GURU KASHI UNIVERSITY

Bachelor of Technology in Electrical Engineering (Single Major)

Session: 2025-2026

Faculty of Engineering & Technology

Graduate Attributes of the Programme:

Type of learning outcomes	**The Learning outcomes descriptors**
Learning outcomes that are specific to disciplinary / interdisciplinary areas of learning	Graduates should be able to demonstrate the acquisition of:
	A strong grasp of the chosen discipline(s), their connections to related fields, and awareness of current and emerging trends in a multidisciplinary context.
	Extensive procedural knowledge for professional tasks, self-employment, entrepreneurship, and innovative organizational strategies.
	Skills in the chosen specialization, including practical abilities for both routine and non-routine tasks in a broad multidisciplinary context.
	Ability to apply learned competencies in new contexts to solve problems, rather than just replicating curriculum content.
Generic learning outcomes	**Complex problem-solving:** Graduates should demonstrate the ability to solve problems in both familiar and unfamiliar contexts and apply their learning to real-life situations.
	Critical thinking: Graduates should analyze and evaluate knowledge, policies, and evidence, identify assumptions, spot logical flaws, and synthesize data to draw valid conclusions.
	Creativity: Graduates should be able to approach tasks diversely, solve complex problems, innovate, and generate creative solutions in unfamiliar contexts.
	Communication Skills: Graduates should be able to listen, read analytically, and present complex information clearly; express ideas effectively in writing and speaking; share views confidently; construct logical arguments using technical language; and communicate respectfully with sensitivity to gender and minority groups.
	Analytical reasoning: Graduates should evaluate evidence, identify logical flaws, synthesize data from various sources, draw valid conclusions, and address opposing viewpoints with evidence.
	Research skills: Graduates should demonstrate strong observation and inquiry, design research proposals, formulate research questions and hypotheses, test them using data, develop appropriate methodologies, use analytical tools, plan and report experiments, and understand and practice research ethics.
	Coordinating/collaborating: Graduates should work effectively with diverse teams, facilitate cooperation, and contribute efficiently

Type of learning outcomes	The Learning outcomes descriptors
	to a common goal.
	Leadership qualities: Graduates should be able to set direction, formulate an inspiring vision, build and motivate a team, and use management skills to guide others toward goals.
	'Learning how to learn' skills: Graduates should be able to acquire new knowledge and skills for lifelong learning, adapt to changing work demands, work independently, identify resources for further learning, and develop a lifelong learning attitude.
	Digital literacy: Graduates should be able to use ICT in learning and work, access and evaluate information, and use software for data analysis.
	Multicultural competence: Graduates should understand diverse values and beliefs, engage respectfully in multicultural settings, and lead diverse teams to achieve common goals.
	Value inculcation: Graduates should embrace ethical and humanistic values, practice responsible global citizenship, address ethical issues from multiple perspectives, follow ethical practices, promote sustainability, and act with integrity and objectivity in all work.
	Autonomy, responsibility, and accountability: Graduates should apply knowledge independently, manage projects, and demonstrate responsibility and accountability in work and learning, ensuring safety and security.
	Environmental awareness and action: Graduates should apply knowledge and skills to mitigate environmental degradation, manage waste, conserve biodiversity, and promote sustainable development.
	Community engagement and service: Graduates should be able to actively participate in services and activities that promote societal well-being.
	Empathy: Graduates should be able to understand and relate to the perspectives and emotions of others.

Programme Learning Outcomes: Undergraduate Certificate in Electrical Engineering is awarded to the students who have demonstrated the achievement of the outcomes located at level 4.5

Element of the descriptor	Learning Outcome of Undergraduate Certificate Programme
Knowledge and understanding	The graduates should be able to master multidisciplinary knowledge, recognize interconnections among learning areas, and acquire procedural skills for effective task performance.
Skills required to perform and accomplish tasks	The graduates should be able to apply cognitive and technical skills to perform multidisciplinary tasks, critically analyze diverse information, and select appropriate methods to enhance problem-solving.
Application of knowledge and skills	The graduates should be able to demonstrate the ability to solve problems in your field, integrate operational, technical, and theoretical knowledge with cognitive and practical skills to choose appropriate methods and tools.
Generic learning outcomes	The graduates should to excel in your field, communicate effectively, engage in self-directed learning, analyze data critically, and make informed, responsible decisions.
Constitutional, humanistic, ethical, and moral values	Uphold constitutional, ethical, and moral values in practice, and effectively articulate related arguments within your field
Employment-ready skills, and entrepreneurship skills and mindset	Develop essential knowledge and skills for effective job performance in the field, while taking responsibility for individual tasks and contributing to group outcomes
Credit Requirement	48
Entry Requirement	A candidate who has passed Senior Secondary Certificate Examination (Class XII level) of the Board of School Education, Punjab; or any other examination recognized as equivalent thereto with minimum passing marks in aggregate, shall be eligible to join First Semester of the Undergraduate (UG) Programme.

Program Structure

SEMESTER: 1st									
Course Code	**Course Title**	**Type of Course**	**L**	**T**	**P**	**No. of Credits**	**Int.**	**Ext.**	**Total Marks**
BEE1100	Engineering Chemistry	MCC	3	0	0	3	30	70	100
BEE1101	Engineering Mathematics–I	MCC	3	1	0	4	30	70	100
BEE1102	Basics of Domestic Appliances	MIN1	3	0	0	3	30	70	100
BEE1103	Manufacturing Practices	SEC	0	0	6	3	30	70	100
BEE1104	Principles of Economics	MDSC1	3	0	0	3	30	70	100
VAC0001	Environment Education	VAC	2	0	0	2	30	70	100
BEE1105	Communication Skills Level-I	AEC/MIL	2	0	0	2	30	70	100
BEE1106	Engineering Chemistry Lab	MCC	0	0	2	1	30	70	100
BEE1107	Basics of Domestic Appliances Lab	MIN1	0	0	2	1	30	70	100
BEE1108	Entrepreneurship Setup & Launch	ESE	0	0	4	2	30	70	100
Total			**16**	**1**	**14**	**24**	**300**	**700**	**1000**

SEMESTER: 2nd									
Course Code	**Course Title**	**Type of Course**	**L**	**T**	**P**	**No. of Credits**	**Int.**	**Ext.**	**Total Marks**
BEE2150	Engineering Physics	MCC	3	0	0	3	30	70	100
BEE2151	Engineering Mathematics–II	MCC	3	1	0	4	30	70	100
BEE2152	Electrical Measuring Instruments	DSEC	3	0	0	3	30	70	100
BEE2153	Basics of Electrical Engineering	MIN2	3	0	0	3	30	70	100
BEE2154	Computer Proficiency	SEC2	2	0	0	2	30	70	100
VAC0002	Human Values & Professional Ethics	VAC	2	0	0	2	30	70	100
BEE2155	Indian Constitution	MDSC 2	3	0	0	3	30	70	100
BEE2156	Communication Skills -II	AEC/ MIL	2	0	0	2	30	70	100
BEE2157	Engineering Physics Lab	MCC	0	0	2	1	30	70	100
BEE2158	Basics of Electrical Engineering Lab	MIN2	0	0	2	1	30	70	100
BEE2159	Computer Proficiency Lab	SEC2	0	0	2	1	30	70	100
BEE2160	Electrical Measuring Instruments Lab	DSEC	0	0	2	1	30	70	100
BEE2161	Entrepreneurship and Marketing Basics	ESE	0	0	4	2	30	70	100
Total			**21**	**1**	**12**	**30**	**360**	**840**	**1200**

Programme Learning Outcomes: Undergraduate Diploma in Electrical Engineering is awarded to the students who have demonstrated the achievement of the outcomes located at level 5

Element of the descriptor	Learning Outcome of undergraduate Diploma Program
Knowledge and understanding	The graduates should be able to develop a broad multidisciplinary theoretical and technical knowledge base, gain in-depth understanding of a specific area, and acquire procedural skills for performing specialized tasks within your program.
Skills required to perform and accomplish tasks	Graduates should to acquire cognitive and technical skills to perform complex tasks and analyze diverse information to generate effective solutions.
Application of knowledge and skills	Graduates should be able to apply specialized knowledge and practical skills to collect and analyze data, selecting appropriate methods and tools to solve field-specific problems.
Generic learning outcomes	The graduates should be able to demonstrate the ability to: • Analyze and communicate complex information effectively to diverse audiences while pursuing self-directed learning to enhance their knowledge and skills. • Evaluate critically theories and practices, make informed decisions, and take responsibility for solving unpredictable problems in their field.
Constitutional, humanistic, ethical, and moral values	The graduates should demonstrate the willingness and ability to: • Embrace the constitutional, humanistic, ethical, and moral values, and practice these values in life, and take a position regarding these values, • Formulate arguments in support of actions to address issues relating the ethical and moral issues relating to the Programme of learning, including environmental and sustainable development issues, from multiple perspectives.
Employment-ready, and entrepreneurship skills and mindset	The graduates should be able to demonstrate the acquisition of knowledge and essential skills set that are necessary to: • Take full responsibility for their tasks and outputs, both individually and as team members, while exercising self-management within their work and study contexts. • Supervise routine work of others, contributing to the evaluation and improvement of activities.
Credit Requirement	98
Entry Requirement	A student can re-enter into second year of a Programme if she/he has taken an exit option after first year (UG Certificate) or having 3 year UG diploma in the relevant field of study.

