will be able to:

1. Calculate both symmetrical and un-symmetrical fault currents.
2. Comprehend the fundamentals of electromechanical relays and digital protective relaying
3. Interpret the basic methods of calculating the magnitude and angle of voltage and current for the digital relaying
4. Apply suitable current transformer, voltage transformer and circuit breakers etc for fulfilling power system protection

Course Content

UNIT-I **10 Hours**

Circuit Breakers:

Introduction, Fault Clearing Time of a Circuit Breaker, Arc Voltage, Arc Interruption, Restriking Voltage and Recovery Voltage, Current Chopping, Interruption of Capacitive Current, Classification of Circuit Breakers, Air – Break Circuit Breakers, Oil Circuit Breakers, Air – Blast Circuit Breakers, SF6 Circuit Breakers, Vacuum Circuit Breakers, High Voltage Direct Current Circuit Breakers, Rating of Circuit Breakers, Testing of Circuit Breakers.

Fuses:

Introductions, Definitions, Fuse Characteristics, Types of Fuses, Applications of HRC Fuses, Selection of Fuses, Discrimination.

UNIT-II **10 Hours**

Introduction to Power System Protection:

Need for protective schemes, Nature and Cause of Faults, Types of Fault, Effects of Faults, Fault Statistics, Zones of Protection, Primary and Backup Protection, Essential Qualities of Protection, Performance of Protective Relaying, Classification of Protective Relays, Automatic Reclosing, Current Transformers for protection, Voltage Transformers for Protection.

Relay Construction and Operating Principles:
Introduction, Electromechanical Relays, Static Relays – Merits and Demerits of Static Relays, Numerical Relays, Comparison between Electromechanical Relays and Numerical Relays.

UNIT-III **15 Hours**

Overcurrent Protection:
Introduction, Time – current Characteristics, Current Setting, Time Setting. Overcurrent Protective Schemes, Reverse Power or Directional Relay, Protection of Parallel Feeders, Protection of Ring Mains, Earth Fault and Phase Fault Protection, Combined Earth Fault and Phase Fault Protective Scheme, Phase Fault Protective Scheme, Directional Earth Fault Relay, Static Overcurrent Relays, Numerical Overcurrent Relays.

Distance Protection:
Introduction, Impedance Relay, Reactance Relay, Mho Relay, Angle Impedance Relay, Effect of Arc Resistance on the Performance of Distance Relays, Reach of Distance Relays. Effect of Power Surges (Power Swings) on Performance of Distance Relays, Effect of Line Length and Source Impedance on Performance of Distance Relays.

UNIT-IV **10 Hours**

Protection of Rotating Machines

Differential Protection:
Introduction, Differential Relays, Simple Differential Protection, Percentage or Biased Differential Relay, Differential Protection of 3 Phase Circuits, Balanced (Opposed) Voltage Differential Protection.

Rotating Machines Protection:
Introduction, Protection of Generators.

Transformer and Buszone Protection:
Introduction, Transformer Protection, Buszone Protection, Frame Leakage Protection.

Protection against over voltages:
Protection of Transmission Lines against Direct Lightning Strokes,

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *Elgerd O. L. (2001) Electrical Energy System Theory - An introduction, (TMH)*
- *Stevenson Jr W. D. (1999) Elements of Power System Analysis, TMH*
- *Wadhwa C.L. (2000) Course in Electrical Power, New Age Int.(P)Ltd.*
- *Nagrath and Kothari. (2003) Power System Analysis, (TMH)*
- *Gupta, B.R. (2001) Power System Analysis & Design, Wheeler Publishing.*

Course Title: HIGH VOLTAGE ENGINEERING
Course Code: BEE707

L	T	P	Credits
3	0	0	3

Total hours: 45

Learning Outcomes: After completion of this course, the learner will be able to:

1. Conceptualize the idea of high voltage and safety measures involved.
2. Analyse the breakdown mechanism of solids, liquids and gases.
3. Calculate the circuit parameters involved in generation of high voltages.
4. Measure direct, alternating and impulse high voltage signals, dielectric loss and partial discharge involved in non-destructive high voltage tests.

Course Content

UNIT-I **15 Hours**

Introduction: Introduction to AC and DC impulse voltages and their use, Problems in dealing with high voltages.