SEMESTER: 3rd									
Course Code	**Course Title**	**Type of Course**	**L**	**T**	**P**	**No. of Credits**	**Int.**	**Ext.**	**Total Marks**
BEE3200	Electrical Circuit Analysis	MCC	3	1	0	4	30	70	100
BEE3201	Electrical Machines – I	MCC	3	0	0	3	30	70	100
BEE3202	Electrical and Electronic Measurements	DSEC	3	0	0	3	30	70	100
BEE3203	Analog Electronics	SEC3	2	0	0	2	30	70	100
BEE3204	Mathematics -III	MIN3	3	1	0	4	30	70	100
BEE3205	Electrical and Electronic Measurements Lab	DSEC	0	0	2	1	30	70	100
BEE3206	Electrical Machines – I Lab	MCC	0	0	2	1	30	70	100
BEE3207	Analog Electronics Lab	SEC3	0	0	2	1	30	70	100
BEE3208	Sustainable Development	MDSC3	3	0	0	3	30	70	100
IKS0009	Indian Agriculture	VAC	2	0	0	2	30	70	100
BEE3209	Proficiency in English Writing	AEC/MIL	2	0	0	2	30	70	100
BEE3212	Operations and Scale	ESE	-	-	-	2	30	70	100
Elective Skill Enhancement Course (Choose any one of the following)									
BEE3210	Disaster Risk Reduction and Management: Skills for Safety and Resilience	ESEC	2	0	2	3	30	70	100
BEE3211	Basics of Cyber Security	ESEC	3	0	0	3	30	70	100
Total			**26**	**2**	**8**	**34**	**360**	**840**	**1200**

SEMESTER: 4th									
Course Code	**Course Title**	**Type of Course**	**L**	**T**	**P**	**No. of Credits**	**Int.**	**Ext.**	**Total Marks**
BEE4250	Electrical Machines – II	MCC	3	0	0	3	30	70	100
BEE4251	Power Electronics	MCC	3	0	0	3	30	70	100
BEE4252	Electromagnetic Fields	MCC	4	0	0	4	30	70	100
BEE4253	Digital Electronics	VOC1	3	0	0	3	30	70	100
IKS0008	Indian Architecture and Town Planning	VAC	2	0	0	2	30	70	100
BEE4254	Presentation Skills	AEC/MIL	2	0	0	2	30	70	100
BEE4255	Digital Electronics Lab	VOC1	0	0	2	1	30	70	100
BEE4256	Electrical Machines – II Lab	MCC	0	0	2	1	30	70	100
BEE4257	Power Electronics Lab	MCC	0	0	2	1	30	70	100
BEE4260	Organic Growth Practical	SEC	-	-	-	2			
Discipline Specific Elective (DSE) Course (Choose any one of the following)									
BEE4258	Substation Equipment & Design	DSE	4	0	0	4	30	70	100
BEE4259	Electrical Materials								
Total			**21**	**0**	**6**	**26**	**270**	**630**	**900**

Programme Learning Outcomes: Bachelor of Vocational (B.Voc.) in Electrical Engineering is awarded to the students who have demonstrated the achievement of the outcomes located at level 5.5

Element of the descriptor	Learning Outcome of Undergraduate B. Voc. Program
Knowledge and understanding	The graduates should be able to demonstrate the comprehensive multidisciplinary knowledge with specialized depth in their field, stay informed on emerging developments, and acquire procedural skills for professional tasks.
Skills required to perform and accomplish tasks	Graduates should be able to develop cognitive and technical skills to perform complex tasks, evaluate intricate ideas, and generate solutions to specific problems within their program.
Application of knowledge and skills	Graduates should be able to apply specialized knowledge and skills to gather and analyze data, assess problem-solving approaches, and employ appropriate strategies to generate effective solutions.
Generic learning outcomes	The graduates should be able to demonstrate the ability to: • Analyze and communicate complex information effectively, present study findings clearly, and engage in self-directed learning to adapt to evolving workplace demands. • Evaluate critically evidence, make informed decisions, and exercise sound judgment to generate solutions for field-specific and real-life problems.
Constitutional, humanistic, ethical, and moral values	Graduates should be able to uphold constitutional, humanistic, ethical, and moral values, identify and address ethical issues in their field, and adhere to ethical research practices, avoiding misconduct such as fabrication, falsification.
Employment-ready and entrepreneurship skills and mindset	The graduates should be able to demonstrate the acquisition of: • Acquire essential knowledge and skills for professional roles in their chosen field, including entrepreneurship abilities for self-employment and business management. Capable of supervising others, managing tasks in unpredictable environments, and taking full responsibility for individual and group outcomes.
Credit Requirement	146
Entry Requirement	A student can re-enter into second year of a Programme if she/he has taken an exit option after second year (UG 2 year Diploma).

SEMESTER: 5th									
Course Code	**Course Title**	**Type of Course**	**L**	**T**	**P**	**No. of Credits**	**Int.**	**Ext.**	**Total Marks**
BEE5300	Power System -I (Apparatus and Modeling)	MCC	3	0	0	3	30	70	100
BEE5301	Control Systems	MCC	3	0	0	3	30	70	100
BEE5302	Wind and Solar Energy	MCC	4	0	0	4	30	70	100
BEE5303	Microcontroller and PLC	VOC2	3	0	0	3	30	70	100
BEE5304	Power System -I (Apparatus and Modeling) Lab	MCC	0	0	2	1	30	70	100
BEE5305	Control Systems Lab	MCC	0	0	2	1	30	70	100
BEE5306	Microcontroller and PLC Lab	VOC2	0	0	2	1	30	70	100
BEE5311	AI Automation & Finance Practical	SEC	-	-	-	2			
Discipline Specific Elective (DSE) Course (Choose any one of the following)									
BEE5307	Electrical Machine Design	DSE	4	0	0	4	30	70	100
BEE5308	Power Plant Engineering								
Discipline Specific Elective (DSE) Course (Choose any one of the following)									
BEE5309	Signals & Systems	DSE	4	0	0	4	30	70	100
BEE5310	Computer Architecture								
Total			**21**	**0**	**6**	**26**	**270**	**630**	**900**

SEMESTER: 6th									
Course Code	**Course Title**	**Type of Course**	**L**	**T**	**P**	**No. of Credits**	**Int.**	**Ext.**	**Total Marks**
BEE6350	Power Systems-II (Protection)	MCC	3	0	0	3	30	70	100
BEE6351	Generation & Economics of Electrical Power	MCC	4	0	0	4	30	70	100
BEE6352	Utilization of Electrical Energy	MCC	4	0	0	4	30	70	100
BEE6353	Fundamentals of Artificial Intelligence	VOC3	4	0	0	4	30	70	100
BEE6354	Power Systems-II (Protection) Lab	MCC	0	0	2	1	30	70	100
Discipline Specific Elective (DSE) Course (Choose any one of the following)									
BEE6355	Electrical Drives	DSE	4	0	0	4	30	70	100
BEE6356	Digital Signal Processing								
Discipline Specific Elective (DSE) Course (Choose any one of the following)									
BEE6357	Introduction to Industrial Management	DSE	4	0	0	4	30	70	100
BEE6358	Waste to Energy								
Total			**23**	**0**	**2**	**24**	**210**	**490**	**700**

Programme Learning Outcomes: Bachelor of Technology (B.Tech) in Electrical Engineering is awarded to the students who have demonstrated the achievement of the outcomes located at level 6.

Element of the descriptor	Learning Outcome of undergraduate B.Tech Programme
Knowledge and understanding	The graduates should d be able to demonstrate the comprehensive multidisciplinary knowledge with specialized depth in their field, stay informed on emerging developments, and acquire procedural skills for professional tasks.
Skills required to perform and accomplish tasks	Graduates should be able to develop cognitive and technical skills to perform complex tasks, evaluate intricate ideas, and generate solutions to specific problems within their program.
Application of knowledge and skills	Graduates should be able to apply specialized knowledge and skills to gather and analyze data, assess problem-solving approaches, and employ appropriate strategies to generate effective solutions.
Generic learning outcomes	The graduates should d be able to demonstrate the ability to: • Analyze and communicate complex information effectively, present study findings clearly, and engage in self-directed learning to adapt to evolving workplace demands. • Evaluate critically evidence, make informed decisions, and exercise sound judgment to generate solutions for field-specific and real-life problems.
Constitutional, humanistic, ethical, and moral values	Graduates should be able to uphold constitutional, humanistic, ethical, and moral values, identify and address ethical issues in their field, and adhere to ethical research practices, avoiding misconduct such as fabrication, falsification, misrepresentation, and plagiarism.
Employment-ready and entrepreneurship skills and mindset	The graduates should be able to demonstrate the acquisition of: • Acquire essential knowledge and skills for professional roles in their chosen field, including entrepreneurship abilities for self-employment and business management. Capable of supervising others, managing tasks in unpredictable environments, and taking full responsibility for individual and group outcomes.
Credit Requirement	189
Entry Requirement	A student can re-enter into fourth year of a Programme if she/he has taken an exit option after third year(B. Voc.) .

SEMESTER: 7th									
Course Code	**Course Title**	**Type of Course**	**L**	**T**	**P**	**No. of Credits**	**Int.**	**Ext.**	**Total Marks**
BEE7400	HVDC & EHVAC Transmission Systems	MCC	4	0	0	4	30	70	100
BEE7401	Electric & Hybrid Vehicles	MCC	4	0	0	4	30	70	100
BEE7402	Introduction to Industry 4.0	MCC	4	0	0	4	30	70	100
BEE7403	MATLAB & Simulink Lab	SEC4	0	0	6	3	30	70	100
BEE7404	Project	MIN4	0	0	8	4	30	70	100
Discipline Specific Elective (DSE) Course (Choose any one of the following)									
BEE7405	High Voltage Engineering	DSE	4	0	0	4	30	70	100
BEE7406	Electrical Energy Conservation and Auditing								
BEE7407	Power System Dynamics & Control								
Total			**16**	**0**	**14**	**23**	**180**	**420**	**600**

Semester: 8th									
Course Code	**Course Title**	**Type of Course (New)**	**L**	**T**	**P**	**No. of Credits**	**Int.**	**Ext.**	**Total Marks**
BEE8450	Industrial Training	Skill Based	0	0	0	20	30	70	100
Total			0	0	0	20	30	70	100
Grand Total			**139**	**4**	**56**	**199**			

Mandatory Visits/ Workshop/Expert Lectures

1. It is mandatory to arrange one industrial visit every semester for the students.
2. It is mandatory to organize at least one expert lecture per semester for each branch by inviting resource persons from domain specific industry.

SEMESTER-I

Course Title: ENGINEERING CHEMISTRY
Course Code: BEE1100

L	T	P	Credits
3	0	0	3

Total Hours: 45

Course Outcomes: On successful completion of this course, the students 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).*

SEMESTER-I

Course Title: ENGINEERING MATHEMATICS – I
Course Code: BEE1101

L	T	P	Credits
3	1	0	4

Total hours 60

Course Outcomes: On successful completion of this course, the students 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.*

SEMESTER-I

Course Title: BASICS OF DOMESTIC APPLIANCES
Course Code: BEE1102

L	T	P	Credits
3	0	0	3

Total hours: 45

Course Outcomes: On successful completion of this course, the students 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. Understand the working principles of different household domestic appliances.
3. Check the electrical connections at house-hold.
4. To 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.

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.

UNIT-III **15 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 **10 Hours**

Electric Mixer, Grinder and Blender:

Construction, working principles, special characteristics and applications of Electric Mixer, Common Faults, their causes, Servicing maintenance and overhauling of Electric Mixer.

Transaction Modes

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.*
- *Handbook of Repair & Maintenance of domestic electronics appliances; BPB Publications.*
- *Consumer Electronics, S.P.Bali, Pearson.*
- *Domestic Appliances Servicing, K.P.Anwer, Scholar Institute Publications*

SEMESTER-I

Course Title: MANUFACTURING PRACTICES
Course Code: BEE1103

L	T	P	Credits
0	0	6	3

Total Hours: 45

Course Outcomes: On successful completion of this course, the students 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 **10 Hours**

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

UNIT II **10 Hours**

CNC machining, Additive manufacturing, Fitting operations & power tools

UNIT III **10 Hours**

Electrical & Electronics Carpentry, Plastic moulding, glass cutting

UNIT IV **15 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.*

SEMESTER-I

Course Title: PRINCIPLES OF ECONOMICS
Course Code: BEE1104

L	T	P	Credits
3	0	0	3

Total Hours: 45

Course Outcomes: On successful completion of this course, the students will be able to:

1. Understand the core micro and macroeconomic concepts, theories, models, principles, tools, and techniques
2. Understanding the role of market and prices in influencing key economic activities
3. Develop the skills to interpret, analyze the economic concepts and variables through diagrams, tables and graphs
4. Relate the key economic principles to real life situations, especially in the context of development challenges which would help students to make informed decisions

Course Content

UNIT I **10 Hours**

Introduction to economics

Basic concepts of Economics, Understanding the philosophy o of economics, Nature of economics: Is economics a science or an art, Definitional pluralities and distinctions such as micro-versus macro, theories versus models, A brief history of ideas in economics, Techniques of economic analysis: theories, models and tools

UNIT II **15 Hours**

Demand, Supply, Elasticities, and Market Efficiency

The economic problem of scarcity, choice, and opportunity cost, Demand, supply, and market equilibrium, Demand and supply applications, Consumer surplus and producer's surplus, Market efficiency and their applications, Elasticity: its various forms and estimation methods, elasticity, and total revenue, Elasticity applications in the field of energy and environment, Utility, Preferences and Choice, Budget constraints, determination of optimal choices using indifference curve analysis and its applications, Behavioral economics as an alternative framework of consumer choice

UNIT III **10 Hours**

Production and Cost

Production Theory, Production function and different forms, Short-run and long-run production function, Isoquants, MRTS, Total, average, and marginal products

Economies of scale and scope, Theory of cost, Short-run and long run costs, cost minimization, Total, average and marginal costs, Applications of production and costs theory

UNIT IV **10 Hours**

Market structure and regulation

Market equilibrium and price determination under different market structure - Perfect and Imperfect market structure, welfare costs of monopoly, Market structure, efficiency, and regulation, Regulation of public monopolies, Application in case of infrastructure industries such as energy and water

National Income Accounting

Measuring national income, output, and employment – different approaches, Determination of aggregate output, price level and interest rate – classical, Keynesian, and modern theories and approaches, GDP estimation in India

Transaction Mode

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

Suggested Readings:

- *Principles of Economics, Karl Case, Ray Fair, and Sharon Oster, 12th Edition, Pearson Education Inc., 2017.*
- *Principles of Economics, Mankiw, N. Gregory, 4th edition. South-Western College Publications, 2006.*
- *Principles of Economics, Stiglitz, J.E. and C.E. Walsh, 3rd Edition. New York: W.W. Norton & Company, 2002.*
- *Macro Economics, R. Dornbusch, S. Fischer, and R. Startz, 10th Edition, Tata-McGraw-Hill, 2012.*
- *Macroeconomics, Olivier Blanchard, 5th edition, Pearson Education Inc., 2009*

SEMESTER-I

Course Title: ENVIRONMENT EDUCATION
Course Code: VAC0001

L	T	P	Credits
2	0	0	2

Total hours: 30

Course Outcomes: On successful completion of this course, the students 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.*

SEMESTER-I

COURSE TITLE: COMMUNICATION SKILLS LEVEL-I
Course Code: BEE1105

L	T	P	Credits
2	0	0	2

Total hours: 30

Course Outcomes: On successful completion of this course, the students will be able to:

1. **Effective Communication**: Students will develop the ability to communicate clearly and confidently in both written and verbal forms across various settings.
2. **Technical Writing Skills**: Students will learn to write clear, concise, and well-structured technical documents, reports, and business communications.
3. **Presentation and Public Speaking**: Students will enhance their presentation skills, using verbal and non-verbal techniques to engage audiences effectively.
4. **Professional Workplace Communication**: Students will be able to apply communication strategies for team collaboration, handling feedback, and managing crises in a professional environment.

Course Content

UNIT-I **7 Hours**

Basics of Communication

- Introduction to the concept and importance of communication
- Types of communication: Verbal, Non-verbal, Written, and Visual
- Communication process: Sender, Message, Channel, Receiver, Feedback, and Noise
- Barriers to communication and how to overcome them.

UNIT II **8 Hours**

Written Communication Skills

- Technical writing: Reports writing
- Business communication: Professional emails, letters.
- Structure and content of formal and informal business correspondence.
- Resume writing: Structure, content, and design

UNIT III **7 Hours**

Verbal and Presentation Skills

- Public speaking: Structuring and delivering speeches
- Using verbal and non-verbal communication (voice modulation, body language)
- Group discussion techniques: Active participation, listening, turn-taking.
- Interview preparation: Common questions, answering techniques, body language.

UNIT IV **8 Hours**

Advanced Communication and Professional Skills

- Interpersonal communication: Building rapport, conflict resolution
- Cross-cultural communication: Navigating cultural differences in professional settings
- Persuasion techniques and strategies for professional communication
- Negotiation skills: Approaches to negotiation and handling objections
- Handling feedback and performance reviews: Giving and receiving feedback constructively

Transaction Modes

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

Suggested Readings

- *"Business Communication: Building Critical Skills" by Kitty O. Locker & Stephen Kaczmarek*
- *"The Elements of Business Writing" by Gary Blake & Robert W. Bly*
- *"Crucial Conversations: Tools for Talking When Stakes Are High" by Kerry Patterson, Joseph Grenny, Ron McMillan, Al Switzler*
- *"The Culture Map: Breaking Through the Invisible Boundaries of Global Business" by Erin Meyer*

SEMESTER-I

Course Title: ENGINEERING CHEMISTRY LABORATORY
Course Code: BEE1106

L	T	P	Credits
0	0	2	1

Total Hours: 15

Course Outcomes: On successful completion of this course, the students 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.

SEMESTER-I

Course Title: BASICS OF DOMESTIC APPLIANCES LABORATORY
Course Code: BEE1107

L	T	P	Credits
0	0	2	1

Total hours: 15

Course Outcomes: On successful completion of this course, the students 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. Understand the working principles of different household domestic appliances.
3. Check the electrical connections at house-hold.
4. To learn the skills to repair the electrical appliances for the general troubleshooting and wiring faults.