Breakdown in Gases: Elementary ideas on ionization by electron collision, Townsend mechanism, Townsend first and second ionization coefficients, Paschen law, breakdown in non-uniform fields and corona discharges, vacuum breakdown mechanisms, breakdown in liquids, fundamentals of insulating oils, conduction and breakdown in pure and commercial liquids.

Breakdown in Solids: Fundamentals of solid insulating materials intrinsic, electromechanical and thermal breakdown, breakdown in simple and composite dielectrics, types of insulating materials, temperature classification, factor affecting dielectric strength, insulation design of rotating machines, transformers, transmission lines, Switch gear, etc.

UNIT-II **10 Hours**

Generation of High Voltages: Generation of high voltages, testing transformers in cascade, series resonant circuits and their advantages, half and full wave rectifier circuits, voltage doubler and cascade circuits, electrostatic generator, characteristics parameters of impulse voltages, single stage impulse generator circuits, multistage impulse generation circuits.

UNIT-III **10 Hours**

Measurement of High Voltages: Measurement of direct, alternating and impulse voltages by electrostatic voltmeters, sphere gap, uniform field gap, ammeter in series with high voltage resistors and voltage divider.

UNIT-IV **10 Hours**

Non-Destructive High Voltage Tests: Loss in a dielectric and its measurement, dielectric loss measurement by Schering bridge, partial discharges at alternating voltages, external and internal partial discharges and discharge measurements.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *Khalifa, M., High Voltage Engineering: Theory and Practice, Marcel Dekker Inc. (2000).*
- *Naidu, M.S. and Kamraju, V., High Voltage Engineering, Tata McGraw−Hill (2008).*
- *Wadhwa, C. L., High Voltage Engineering, New Age International (P) Limited, Publishers (2006).*
- *Dass, R., Extra High Voltages, Tata McGraw−Hill (2006).*
- *Kind, D. and Feser, K, High Voltage Test Techniques, Reed Educational and Professional Publishing Limited (2001).*

Course Title: PROGRAMMING IN MATLAB
Course Code: BEE708

L	T	P	Credits
0	0	2	1

Total hours: 15

Learning Outcomes: After completion of this course, the learner will be able to:

1. Interpret the features of MATLAB as a programming tool.
2. Promote new teaching model that will help to develop programming skills and technique to solve mathematical problems.
3. Interpret the MATLAB graphic feature and its applications.
4. Apply MATLAB as a simulation tool.

UNIT-1

Introduction to MATLAB **5 Hours**

- The MATLAB Environment
- MATLAB Basics – Variables, Numbers, Operators, Expressions, Input and output.
- Vectors, Arrays – Matrices

MATLAB Functions

- Built-in Functions
- User defined Functions

UNIT-2

Graphics with MATLAB **4 Hours**

- Files and File Management – Import/Export
- Basic 2D, 3D plots
- Graphic handling

UNIT-3

Programming with MATLAB **3 Hours**

- Conditional Statements, Loops
- MATLAB Programs – Programming and Debugging.
- Applications of MATLAB Programming.

UNIT-4 **3 Hours**

Mathematical Computing with MATLAB

- Algebraic equations
- Basic Symbolic Calculus and Differential equations
- Numerical Techniques and Transforms

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *"A Guide to MATLAB - for Beginners and Experienced Users", 2nd ed., Brian R. Hunt, Ronald L. Lipsman, Jonathan M. Rosenberg, Cambridge University Press, (2006).*
- *"Essentials of MATLAB Programming", 2nd ed., Stephen J. Chapman, Cengage Learning, (2009).*
- *"MATLAB Demystified", David McMahon, The McGraw-Hill Companies, (2007).*
- *"MATLAB® for Engineers", 3rd ed., Holly Moore, Pearson Education, Inc., (2012).*
- *"Engineering computation with MATLAB", 2nd ed., David M. Smith, Pearson Education, Inc., (2010).*

Course Title: PROJECT-II
Course Code: BEE709

L	T	P	Credits
0	0	4	2

Total Hours: 30

The objective of Project Work II is to enable the student to take up investigative study in the broad field of Electrical Engineering, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis or two/three students in a group, under the guidance of a supervisor. This is expected to provide a good initiation for the student(s) in R&D work.