Course Content

Co-curricular Activities (Hands on Exercises):

1. Identifying Phase, Neutral and Earth on power sockets.
2. Identifying primary and secondary windings and measuring primary and secondary voltages in various types of transformers.
3. Observing the working of transformer under no-load and full load conditions.
4. Observing the connections of elements and identify current flow and voltage drops.
5. Studying electrical circuit protection using MCBs, ELCBs.
6. Dismantling and reassemble of reflector type room Heater.
7. Dismantling and reassembling of Electric Iron
   (i) Ordinary type (ii) Automatic/Thermostat control type.
8. Testing and repair of Electric Iron (i) Ordinary type (ii) Automatic/Thermostat control type.
9. Dismantling and reassembling of Electric Stove (i) Coiled type (ii) Covered type Hot plate (b) Grill (iii) Induction Heater (iv) Microwave oven, (v) Three phase heater star and delta connection
10. Connection of Fluorescent tube light (FTL) circuit.
11. Testing and repair of (i) Table Lamp (ii) Night Lamp and (ii) Tube Light (iv) LED table lamp
12. Testing fault finding, repair and overhauling of electric fans.
13. Testing fault finding, repair and overhauling of
    (i) electric mixer (ii) grinder (iii) blender.
14. Testing fault finding, repair and overhauling of emergency light

15. Testing fault finding, repair and overhauling of voltage stabilizer (manual and automatic)

SEMESTER-I

Course Title: Entrepreneurship Setup & Launch
Course Code: BEE1108

L	T	P	Credits
0	0	4	2

Total hours: 30

Introduction:

This semester lays the foundation for the learner to understand what entrepreneurship is, beyond just starting a business. It introduces key ideas like problem-solving, value creation, and self-awareness. The learner will begin exploring basic business concepts while discovering their own interests and strengths.

Learners Objective:

1. Understand the core concepts of entrepreneurship through relatable, real-life examples.
2. Begin to see themselves as problem-solvers and creators.
3. Learn about business paths and choose one to try based on interest or local fit.
4. Launch a micro-hustle (online or offline) to earn their first income.
5. Build confidence and self-belief by doing.

Outcome: By the end of this semester, learners will start a simple business activity, earn their first income, and build belief in their ability to do business.

Guiding Principles/Approach:

This syllabus is built on principles of **experiential learning, growth mindset development**, and **identity-first learning**. Drawing from learning science and behavior design, the course shifts students from passive learning to *active doing*, where they try out small business activities in real contexts. The design helps students not just learn entrepreneurship, but begin to see themselves as entrepreneurs. Emphasis is placed on *small wins, peer collaboration, and locally relevant opportunities* to ensure learning feels achievable and connected to their realities. The curriculum focuses on conceptual understanding without heavy theory, combining practical action, reflection, and collaboration. By making progress visible and success feel possible, it plants the seeds of self-reliance, initiative, and long-term motivation.

Semester Syllabus:

Format: 12 weeks, 4 hours/week | 2 credits

Revenue Target: ₹10,000

Week	Learning Goal	Measurable Outcome
1	Understand what entrepreneurship is and who can be an entrepreneur	Students define entrepreneurship in their own words and list 2 entrepreneurs from their local area or community
2	Connect personal identity to entrepreneurship (strengths, interests, struggles)	Students create a "value map" showing how a skill/interest/problem from their life could become a business opportunity
3	Learn about 5 business paths: content creation, dropshipping, cloud kitchen/food business, gig economy and local services	Students explore 1–2 examples from each domain and share one they're most curious to try and why
4	Choose a path and generate a basic business idea	Students write down a clear offer (what, for whom, why) and one way to reach their customer
5	Take first real action: message, post, pitch, or sell	Students reach out to or serve 1 real potential customer and record what happened

6	Reflect on first attempt and share with peers	Students share their result, a challenge faced, and one idea to improve next time
7	Improve and try again: aim for first ₹100	Students apply a change, try again, and aim to make their first ₹100 or get meaningful response
8	Learn how to identify and understand your target customer	Students talk to 2 potential customers or observe them and list 3 insights about their needs
9	Learn how to serve your target audience better	Students improve one part of their offer (product, delivery, messaging, or interaction) based on customer feedback or need
10	Explore core entrepreneurial values (resilience, honesty, effort)	Students reflect on 1 value they're building and show it in a business task or peer story
11	Focus on earning and staying consistent	Students complete a second earning task and track their consistency (e.g., same product or message for 3 days)
12	Reflect on earnings, grit, and how to keep going	Students record total earnings, one resilience moment, and one support system or habit they'll continue with

Weekly Component:

Component	**Duration**	**Description**
Learning Module	~1.5 hrs	- Introduces key concepts in a simple and engaging way - Includes, examples, and 1–2 interactive discussions or quizzes

Action Lab	~2 hrs	- Hands-on task on the weekly concept - Includes step-by-step guidance, templates, and worksheets - Ends with a submission (e.g., video, reflection, or proof of action)
Resources	Self-paced	- Supplementary videos, short readings, real- life stories, and tools to deepen understanding at their own pace

Evaluation Criteria

Evaluation Component	**Description**	**Weightage**
Weekly Task Completion	Timely submission of weekly tasks including reflections, activities, quizzes etc.	40%
Target Completion	Performance-based evaluation on hitting **revenue or profit targets** (e.g., generating ₹10,000 revenue)	30%
Final Project	A comprehensive project based on the semester's theme	30%

SEMESTER-II

Course Title: ENGINEERING PHYSICS

Course Code: BEE2150

L	T	P	Credits
3	0	0	3

Total hours 45

Course Outcomes: On successful completion of this course, the students 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 **10 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 **10 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 **10 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, Fraunh offer 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.*

SEMESTER-II

Course Title: ENGINEERING MATHEMATICS –II
Course Code: BEE2151

L	T	P	Credits
3	1	0	4

Total Hours: 60

Course Outcomes: On successful completion of this course, the students 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 **15 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 **15 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 Publication*

SEMESTER - II

Course Title: ELECTRICAL MEASURING INSTRUMENTS	L	T	P	Credits
Course Code: BEE2152	3	0	0	3

Total hours: 45

Course Outcomes: On successful completion of this course, the students will be able to:

1. Explain working principle of different measuring instruments
2. Identify and use different measuring instruments
3. Differentiate between AC and DC supply
4. Acquire knowledge various methods of electrical parameters measurement.

Course Content

UNIT-I **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.

UNIT-II **15 Hours**

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-III **10 Hours**

Multimeter – Principle of digital multimeter, study their different controls, frequently occurring problems in digital multimeter, Working of insulation tester and earth tester, safety measures to be taken during use of instruments

UNIT-IV **10 Hours**

Define power factor, working principle of power factor meter and their connections Working principle of 3 phase and single phase digital energy meter, their connection diagrams and errors during utilization, Working of tachometer, analog and digital tachometer, Working principle of wattmeter and connections

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.*

SEMESTER- II

Course Title: BASICS OF ELECTRICAL ENGINEERING
Course Code: BEE2153

L	T	P	Credits
3	0	0	3

Total hours 45

Course Outcomes: On successful completion of this course, the students 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 **7 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 **8 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 **8 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 **7 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.*

SEMESTER- II

Course Title: COMPUTER PROFICIENCY

Course Code: BEE2154

L	T	P	Credits
2	0	0	2

Total Hours 30

Course Outcomes: On successful completion of this course, the students will be able to:

1. To formulate simple algorithms for arithmetic and logical problems
2. To translate the algorithms to programs (in C language)
3. To test and execute the programs and correct syntax and logical errors
4. To implement conditional branching, iteration and recursion
5. To use arrays, pointers and structures to formulate algorithms and programs

Course Content

UNIT I **8 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 **8 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 **7 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 Outline of Programming with C, McGraw-Hill*
- *E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill*
- *Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India*

SEMESTER-II

Course Title: HUMAN VALUES & PROFESSIONAL ETHICS
Course Code: VAC0002

L	T	P	Credits
2	0	0	2

Total hours: 30

Learning Outcomes:

On successful completion of this course, the students will be able to:

1. Develop the ability to distinguish between 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.
4. Create Ethical reason and achieve harmony in life
5. Develop moral responsibility and mould themselves as good professionals

Course Content

UNIT-I **7 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 **8 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 **7 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 **8 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-II

Course Title: INDIAN CONSTITUTION

Course Code: BEE2155

L	T	P	Credits
3	0	0	3

Total Hours: 45

Course Outcomes: On successful completion of this course, the students will be able to:

1. Have general 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.
4. Understand Engineering ethics and responsibilities of Engineer and awareness about basic human rights in India

Course Content

UNIT I **10 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 **15 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, Panchyats and Co – Operative Societies.

UNIT IV **10 Hours**

Scope & Aims of Engineering Ethics, Responsibility of Engineers Impediments to Responsibility. Risks, Safety and liability of Engineers, Honesty, Integrity & Reliability in Engineering.

Transaction Mode

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

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: COMMUNICATION SKILLS - II

Course Code: BEE2156

L	T	P	Credits
2	0	0	2

Total Hours: 30

Course Outcomes: On successful completion of this course, the students will be able to:

1. Identify and understand various barriers to effective communication (physiological, psychological, cultural, etc.).
2. Develop active listening skills and apply them in both personal and professional contexts.
3. Enhance written communication by focusing on clarity, structure, and audience awareness.
4. Master effective communication in interviews and presentations, including overcoming common challenges.

Course Content

UNIT I **8 Hours**

Barriers to Communication:

Physiological, Physical, Cultural, Language, Gender, Interpersonal, Psychological, Emotional.

Perspectives in Communication:

Visual Perception, Language, Past Experiences, Prejudices, Feelings, Environment

UNIT II **7 Hours**

Elements of Communication:

Face-to-Face, Tone of Voice, Body Language (Non-Verbal), Verbal, Physical Communication.

Communication Styles:

Direct, Spirited, Systematic, Considerate.

UNIT III **7 Hours**

Basic Listening Skills:

Self-Awareness, Active Listening, Difficult Situations.

Effective Written Communication:

When to Use Written Communication, Writing Effectively (Subject Lines, Main Point First, Audience, Organization).