The assignment to normally include:

1. Survey and study of published literature on the assigned topic;
2. Working out a preliminary Approach to the Problem relating to the assigned topic;
3. Conducting preliminary Analysis/ Modelling/ Simulation/ Experiment/ Design/ Feasibility;
4. Preparing a Written Report on the Study conducted for presentation to the Department
5. Final Seminar, as oral Presentation before a departmental committee.

Course Title: ELECTRIC AND HYBRID VEHICLES
Course Code: BEE710

L	T	P	Credits
3	0	0	3

Total hours: 45

Learning Outcomes: After completion of this course, the learner will be able to:

1. Interpret the fundamental concepts, principles, analysis and design of hybrid and electric vehicles.
2. Evaluate the hybrid drive-train topologies
3. Comprehend the DC motor drives configuration and control
4. Analyze the selection and sizing of energy storage systems. Compare different energy management strategies

Course Content

UNIT-I **10 Hours**

History of Hybrid and Electric Vehicles**:** Social and environmental importance of hybrid and electric vehicles, Impact of modern drive-trains on energy supplies, Basics of vehicle performance, vehicle power source characterization Transmission characteristics.

UNIT-II **10 Hours**

Basic concept of hybrid traction, Introduction to various hybrid drive-train topologies, Power flow control in hybrid drive-train topologies, Fuel efficiency analysis.

UNIT-III **10 Hours**

Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance, Drive system efficiency.

UNIT-IV **15 Hours**

Matching the Electric Machine and Internal Combustion Engine: Sizing the propulsion motor, selecting the energy storage technology, sizing the power electronics devices for energy storage, Classification of different energy management strategies Comparison of different energy management strategies Implementation issues of energy strategies.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *Ramirez S., Ortigoza R. S. (2011) Control Design Techniques in Power Electronics Devices. Springer.*
- *Tan S. C., Y. M. Laiand & C. K. Tse (2012) Sliding mode control of switching Power Converters. CRC press.*

Course Title: EHVAC TRANSMISSION
Course Code: BEE711

L	T	P	Credits
3	0	0	3

Total hours: 45

Learning Outcomes: After completion of this course, the learner will be able to:
1. Comprehend the advantages of EHVAC Transmission and problems associated with it.
2. Analyse the reactive parameters of lines and methods of voltage control.
3. Interpret the voltage gradients of conductors.
4. Interpret the corona effects on EHVAC transmission.

UNIT-I **10 Hours**

Preliminaries: Necessity of EHV AC transmission, advantages and problems, power handling capacity and line losses, mechanical considerations, resistance of conductors, properties of bundled conductors, bundle spacing and bundle radius, Examples.

UNIT-II **10 Hours**

Line and Ground Reactive Parameters: Line inductance and capacitance, sequence inductances and capacitances, modes of propagation, ground return, Examples Voltage Control: Power circle diagram and its use, voltage control using synchronous condensers, cascade connection of shunt and series compensation, sub synchronous resonance in series capacitor, compensated lines, static VAR compensating system.

UNIT-III **15 Hours**

Voltage Gradients of Conductors: Electrostatics, field of sphere gap, field of line charges and properties, charge, potential relations for multi-conductors, surface voltage gradient on conductors, distribution of voltage gradient on sub conductors of bundle, Electrostatic field, calculation of electrostatic field of EHV/AC lines, effect on humans, animals and plants, electrostatic induction in un-energized circuit of double-circuit line, electromagnetic interference, No load voltage conditions and charging current.

UNIT-IV **10 Hours**

Corona Effects: Power loss and audible noise (AN), corona loss formulae, charge voltage diagram, generation, characteristics, limits and measurements of AN, relation between 1- phase and 3-phase AN levels, Radio interference (RI), corona pulses: generation, properties, limits, frequency spectrum, modes of propagation, excitation function, measurement of RI, RIV and excitation functions.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- R.D. Begamudre, 'EHVAC Transmission Engineering', New Academic Science, 4th Edn., 2011.
- S. Rao, 'EHVAC and HVDC Transmission and Distribution Engineering', 3rd Edn., Khanna Publishers, 2008.