UNIT IV **8 Hours**

Interview Skills:

Purpose of an Interview, Dos and Don'ts.

Giving Presentations:

Dealing with Fears, Planning, Structuring, Delivery Techniques.

Transaction Mode

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

Suggested Readings:

- *"Communication in Action" by Kory Floyd*
- *"The Art of Communicating" by Thich Nhat Hanh*
- *"On Writing Well" by William Zinsser*
- *"Talk Like TED" by Carmine Gallo*

SEMESTER- II

Course Title: ENGINEERING PHYSICS LAB

Course Code: BEE2157

L	T	P	Credits
0	0	2	1

Total Hours: 15

Course Outcomes: On successful completion of this course, the students will 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 **15 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: BASICS OF ELECTRICAL ENGINEERING LAB
Course Code: BEE2158

L	T	P	Credits
0	0	2	1

Total Hours: 15

Course Outcomes: On successful completion of this course, the students 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.

SEMESTER-II

Course Title: COMPUTER PROFICIENCY LAB
Course Code: BEE2159

L	T	P	Credits
0	0	2	1

Total hours: 15

Course Outcomes: On successful completion of this course, the students 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 **15 Hours**

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. Balaguru swamy (2005) Programming in ANSI C, Tata McGraw-Hill.*

SEMESTER-II

Course Title: ELECTRICAL MEASURING INSTRUMENTS LAB
Course Code: BEE2160

L	T	P	Credits
0	0	2	1

Total hours: 15

Course Outcomes: On successful completion of this course, the students will be able to:

1. Identify and use different measuring instruments
2. Interpret the characteristics of measuring instruments and their classification.
3. Acquire knowledge of various methods of electrical parameters measurement.
4. Evaluate and demonstrate various instruments for the measurement of electrical quantities.

Course Content **15 Hours**

1. Measure voltage, current, resistance and power using ammeter and voltmeter
2. Identify different types of measuring instruments and their connectors
3. Measure insulation value of different cables using insulation tests
4. Measure value of different resistors using multimeter and also note down their voltage and current variation in tabular form
5. Measure power factor in polyphase circuit using voltmeter, ammeter and wattmeter
6. Perform the connections of 3 phase energy meter
7. Measure speed of motor using tachometer
8. Measure power of inductor using wattmeter

SEMESTER - III

Course Title: ELECTRICAL CIRCUIT ANALYSIS

Course Code: BEE3200

L	T	P	Credits
3	1	0	4

Total hours: 60

Course Outcomes: On successful completion of this course, the students 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 **15 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 **15 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 **15 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.*

SEMESTER - III

Course Title: ELECTRICAL MACHINES - I
Course Code: BEE3201

L	T	P	Credits
3	0	0	3

Total hours: 45

Course Outcomes: On successful completion of this course, the students 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 **10 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 **15 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.*
- *Electric Machinery Fundamentals 4th Edition by Stephen Chapman.*
- *Electrical Machinery 7th Edition P. S. Bimbhra.*
- *Electric Machines and Power System by Del Toro.*

SEMESTER - III

Course Title: ELECTRICAL AND ELECTRONIC MEASUREMENTS
Course Code: BEE3202

L	T	P	Credits
3	0	0	3

Total hours: 45

Course Outcomes: On successful completion of this course, the students 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.*

SEMESTER - III

Course Title: ANALOG ELECTRONICS
Course Code: BEE3203

L	T	P	Credits
2	0	0	2

Total hours: 30

Course Outcomes: On successful completion of this course, the students will be able to:

1. Demonstrate electronics components 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 **8 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 **8 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 **8 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 **6 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.*

SEMESTER - III

Course Title: MATHEMATICS-III
Course Code: BEE3204

L	T	P	Credits
3	1	0	4

Total hours: 60

Course Outcomes: On successful completion of this course, the students will be able to:

1. Basic probability axioms and rules and the moments of discrete and continuous random variables as well as be familiar with common named discrete and continuous random variables.
2. How to derive the probability function of transformations of random variables and use these techniques to generate data from various distributions.
3. How to calculate and apply measures of location and measures of dispersion in grouped and ungrouped data cases.
4. Test of Hypothesis as well as calculate confidence interval for a population parameter for single sample and two sample cases

Course Content

UNIT I **15 Hours**

Basic Probability: Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's Inequality.

UNIT II **15 Hours**

Continuous Probability Distributions: Continuous random variables and their properties, distribution functions and densities, normal, exponential and gamma densities.

Bivariate Distributions: Bivariate distributions and their properties, distribution of sums and quotients, conditional densities, Bayes' rule.

UNIT III **15 Hours**

Basic Statistics: Measures of Central tendency: Moments, skewness and Kurtosis - Probability distributions: Binomial, Poisson and Normal - evaluation of statistical

parameters for these three distributions, Correlation and regression – Rank correlation.

UNIT–IV **15 Hours**

Applied Statistics: Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves. Test of significance: Large sample test for single proportion, difference of proportions, single mean, difference of means, and difference of standard deviations.

Small samples: Test for single mean, difference of means and correlation coefficients, test for ratio of variances - Chi-square test for goodness of fit and independence of attributes.

Transaction Modes

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

Suggested Readings

- *E. Kreyszig, ―Advanced Engineering Mathematics‖, John Wiley & Sons, 2006.*
- *P. G. Hoel, S. C. Port and C. J. Stone, ―Introduction to Probability Theory‖, Universal Book Stall, 2003.*
- *S. Ross, ―A First Course in Probability‖, Pearson Education India, 2002.*
- *W. Feller, ―An Introduction to Probability Theory and its Applications‖, Vol. 1, Wiley, 1968.*
- *N.P. Bali and M. Goyal, ―A text book of Engineering Mathematics‖, Laxmi Publications, 2010.*
- *B.S. Grewal, ―Higher Engineering Mathematics‖, Khanna Publishers, 2000.*
- *T. Veerarajan, ―Engineering Mathematics‖, Tata McGraw-Hill, New Delhi, 2010.*

SEMESTER - III

Course Title: ELECTRICAL AND ELECTRONIC MEASUREMENTS LABORATORY
Course Code: BEE3205

L	T	P	Credits
0	0	2	1

Total hours: 15

Course Outcomes: On successful completion of this course, the students 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 of 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.

SEMESTER - III

Course Title: ELECTRICAL MACHINES - I LABORATORY
Course Code: BEE3206

L	T	P	Credits
0	0	2	1

Total hours: 15

Course Outcomes: On successful completion of this course, the students 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.

SEMESTER - III

Course Title: ANALOG ELECTRONICS LABORATORY

Course Code: BEE3207

L	T	P	Credits
0	0	2	1

Total hours: 15

Course Outcomes: On successful completion of this course, the students will be able to:

1. Demonstrate electronics component and equipment's 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 V-I Characteristics of Silicon & Germanium PN Junction diodes
2. To study the V-I Characteristics of Zener Diode.
3. To analyse the response of Zener diode as regulator.
4. Characteristics of BJT in Common Emitter Configuration
5. Characteristics of JFET in Common Source Configuration
6. To study the characteristics of Half Wave Rectifier.
7. To study the characteristics of Full Wave Rectifier.
8. To study the characteristics of Half Wave and Full Wave Rectifier with Filter circuits.
9. Common Emitter BJT Amplifier
10. To study the characteristics of Phase shift oscillators.
11. To study the characteristics of Wein bridge oscillators.
12. Implement a non-Inverting (NI) amplifier circuit using op-amp
13. Implement an inverting amplifier circuit using op-amp.
14. Study of OP-AMP as inverting amplifier.
15. Study of OP-AMP as a differentiator.
16. Study of OP-AMP an integrator.
17. Performance evolution of a summing amplifier circuit.

SEMESTER - III

Course Title: SUSTAINABLE DEVELOPMENT

Course Code: BEE3208

L	T	P	Credits
3	0	0	3

Total hours: 45

Course Outcomes: On successful completion of this course, the students will be able to:

1. Understand the three pillars of sustainability and theories of sustainability
2. Understand the concept of sustainable development, theories of sustainability
3. Got a knowledge of sustainable development goals 2030 and their target, ranking, government initiatives for sustainable development
4. Apply measurement and indicators of sustainable development
5. Understand the contemporary issues of sustainable development

Course Content

UNIT-I **10 Hours**

Sustainability

Concept, Meaning, and Definitions – Importance of sustainability goals of sustainability – History of sustainability – Three Pillars of Sustainability – Theories of Sustainability: Systems Theory, Popular sustainability theory, and Ideal scientific model - Issues and Challenges relating to sustainability.

UNIT-II **10 Hours**

Sustainable Development

Concept, meanings, scope, and definitions of sustainable development – Principle of Sustainable Development – The pillars of sustainable development – Approaches to Sustainable Development: Status Quo Approach, Community Capacity Building Approach, Industrial Sector Approach, Integrated Systems Approach, Human Development Approach, and Green Account Approach.

UNIT-III **10 Hours**

Goals of Sustainable Development

Nature of Sustainable Development Goals – 2030 Global Agenda for Sustainable Development – Government Policies and their implications for sustainable

development in India – Contribution of International Organizations and NGOs – Government Initiatives for Sustainable Development.

UNIT-IV **10 Hours**

Challenges in Sustainable Development

Diversity and Social Exclusion: Concept and implications, human development of the sociocultural and other ethnic groups of the society; Contemporary Issues of Development – Bottom of the pyramid approach; Understanding the importance of social capital, social mobilization, social security, and population stabilization.