Course Title: ENERGY CONSERVATION AND PRACTICES
Course Code: BEE712

L	T	P	Credits
3	0	0	3

Total hours: 45

Learning Outcomes: After completion of this course, the learner will be able to:

1. Comprehend the energy management and auditing.
2. Recognize how energy can be conserved and managed in industries.
3. Acquire a comprehensive idea on tariffs in Transmission & Distribution systems.
4. Analyze the utilization and effects of energy on Environment and handle the Energy auditing procedure.

Course Content

UNIT-I **10 Hours**

Basics of Energy Conservation

Need of energy conservation and energy audit; Energy Intensive processes, Heating: methods/Techniques of energy Saving in Furnaces, Ovens and Boilers; Cooling: Methods/ Techniques of Energy Saving in Ventilating systems and Air Conditioners; Lighting energy: methods/Techniques of efficient lighting; Cogeneration -Types and Advantages

UNIT-II **15 Hours**

Efficiency improvement in Motors

Losses in Electrical Machines, Methods to reduce these losses, efficient use of energy in motors with the help of voltage reducers, automatic star/ delta converters; Energy Efficient Motors: Construction, operation and characteristics; Power factor improvement devices and soft starters/Variable Frequency Drives.

Energy Conservation in Transmission and Distribution (T&D) Systems

Reactive power compensation, demand side management, system voltage optimization and phase current balancing, Losses in transmission and distribution system and its minimization; Amorphous Core Transformers

UNIT-III **10 Hours**

Tariff and Energy Conservation in Industries

Energy cost and Recent Electricity Board tariffs, Application of Tariff System to reduce Energy bill, Energy Conservation by improving load factor and power factor.

Energy and the Environment

Environment and social concerns related to energy utilization, The green-house effect, Global Warming and its effect, Pollution, Acid Rains, Global Energy and environment Management.

UNIT-IV **10 Hours**

Energy Audit

Procedure of Energy audit, Selective Inventory Control analysis, Energy Flow Diagram and its importance, Measurements in energy audit and various measuring instruments, Questionnaires for the energy audit, internal energy audit checklist, Equipment used for energy conservation, Calculation of payback period for energy conservation equipment. IE rules and regulations for energy audit, Electricity act 2003

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *Bureau of Energy Efficiency, Bureau of Energy Efficiency Handbooks.*
- *C. L. Wadhwa, Generation Distribution & Utilization of Electrical Energy, New Age international,1989*
- *G Petrecca, Industrial Energy Management: Principles & applications, Kluwer Academic Publisher,1993*

Course Title: INDUSTRIAL SAFETY AND ENVIRONMENT Course Code: OEC081	L	T	P	Credits
	3	0	0	3

Total hours: 45

Learning Outcomes: After completion of this course, the learner will be able to:

1. Interpret the general safety rules, principles, maintenance, Inspections of turning machines
2. Design lathe-drilling-boring-milling-grinding-shaping-sawingshearingpresses-forge hammer-flywheels-shafts-couplings-gears-sprockets
3. Understand the Cold working, power presses, point of operation safe guarding, auxiliary mechanisms
4. Comprehend the Safety in gas furnace operation, cupola, crucibles, ovens, foundry health hazards, work environment, material handling in foundries

Course Content

UNIT-I **10 Hours**

SAFETY IN METAL WORKING MACHINERY AND WOOD WORKING MACHINES

General safety rules, principles, maintenance, Inspections of turning machines, boring machines, milling machine, planning machine and grinding machines, CNC machines, Wood working machinery, types, safety principles, electrical guards, work area, material handling, inspection, standards and codes- saws, types, hazards.

UNIT-II **10 Hours**

PRINCIPLES OF MACHINE GUARDING

Guarding during maintenance, Zero Mechanical State (ZMS), Definition, Policy for ZMS – guarding of hazards - point of operation protective devices, machine guarding, types, fixed guard, interlock guard, automatic guard, trip guard, electron eye, positional control guard, fixed guard fencing- guard construction- guard opening. Selection and suitability: lathe-drilling-boring-milling-grinding-shaping-sawingshearingpresses- forge hammer-flywheels-shafts-couplings-gears-sprockets wheels and chains-pulleys and belts-authorized entry to hazardous installations-benefits of good guarding systems.

UNIT-III **10 Hours**

SAFETY IN WELDING AND GAS CUTTING

Gas welding and oxygen cutting, resistances welding, arc welding and cutting, common hazards, personal protective equipment, training, safety precautions in brazing, soldering and metalizing – explosive welding, selection, care and maintenance of the associated equipment and instruments – safety in generation, distribution and handling of industrial gases- colour coding – flashback arrestor – leak detection-pipe line safety-storage and handling of gas cylinders.

UNIT-IV **15 Hours**

SAFETY IN COLD FORMING AND HOT WORKING OF METALS

Cold working, power presses, point of operation safe guarding, auxiliary mechanisms, feeding and cutting mechanism, hand or foot-operated presses, power press electric controls, power press set up and die removal, inspection and maintenance-metal sheers-press brakes. Hot working safety in forging, hot rolling mill operation, safe guards in hot rolling mills – hot bending of pipes, hazards and control measures. Safety in gas furnace operation, cupola, crucibles, ovens, foundry health hazards, work environment, material handling in foundries, foundry production cleaning and finishing foundry processes.

SAFETY IN FINISHING, INSPECTION AND TESTING

Heat treatment operations, electro plating, paint shops, sand and shot blasting, safety in inspection and testing, dynamic balancing, hydro testing, valves, boiler drums and headers, pressure vessels, air leak test, steam testing, safety in radiography, personal monitoring devices, radiation hazards, engineering and administrative controls, Indian Boilers Regulation.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *Joselin, E. L. (1934). Ventilation. EdwardArnold.*
- *Beranek, L. L. (1960). Noise Reduction. McGraw Hill.*
- *DeReamer, R. (1980). Modern Safety and health Technology. RWiley.*
- *Heinrich, H. W. (1959). Industrial Accident Prevention. McGraw Hill.*

SEMESTER- VIII

Course Title: PROJECT-III
Course Code: BEE802

L	T	P	Credits
0	0	10	5

Total hours: 60

The object of Project Work III & Dissertation is to enable the student to extend further the investigative study taken up, either fully theoretical/practical or involving both theoretical and practical work, under the guidance of a Supervisor from the Department alone or jointly with a Supervisor drawn from R&D laboratory/Industry. This is expected to provide a good training for the student(s) in R&D work and technical leadership.

The assignment to normally include:

1. In depth study of the topic assigned in the light of the Report prepared under EEP1.
2. Review and finalization of the Approach to the Problem relating to the assigned topic.
3. Preparing an Action Plan for conducting the investigation, including team work.
4. Detailed Analysis/Modelling/Simulation/Design/Problem Solving/Experiment as needed.
5. Final development of product/process, testing, results, conclusions and future directions.
6. Preparing a paper for Conference presentation/Publication in Journals, if possible.
7. Preparing a Dissertation in the standard format for being evaluated by the Department.
8. Final Seminar Presentation before a Departmental Committee.

Course Title: UTILIZATION OF ELECTRICAL ENERGY
Course Code: BEE803

L	T	P	Credits
3	0	0	3

Total hours: 45

Learning Outcomes: After completion of this course, the learner will be able to:

1. Interpret the basic principles of electric heating and welding.
2. Determine the lighting requirements for flood lighting, household and industrial needs.
3. Calculate heat developed in induction furnace.
4. Evaluate speed time curves for traction. Determine the Principle of air conditioning, vapour pressure, refrigeration cycle, eco-friendly refrigerants.

Course Content

UNIT-I **10 Hours**

Electric Drives

Advantages of electric drives, Characteristics of different mechanical loads, Parts of electric drives electric motors, close loop of electric drive system, Types of motors used in electric drive pulley drives etc., Examples of selection of motors for different types of domestic loads, Selection of drive for applications such as general workshop, textile mill, paper mill, steel mill, printing press, crane and lift etc.