Transaction Mode

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

Suggested Readings:

- *Agrawal, A N (1995). Indian Economy: Problems of development and planning. pune: Vishwa Prakashan.*
- *Baldev Raj Nayar, Globalization and Nationalism: The Changing Balance of India's Economic Policy, 1950–2000 (New Delhi: Sage, 2001)*
- *Beckman, M. (1968), Location Theory, Random House, London.*
- *Bidyut Mohanty (1993) Urbanization in Developing Countries Basic Services and community Participation, Institute of Social Science, Concept Publishing House.*
- *Brahmadanda, P.R. and V.R. Panchmukhi (Eds.) (2001), Development Experience in the Indian Economy: Inter-State Perspectives, Bookwell, Delhi.*
- *Dholakia, R.H. (1985), Regional Disparity in Economic Growth in India, Himalaya Publishing House, Bombay.*

SEMESTER - III

Course Title: INDIAN AGRICULTURE

Course Code: IKS0009

L	T	P	Credits
2	0	0	2

Total hours: 30

Course Outcomes: On successful completion of this course, the students will be able to:

1. Understand the significance of agriculture and irrigation in ancient Indian texts.
2. Analyze historical accounts of Indian agriculture by Greek historians and travelers.
3. Explore ancient water management systems and advanced agricultural technologies.
4. Assess agricultural productivity in medieval and early modern India through historical reports.

Course Content

UNIT-I **7 Hours**

Introduction, the significance of agriculture and irrigation as emphasised in the Ramayana, Mahabharata and other texts.

UNIT-II **7 Hours**

Mention of Indian agriculture by the Greek historians and later travellers. Significance of agriculture and irrigation for the kings of Indian tradition.

UNIT-III **8 Hours**

Major water-bodies of the ancient times. The Ery system of south India. Excellence of Indian agricultural technologies as observed by more recent European observers.

UNIT-IV **8 Hours**

Productivity of Indian agriculture in medieval Thanjavur and eighteenth-century Allahabad, Chengalpattu, etc. Indian attitude towards agriculture, based on Walker and later reports.

Transactional Mode

Seminars, Group discussion, Team teaching, Focused group discussion, Assignments, Project-based learning, Simulations, reflection and Self-assessment

Suggested Readings

- *Srivastava, Vinod Chandra. History of Agriculture in India, up to c. 1200 AD. Vol. 5. Concept Publishing Company, 2008.*
- *Buckley, Robert Burton. The Irrigation Works of India. E. & FN Spon, 1905.*
- *Sunil Kumar. Agriculture in Ancient India. Shivalik Prakashan.*
- *Saxena, R. C., S.L. Choudhary, and Y.L. Nene. Textbook on Ancient History of Indian Agriculture. Munshiram Manoharlal Publishers.*

SEMESTER - III

Course Title: PROFICIENCY IN ENGLISH WRITING

Course Code: BEE3209

L	T	P	Credits
2	0	0	2

Total hours: 30

Course Outcomes: On successful completion of this course, the students will be able to:

1. Students will write clear, concise, and structured technical documents for diverse audiences.
2. Students will create professional technical reports, proposals, user manuals, and software documentation.
3. Students will master writing for digital platforms, including web content, emails, and blogs.
4. Students will develop editing, proofreading, and collaborative writing skills for high-quality technical content.

Course Content

UNIT-I **8 Hours**

Fundamentals of Technical Writing

Understanding Technical Writing: Defining technical writing, its scope, and importance in the tech field.

Writing for Different Audiences: Adapting writing style for various audiences (e.g., engineers, managers, clients).

Clarity and Conciseness: Techniques for clear, concise, and unambiguous writing.

Grammar and Syntax: Focus on sentence structure, punctuation, and avoiding common grammatical errors in technical writing.

UNIT-II **7 Hours**

Writing Technical Documents

Reports: Structure, purpose, and writing techniques for technical reports.

Document Formatting: Best practices for formatting technical documents for readability and organization (headings, subheadings, bullet points).

UNIT-III **5 Hours**

Digital Communication and Professional Writing

Creating Clear Web Content: Writing effective and engaging content for websites and blogs.

Professional Email Etiquette: Crafting concise, clear, and professional emails for workplace communication.
Digital Communication Tools: Using collaboration tools like Google Docs, Slack, and Microsoft Teams for professional communication.

UNIT-IV **10 Hours**

Technical Writing and Document Creation

Writing Project Reports: Structuring and writing clear, concise technical project reports.
Creating Instructional Guides: Writing user manuals and how-to guides for technical products or systems.
Editing and Refining Technical Documents: Techniques for improving clarity and accuracy in technical writing through editing and proofreading.

Transaction Mode

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

Suggested Readings:

- *Technical Writing: Process and Product by Sharon J. Gerson & Steven M. Gerson*
- *The Elements of Technical Writing by Gary Blake & Robert W. Bly*
- *The Chicago Manual of Style by University of Chicago Press*
- *The Craft of Scientific Writing by Michael Alley*

SEMESTER - III

Course Title: DISASTER RISK REDUCTION AND MANAGEMENT: SKILLS FOR SAFETY AND RESILIENCE
Course Code: BEE3210

L	T	P	Credits
2	0	2	**3**

Total hours: 45

Course Outcomes: On successful completion of this course, the students will be able to:

1. Identify hazards, vulnerabilities and risks at individual, institutional and community levels.
2. Outline the legal and institutional frameworks of DRR in India and globally.
3. Demonstrate life-saving skills, emergency communication, disaster response and risk mitigation techniques.
4. Utilize and implement basic tools and technologies for risk assessment, preparedness and resilience-building.
5. Prepare disaster management plans and design community awareness activities, or prototypes in regional/local contexts.

Course Content

UNIT-I **10 Hours**

Understanding Disaster Risk Reduction and Management

- Basic concepts and terminology: Hazard, Vulnerability, Capacity, Exposure, Disaster, Risk, Disaster Management & Disaster Risk Reduction.
- Hazard profile of India: Regional profile.
- Disaster Management Cycle: Mitigation, preparedness, response, relief, recovery, rehabilitation.
- Policy and legal frameworks: DM Act 2005, DM Amendment Act 2025, National Policy, State-specific Acts; PM 10 Points agenda.
- International frameworks: Sendai Framework, Paris Agreement, SDGs.
- Role of Institutions in DRR (overview only): NDMA, NIDM, IMD, CWC, GSI, BIS, ISRO, INCOIS, SDMA, DDMA, NDRF.
- Case studies of different disasters in India: Lessons learned (minimum 2).

Unit-II **10 Hours**

Preparedness, Mitigation and Response Planning

- Framework for Developing Disaster Management Plans.
- Hazard, Vulnerability, Capacity and Risk (HVCR) Assessment tools and techniques: Transect walk, Hazard mapping, Problem tree, Chapatti diagram etc.

- Mitigation and Preparedness: Evacuation planning, mock drills, tabletop exercises; disaster specific mitigation, Crowd Management techniques.
- Basics of Incident Response System (IRS).
- Role of emergency forces: NDRF, SDRF, police, fire services, armed forces, NCC, NSS.
- Planning for more vulnerable groups.
- Emerging technologies: Drones, digital literacy, mobile apps (GIRI tool, SAFAR, Meghdoot, UMANG, Sachet, CWC Flood Alerts, IMD, BIS, IHIP), social media for DRR.
- Basics of safe construction and structural & nonstructural audit exercise (safety of home/college buildings).
- Funding mechanisms for disasters in India.
- Emergency Communication Network.

Unit-III **10 Hours**

Life-Saving Skills

- First Aid in disasters: Golden hour concept, CPR, wounds, choking, burns, fractures, animal bites (snake/dog/rabid), heat-related illnesses, triaging, stampede.
- Household and personal preparedness and protection: 72-hour emergency kit, safe food storage, water purification, ORS use, water sanitation and hygiene (WASH) and Infection Prevention Control (IPC) practices, Basic Sign Language.
- Search and Rescue methods.
- Fire safety and electrical/gas/LPG safety: Causes, prevention, fire extinguisher demonstration, indigenous methods (Natural first-aid remedies- aloe vera, turmeric, coconut oil, salt solution); traditional risk-reduction practices.
- Disaster-specific response: Floods, landslides, earthquakes, CBRN emergencies, pandemics, drowning, lightning, gas leakage, cyclone, heatwave, coldwave.
- Psychosocial support in DRR; Steps for implementing psychological first aid and its importance.
- Public health preparedness: Public health impacts of various disasters, Prevention of post-disaster water-borne and vector-borne diseases.

Unit-IV **15 Hours**

Field Exposure and Community Engagement

- Field visits: District Emergency Operations Centre, State Disaster Response Force/ National Disaster Response Force units, fire stations, State Emergency Operations Center, hazard-prone communities, heat-prone areas (flood-prone village, fire-vulnerable urban slum).
- Practical exposure: Mock drills, demonstrations and simulations (multi-hazard, evacuation, earthquake, flood); interaction with responders and officials (Aapda Mitras, National Cadet Corps/National Service Scheme/Nehru Yuva Kendra Sangathan, Red Cross).
- Community Engagement projects: Street plays (nukkad natak), awareness campaigns, DRR clubs (institute and community level clubs), Information,

Education and Communication material (podcasts, videos, comics, photo essays, posters, Knowledge exchange webinars).