UNIT-II **10 Hours**

Illumination

Nature of light, visibility spectrum curve of relative sensitivity of human eye and wave length of light, Definition: Luminous flux, solid angle, luminous intensity, illumination, luminous efficiency, depreciation factor, coefficient of utilization, space to height ratio, reflection factor, glare, shadow, lux, Laws of illumination, Different type of lamps, construction and working of incandescent and discharge lamps – their characteristics, fittings required for filament lamp, mercury vapour lamp, fluorescent lamp, metal halide lamp, neon lamp, Main requirements of proper lighting; absence of glare, contrast and shadow, General ideas bout street lighting, flood lighting, monument lighting and decorative lighting, light characteristics etc

UNIT-III **15 Hours**

Electric Heating

Advantages of electrical heating, Heating methods: Resistance heating – direct and indirect resistance heating, electric ovens, their temperature range, properties of resistance heating elements, domestic water heaters and other heating appliances and thermostat control circuit, Induction heating; principle of core type and coreless induction furnace, Electric arc heating; direct and indirect arc heating, construction, working and applications of arc furnace.

Electric Welding:
Advantages of electric welding, Welding method, Principles of resistance welding, types, Principle of arc production, electric arc welding, characteristics of arc; carbon arc, metal arc, hydrogen arc welding method of and their applications.

UNIT-IV **10 Hours**

Electrical Circuits used in Refrigeration and Air Conditioning and Water Coolers:
Principle of air conditioning, vapour pressure, refrigeration cycle, eco-friendly Refrigerants, Electrolytic Processes, Laws of electrolysis, process of electro-deposition - clearing, operation, deposition of metals, polishing, buffing.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *Partap, H. (1999). Art and Science of Utilization of Electrical Energy. Dhanpat Rai & Sons, Delhi.*
- *Gupta, JB. (1998). Utilization of Electrical Energy. Kataria Publications, Ludhiana.*
- *Sahdev. (2003). Utilization of Electrical Energy. Uneek Publication, Jalandhar.*
- *E. O. Taylor (2005) Utilization of electrical energy.*
- *Vedam Subrahmanyam (2008) Electrical Drives: Concept and applications. THM*

Course Title: HVDC TRANSMISSION SYSTEMS

Course Code: BEE804

L	T	P	Credits
3	0	0	3

Total hours: 45

Learning Outcomes: After completion of this course, the learner will be able to:

1. Comprehend the advantages of dc transmission over ac transmission.
2. Interpret the operation of Line Commutated Converters and Voltage Source Converters.
3. Summarize the control strategies used in HVDC transmission system.
4. Evaluate the power system stability using an HVDC system.

Course Content

UNIT-I **5 Hours**

DC Transmission Technology

Comparison of AC and dc Transmission (Economics, Technical Performance and Reliability). Application of DC Transmission. Types of HVdc Systems. Components of a HVdc system. Line Commutated Converter and Voltage Source Converter based systems.

UNIT-II **10 Hours**

Analysis of Line Commutated and Voltage Source Converters

Line Commutated Converters (LCCs): Six pulse converter, Analysis neglecting commutation overlap, harmonics, Twelve Pulse Converters. Inverter Operation. Effect of Commutation Overlap. Expressions for average dc voltage, AC current and reactive power absorbed by the converters. Effect of Commutation Failure, Misfire and Current Extinction in LCC links.

Voltage Source Converters (VSCs): Two and Three-level VSCs. PWM schemes: Selective Harmonic Elimination, Sinusoidal Pulse Width Modulation. Analysis of a six pulse converter. Equations in the rotating frame. Real and Reactive power control using a VSC.

UNIT-III **15 Hours**

Control of HVDC Converters:

Principles of Link Control in a LCC HVDC system. Control Hierarchy, Firing Angle Controls – Phase-Locked Loop, Current and Extinction Angle Control, Starting and Stopping of a Link. Higher level Controllers Power control, Frequency Control, Stability Controllers. Reactive Power Control. Principles of Link Control in a VSC HVDC system: Power flow and dc Voltage Control. Reactive Power Control/AC voltage regulation.

Components of HVDC systems:

Smoothing Reactors, Reactive Power Sources and Filters in LCC HVDC systems DC line: Corona Effects. Insulators, Transient Over-voltages. DC line faults in LCC systems. DC line faults in VSC systems. DC breakers. Monopolar Operation. Ground Electrodes.