- Environmental hazards: Youth/community participation (tree plantation, soil conservation).
- Project/assignment: Preparation of institutional/household DM plan in local language; budget-friendly multi-disaster survival kit prototype; reflective field report, youth-led community engagement projects and creation of IEC/digital communication materials.
- Multidisciplinary integration: Links with local governments, HEIs, youth/adolescent networks.
- Activities for mitigating disaster risks: Increasing green cover, plantation and knowledge of human anatomy.
- Interaction with: State, district, gram panchayat level officials, DRR helpline numbers, and knowledge of physical resources required and available locally; interview /session with disaster survivors.

Transaction Mode

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

Suggested Readings:

- *Sphere Handbook for humanitarian response standards. Link: https://spherestandards.org/handbook/*
- *Health emergency and disaster risk management framework (Health EDRM), WHO. Link: https://www.who.int/publications/i/item/9789241516181*

Websites of Key Agencies:

- *National Disaster Management Authority (NDMA): https://ndma.gov.in India's apex body for policy and planning in disaster management.*
- *India Disaster Resource Network (IDRN): https://idrn.gov.in Inventory of emergency response resources across India.*

NDMA Booklets:

- *AAPDA MITRA: A prime example of community-based disaster management: https://ndma.gov.in/sites/default/files/IEC/Booklets/AAPDA%20MITRA%20A5%20BOOK%20Final.pdf*
- *REACHING OUT TO SAVE LIVES: How social media transformed India's readines -s towards disasters: https://ndma.gov.in/sites/default/files/IEC/Booklets/Social%20Media%20A5%20 BOOK.pdf*

SEMESTER - III

Course Title: BASICS OF CYBER SECURITY

Course Code: BEE3211

L	T	P	Credits
3	0	0	**3**

Total hours: 45

Course Outcomes: On successful completion of this course, the students will be able to:

1. Understand the concept of Cyber security and issues and challenges associated with it.
2. Understand the cybercrimes, their nature, legal remedies and as to how report the crimes through available platforms and procedures.
3. Appreciate various privacy and security concerns on online Social media and understand the reporting procedure of inappropriate content, underlying legal aspects and best practices for the use of Social media platforms.
4. Understand the basic concepts related to E-Commerce and digital payments.
5. Understand the basic security aspects related to Computer and Mobiles.

Course Content

UNIT-I **15 Hours**

Introduction to Cyber security, Cybercrime and Cyber law

Defining Cyberspace, Architecture of cyberspace, Communication and web technology, Internet, Internet infrastructure for data transfer and governance, Internet society, Regulation of cyberspace, Concept of cyber security, Issues and challenges of cyber security. Classification of cybercrimes, Common cybercrimes-cybercrime targeting computers and mobiles, cybercrime against women and children, financial frauds, social engineering attacks, malware and ransomware attacks, zero day and zero click attacks, Reporting of cybercrimes, Remedial and mitigation measures, Legal perspective of cybercrime, IT Act 2000 and its amendments, Organisations dealing with Cybercrime and Cyber security in India.

UNIT-II **10 Hours**

Social Media Overview and Security

Introduction to Social networks. Types of Social media, Social media platforms, Social media monitoring, Hashtag, Viral content, Social media marketing, Social media privacy, Challenges, opportunities and pitfalls in online social network, Security issues related to social media, Flagging and reporting of inappropriate content, Laws regarding posting of inappropriate content, Best practices for the use of Social media.

UNIT-III **10 Hours**

E-Commerce and Digital Payments

Definition of E- Commerce, Main components of E-Commerce, Elements of E-Commerce security, E-Commerce threats, E-Commerce security best practices, Introduction to digital payments, Components of digital payment and stake holders, Modes of digital payments- Banking Cards, Unified Payment Interface (UPI), e-Wallets, Unstructured Supplementary Service Data (USSD), Aadhar enabled payments, Digital payments related common frauds and preventive measures. RBI guidelines on digital payments and customer protection in unauthorised banking transactions. Relevant provisions of Payament Settlement Act,2007,

UNIT-IV **10 Hours**

Digital Devices Security, Tools and Technologies for Cyber Security

End Point device and Mobile phone security, Password policy, Security patch management, Data backup, Downloading and management of third party software, Device security policy, Cyber Security best practices, Significance of host firewall and Ant-virus, Management of host firewall and Anti-virus, Wi-Fi security, Configuration of basic security policy and permissions.

Transaction Mode

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

Suggested Readings:

- Cyber Crime Impact in the New Millennium, by R. C Mishra , Auther Press. Edition 2010.
- Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Sumit Belapure and Nina Godbole, Wiley India Pvt. Ltd. (First Edition, 2011)
- Security in the Digital Age: Social Media Security Threats and Vulnerabilities by Henry A. Oliver, Create Space Independent Publishing Platform. (Pearson , 13th November, 2001)
- Cyber Laws: Intellectual Property & E-Commerce Security by Kumar K, Dominant Publishers.
- Network Security Bible, Eric Cole, Ronald Krutz, James W. Conley, 2nd Edition, Wiley India Pvt. Ltd.
- Fundamentals of Network Security by E. Maiwald, McGraw Hill.

SEMESTER-IV

Course Title: ELECTRICAL MACHINES – II
Course Code: BEE4250

L	T	P	Credits
3	0	0	3

Total hours: 45

Course Outcomes: On successful completion of this course, the students 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 **10 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 **15 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: BEE4251

L	T	P	Credits
3	0	0	3

Total hours: 45

Course Outcomes: On successful completion of this course, the students 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 **10 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 **15 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.*

SEMESTER- IV

Course Title: ELECTROMAGNETIC FIELDS
Course Code: BEE4252

L	T	P	Credits
4	0	0	4

Total hours: 60

Course Outcomes: On successful completion of this course, the students 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 **15 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 **15 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 **15 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:

- *Edward C. Jordan and Keith G. Balmain, (2003) Electromagnetic Waves and Radiation System, Prentice Hall of India. Pvt. Ltd.*
- *Kraus/ Fleisch, (1999) Electromagnetics, Tata McGraw Hill.*

Fraser, W. (2003) Telecommunications, CBS Publication and Distributor.

SEMESTER- IV

Course Title: DIGITAL ELECTRONICS
Course Code: BEE4253

L	T	P	Credits
3	0	0	3

Total hours: 45

Course Outcomes: On successful completion of this course, the students 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.

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)*

SEMESTER- IV

Course Title: INDIAN ARCHITECTURE AND TOWN PLANNING
Course Code: IKS0008

L	T	P	Credits
2	0	0	2

Total hours: 30

Course Outcomes: On successful completion of this course, the students will be able to:

1. Explore the historical development of Indian architecture from the Indus Valley Civilization to modern times, including key styles such as Buddhist, Hindu, Mughal, and colonial architecture.
2. Study ancient Indian town planning concepts from texts like Manasara and Shilpa Shastra, including Vastu Shastra, grid-based city layouts, water management, and sustainable urban planning techniques.
3. Investigate how geography, climate, materials, and cultural diversity influenced architectural styles in different regions of India, such as Dravidian, Nagara, and Indo-Saracenic architecture.
4. Development the relevance of ancient Indian architectural principles in contemporary urban planning, smart cities, and sustainable architecture in India

Course Content

UNIT-I **7 Hours**

Introduction, The importance of Sthapatya-veda**.** The ancient cities of the Indus Saraswati region. Town planning and drainage systems. Examples of the significance of architecture and materials in Ramayana and Mahabharata.

UNIT-II **8 Hours**

Public opulence and private austerity in Indian architecture. Why there are many more of Temples than Palaces.

UNIT-III **8 Hours**

Important texts of Architecture and Sculpture. The prevalence of high Indian architecture in almost all parts of India except the Ganga plains. Examples of high Indian architecture from ancient and medieval periods from different parts of India.

UNIT-IV **7 Hours**

The building of Jaipur in the 18th century. How temple art and architecture continues to flourish in modern India

Transactional Mode

Seminars, Group discussion, Team teaching, Focused group discussion, Assignments, Project-based learning, Simulations, reflection and Self-assessment

Suggested Readings

- *"Indian Architecture (Buddhist and Hindu Periods)" – Percy Brown*
- *"The History of Indian Architecture" – James Fergusson*
- *"Concepts of Space in Traditional Indian Architecture" – Yatin Pandya*
- *"Vastu Shastra: The Ancient Indian Science of Architecture" – B. B. Puri*
- *Brown, P. (1942). Indian Architecture (Buddhist and Hindu Periods). D. B. Taraporevala Sons & Co.*
- *Fergusson, J. (1910). History of Indian and Eastern Architecture. John Murray.*
- *Tadgell, C. (1990). The History of Architecture in India. Phaidon Press.*
- *Acharya, P. K. (1997). Architecture of Manasara: Translated from Sanskrit. Munshiram Manoharlal Publishers.*
- *Grover, S. (2003). Buddhist and Hindu Architecture in India. CBS Publishers.*
- *Rao, S. R. (1985). Lothal and the Indus Civilization. Asia Publishing House.*
- *Sharma, S. (2014). Influence of Vastu Shastra in Indian Town Planning. International Journal of Engineering Research and Applications*

SEMESTER- IV

Course Title: PRESENTATION SKILLS
Course Code: BEE4254

L	T	P	Credits
2	0	0	2

Total hours: 30

Course Outcomes: On successful completion of this course, the students will be able to:

1. Understand how to structure and design an effective engineering presentation.
2. Utilize visual aids and verbal/non-verbal communication techniques.
3. Build confidence in public speaking and handling presentation anxiety.
4. Deliver a professional and engaging technical presentation.

Course Content

UNIT-I **8 Hours**

Introduction to Presentation Skills and Effective Planning - Importance of Presentation Skills for Engineer - Need for effective communication in the engineering field, Types of presentations: Formal, Informal, Technical, Non-technical, Planning and Structuring a Presentation, Components of a presentation: Introduction, Body, Conclusion.