UNIT-IV **15 Hours**

Stability Enhancement using HVDC Control

Basic Concepts: Power System Angular, Voltage and Frequency Stability. Power Modulation: basic principles – synchronous and asynchronous links. Voltage Stability Problem in AC/dc systems.

MTDC Links

Multi-Terminal and Multi-Infeed Systems. Series and Parallel MTDC systems using LCCs. MTDC systems using VSCs. Modern Trends in HVDC Technology. Introduction to Modular Multi-level Converters.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *K. R. Padiyar, ―HVDC Power Transmission Systems‖, New Age International Publishers, 2011.*
- *J. Arrillaga, ―High Voltage Direct Current Transmission‖, Peter Peregrinus Ltd., 1983.*
- *E. W. Kimbark, ―Direct Current Transmission‖, Vol.1, Wiley-Inter science, 1971.*

Course Title: WIND AND SOLAR ENERGY
Course Code: BEE805

L	T	P	Credits
3	0	0	3

Total hours: 45

Learning Outcomes: After completion of this course, the learner will be able to:

1. Identify with the energy scenario and the consequent growth of the power generation from renewable energy sources.
2. Analyze the issues related to the grid-integration of solar and wind energy systems.
3. Realize the basic physics of wind and solar power generation.
4. Interpret the power electronic interfaces for wind and solar generation.

Course Content

UNIT-I **10 Hours**

Physics of Wind Power:

History of wind power, Indian and Global statistics, Wind physics, Betz limit, Tip speed ratio, stall and pitch control, Wind speed statistics-probability distributions, Wind speed and power-cumulative distribution functions.

UNIT-II **10 Hours**

Wind generator topologies:

Review of modern wind turbine technologies, Fixed and Variable speed wind turbines, Induction Generators, Doubly-Fed Induction Generators and their characteristics, Permanent-Magnet Synchronous Generators, Power electronics converters. Generator-Converter configurations, Converter Control.

UNIT-III **10 Hours**

The Solar Resource:

Introduction, solar radiation spectra, solar geometry, Earth Sun angles, observer Sun angles, solar day length, Estimation of solar energy availability.

Solar photovoltaic:

Technologies-Amorphous, monocrystalline, polycrystalline; V-I characteristics of a PV cell, PV module, array, Power Electronic Converters for Solar Systems, Maximum Power Point Tracking (MPPT) algorithms. Converter Control.

UNIT-IV **15 Hours**

Network Integration Issues:

Overview of grid code technical requirements. Fault ride-through for wind farms - real and reactive power regulation, voltage and frequency operating limits, solar PV and wind farm behavior during grid disturbances. Power quality issues. Power system interconnection experiences in the world. Hybrid and isolated operations of solar PV and wind systems.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *Ackermann, T. (2005) Wind Power in Power Systems. John Wiley and Sons Ltd.*
- *Masters, G. M. (2004). Renewable and Efficient Electric Power Systems. John Wiley and Sons.*
- *Sukhatme, S. P. (1984). Solar Energy: Principles of Thermal Collection and Storage. McGraw Hill.*

Course Title: BASICS OF ELECTRICAL DOMESTIC APPLIANCES
Course Code: OEC082

L	T	P	Credits
3	0	0	3

Total hours: 45

Learning Outcomes: After completion of this course, the learner will be able to:

1. Acquire necessary skills/hand on experience/ working knowledge on multimeters, galvanometers, ammeters, voltmeters, ac/dc generators, motors, transformers, single phase and three phase connections, basics of electrical wiring with electrical protection devices.
2. Comprehend the working principles of different household domestic appliances.
3. Check the electrical connections at house-hold.
4. Learn the skills to repair the electrical appliances for the general troubleshooting and wiring faults.

Course Content

UNIT-I **10 Hours**

Basics of House wiring, Principles of working, parts and servicing of Electric fan, Electric Iron box, Water heater; Induction heater, Microwave oven; Refrigerator, Concept of illumination, Electric bulbs, CFL, LED lights, Energy efficiency in electrical appliances.

Co-curricular Activities (Hands on Exercises):

[Any four of the following may be taken up]

1. Identifying Phase, Neutral and Earth on power sockets.

3. Identifying primary and secondary windings and measuring primary and secondary voltages in various types of transformers.

4. Observing the working of transformer under no-load and full load conditions.

5. Observing the connections of elements and identify current flow and voltage drops.

6. Studying electrical circuit protection using MCBs, ELCBs.

UNIT-II **10 Hours**

Electric Iron:

Type of Electric Iron – Ordinary type and automatic/Thermostat Control type/steam iron, Construction and working principle of electric irons; common defects, testing and repairs

Electric Stove:

Types of Electric Stoves- Coiled type, covered type, Hot Plate, Grill/Oven,

Cooking Range- Construction and working principle of electric stoves, common defects, testing and repairs; Induction heater; OTG and Microwave oven; Three phase heater, star and Delta connections.

Electric Toasters:

Types of Toasters - Ordinary and Automatic; Construction and working principles of electric toaster; common defects, testing and repairs.

UNIT-III **10 Hours**

Table Lamp and Tube Light:

Construction, working principles and use of Table Lamp, Night Lamp and Tube Light; Common faults, their causes, testing and repair, LED Table lamp.

Electric Fan:

Type of Fans – ceiling fan, Pedestal fan, Bracket Fan, Exhaust Fan; Construction working principles, special characteristics and applications of Electric fans; Common faults, their causes, testing and repairs; Installation of Bracket Fan and Exhaust Fan.

UNIT-IV **15 Hours**

Electric Mixer, Grinder and Blender:

Construction, working principles, special characteristics and applications of Electric Mixer, Grinder and Blender; Common Faults, their causes, testing and repairs; Servicing maintenance and overhauling of Electric Mixer, Grinder and Blender.

Emergency Light and Stabilizer:

Constructions and working principles of Emergency Light and Stabilizer; Common faults, their causes, testing and repairs.

Co-curricular Activities (Hands on Exercises): Dismantling and reassemble of reflector type room Heater.

1. Dismantling and reassembling of Electric Iron (i) Ordinary type (ii) Automatic/Thermostat control type.

2. Testing and repair of Electric Iron (i) Ordinary type (ii) Automatic/Thermostat control type.
3. Dismantling and reassembling of Electric Stove (i) Coiled type (ii) Covered type

   (a) Hot plate (b) Grill (iii) Induction Heater (iv) Microwave oven, (v) Three phase heater star and delta connection
4. Connection of Fluorescent tube light (FTL) circuit.
5. Testing and repair of (i) Table Lamp (ii) Night Lamp and (ii) Tube Light (iv) LED table lamp
6. Testing fault finding, repair and overhauling of electric fans.
7. Testing fault finding, repair and overhauling of (i) electric mixer (ii) grinder (iii) blender.
8. Testing fault finding, repair and overhauling of emergency light
9. Testing fault finding, repair and overhauling of voltage stabilizer (manual and automatic)

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *A Text book on Electrical Technology, B.L. Theraja, S. Chand & Co.,*
- *A Text book on Electrical Technology, A.K. Theraja, 2014.*
- *Performance and design of AC machines, M.G. Say, ELBSEdn, 2005.*
- *Handbook of Repair & Maintenance of domestic electronics appliances; BPB Publications. Consumer Electronics, S.P. Bali, Pearson, 2016.*

Course Title: POWER PLANT ENGINEERING
Course Code: OEC083

L	T	P	Credits
3	0	0	3

Total hours: 45

Learning Outcomes: After completion of this course, the learner will be able to:

1. Evaluate the efficiency and output of Rankine cycle Steam Power Plant from given data, including, super heat, reheat, regeneration and reversibility's.
2. Explicate the blade shapes, and calculate work output of typical turbine stages.
3. Compare the major types of hydro power and wind power turbines.
4. Clarify the basic principle of thermal fission and fast breeder nuclear power plant.

Course Content

UNIT-I **15 Hours**

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

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

UNIT-II **10 Hours**

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

Nuclear power plants:

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

UNIT-III **10 Hours**

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

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

UNIT-IV **10 Hours**

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

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

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *Sharma, P.C. (1999) Power Plant Engineering (Kataria & Sons)*
- *Skrotzki, B.G.A. & Vapot, W. (2001) A Power Station Engineering and Economy (TMH)*
- *Rajput, R.K. (1997) Power Plant Engineering (Luxmi Publications)*