UNIT-II **8 Hours**

Audience analysis: Understanding your audience's needs, Creating an outline and organizing content. Visual Aids and Content Design - Designing Visual Aids, Slide design principles: Simplicity, readability, and effective use of visuals, Using charts, graphs, diagrams, and other visual elements in engineering topics, Best practices for using PowerPoint and other presentation tools, Content Design.

UNIT-III **7 Hours**

Delivery Techniques and Audience Engagement – How to simplify complex engineering topics, Organizing data and presenting it in a digestible format for the audience. Verbal Communication, Effective use of voice: Tone, pitch, pace, Articulation and clarity of speech, Non-Verbal Communication, Body language: Posture, gestures, facial expressions, Effective use of eye contact and movements.

UNIT-IV **7 Hours**

Overcoming Anxiety and Final Presentations – Overcoming Presentation Anxiety, Common causes of anxiety and techniques for managing it, Handling questions and

maintaining interaction with the audience, Engaging the Audience, Techniques to grab the audience's attention.

Transaction Mode

Lecture, Seminar, Final Presentation, Peer Group Discussion, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *Effective Presentation Skills – Robert Dilts, Meta Publication*
- *Business Communication Today - Bovee and Thill: Tata McGraw Hill,*
- *Presentation Zen" by Garr Reynolds*
- *"Talk Like TED" by Carmine Gallo*
- *"The Art of Public Speaking" by Dale Carnegie*

SEMESTER- IV

Course Title: DIGITAL ELECTRONICS LAB
Course Code: BEE4255

L	T	P	Credits
0	0	2	1

Total hours: 15

Course Outcomes: On successful completion of this course, the students 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), 7432(OR Gate), 7402 (NOR Gate), 7486 (XOR Gate) and 7404 (NOT Gate), 7486 (XOR Gate).
2. Design and fabrication and realization of all gates using NAND/NOR gates.
3. Verification of truth table of Mutiplexer (74150)
4. Verification of truth table of Demultiplexer (74154)
5. Design and verification of truth tables of half-adder circuits using gates 7483 and 7486(controlled inverter).
6. Design and verification of truth tables of full-adder circuit using gates 7483 and 7486(controlled inverter).
7. Design and verification of truth tables of subtractor circuits using gates 7483 and 7486(controlled inverter).
8. To study the operation of Arithmetic Logic Unit IC 74181.
9. Design and test S-R flip-flop using NOR/NAND gates.
10. Verify the truth table of a JK flip flop using IC 7476,
11. Verify the truth table of a D flip flop using IC 7474 and study its operation in the toggle and asynchronous mode.

SEMESTER- IV

Course Title: ELECTRICAL MACHINES-II LABORATORY
Course Code: BEE4256

L	T	P	Credits
0	0	2	1

Total hours: 15

Course Outcomes: On successful completion of this course, the students 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
6. To draw electrical connection diagram
7. To start the three-phase Induction motor using it.
8. To reverse the direction of three-phase Induction motor
9. To start a three-phase slip –ring induction motor by inserting different levels of resistance in the rotor circuit and plot torque–speed characteristics.
10. 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.

11. To perform no load and short circuit. Test on three-phase alternator and draw open and short circuit characteristics.
12. To find voltage regulation of an alternator by zero power factor (ZPF.) method.
13. 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.
14. Parallel operation of three phase alternators using
    (i) Dark lamp method (ii) Two-Bright and one dark lamp method
15. To study synchroscope physically and parallel operation of three-phase alternators using synchroscope.
16. Starting of synchronous motors using:
    (i) Auxiliary motor (ii) Using Damper windings

SEMESTER- IV

Course Title: POWER ELECTRONICS LABORATORY
Course Code: BEE4257

L	T	P	Credits
0	0	2	1

Total hours: 15

Course Outcomes: On successful completion of this course, the students 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.

Semester - IV

Course Title: SUBSTATION EQUIPMENT & DESIGN

Course Code: BEE4258

L	T	P	Credits
4	0	0	4

Total hours: 60

Course Outcomes: On successful completion of this course, the students will be able to:

1. Describe the main consideration in the process of substation design.
2. Outline the working principles of substation switching equipment.
3. Explain the different types of bus configurations.
4. Design criteria of substation grounding and protection.

Course Content

UNIT-I **15 Hours**

INTRODUCTION

Background, Need Determination, Budgeting, Financing, Traditional and innovative Substation Design, Site Selection and Acquisition, Design, Construction and Commissioning Process

UNIT-II **15 Hours**

HIGH VOLTAGE SWITCHING EQUIPMENT

Ambient conditions, Disconnect switches, Load Break switches, high speed grounding switches, power fuses, circuit switches, circuit breakers.

UNIT-III **15 Hours**

TYPES OF SUBSTATIONS & BUS/SWITCHING CONFIGURATIONS

Transmission substation, distribution substation, collector substation, switching substations, gas insulated substations, air insulated substations, bus configurations: single bus, double bus, double break, main and transfer bus, double bus, single breaker, ring bus, break-and-a-half, Comparison of configurations.

UNIT-IV **15 Hours**

DESIGN OF SUBSTATION GROUNDING AND PROTECTION

Reasons for substation grounding system, accidental ground circuit, Design criteria-Actual Touch and step voltage, soil resistivity, grid resistance, grid current, use of

the design equations, selection of conductors, grounding fence, other design considerations. Lightning stroke protection-lightning parameters, empirical design methods. Substation fire protection, Fire hazards, fire protection measures, fire protection selection criterion.

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. S. Dahiya, VinayAttri,"Sub-Station Engineering Design & Computer Applications" S K Kataria and sons Publications, 1 st Edition, 2013.*
- *P. S. Satnam, P. V. Gupta, "Substation Design and Equipment" Dhanapat Rai Publications, 1 st Edition, 2013.*
- *Turan Gonen, "Electric Power Distribution Engineering" CRC press, third edition, 2014.*

SEMESTER- IV

Course Title: ELECTRICAL MATERIALS

Course Code: BEE4259

L	T	P	Credits
4	0	0	4

Total hours: 60

Course Outcomes: On successful completion of this course, the students 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 **15 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 **15 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 **15 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*

SEMESTER- V

Course Title: POWER SYSTEM -I (APPARATUS AND MODELLING)
Course Code: BEE5300

L	T	P	Credits
3	0	0	3

Total hours: 45

Course Outcomes: On successful completion of this course, the students 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 **10 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 **10 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 **10 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.*

SEMESTER- V

Course Title: CONTROL SYSTEMS
Course Code: BEE5301

L	T	P	Credits
3	0	0	3

Total hours: 45

Course Outcomes: On successful completion of this course, the students 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 **10 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 **10 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 **10 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.*

SEMESTER- V

Course Title: WIND AND SOLAR ENERGY
Course Code: BEE5302

L	T	P	Credits
4	0	0	4

Total hours: 60

Course Outcomes: On successful completion of this course, the students 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 **15 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 **15 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 **15 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.*

SEMESTER- V

Course Title: MICROCONTROLLER AND PLC
Course Code: BEE5303

L	T	P	Credits
3	0	0	3

Total hours: 45

Course Outcomes: On successful completion of this course, the students will be able to**:**

1. To study the architecture of microprocessor and microcontroller.
2. Know about the architecture, operation and instruction set of 8051 Microcontroller.
3. Be able to do programming of 8051 microcontrollers.
4. Be able to use PLCs.

Course Content

UNIT-I **10 Hours**

Fundamentals of Microprocessors:

Fundamentals of microprocessor architecture, 8-bit Microprocessor and Microcontroller architecture, Difference between microprocessor and microcontroller, Definition of embedded system and its characteristics, Role of microcontrollers in embedded Systems.

UNIT-II **10 Hours**

PIN diagram of 8051, Internal block diagram, CPU, ALU, address, data and control bus, working registers, SFRs, Clock and RESET circuits, Stack and Stack Pointer, Program Counter, I/O ports, Memory Structures, Data and Program Memory, Timing diagrams and Execution Cycles.

UNIT-III **15 Hours**

Instruction Set and Programming of 8051

Addressing modes: Introduction, Instruction syntax, Data types, Subroutines Immediate addressing, Register addressing, Direct addressing, Indirect addressing, Relative addressing, Indexed addressing, Bit inherent addressing, Bit direct addressing.

8051 Instruction set: Instruction timings, Data transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Subroutine instructions, Bit manipulation instructions. Assembly language programs, Assemblers and compilers, Programming and debugging tools.

UNIT-IV **10 Hours**

Introduction to Programmable Logic Controllers: Introduction, Operation of PLC, Difference between PLC and Hardwired system, Difference between PLC and Computer, Relay logic and ladder logic, Ladder commands and examples of PLC ladder diagram realization, PLC timers, PLC counters, Applications of PLC, PLC interfacing with HMI/SCADA system

Transaction Mode

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

Suggested Readings:

- *M. A. Mazidi, The 8051 Microcontroller and Embedded System, Pearson Education (2008).*
- *Kenneth J Ayola, The 8051 Micro Controller- Architecture, Programming and Application, Penram International Publication*
- *R. S. Gaonkar, ", Microprocessor Architecture: Programming and Applications with the 8085", Penram International Publishing (India) Pvt. Ltd., 2004.*
- *D. V. Hall, "Microprocessors & Interfacing", McGraw Hill Higher Education, 1991.*
- *B. Ram, Fundamentals of Microprocessors and Microcomputers, Dhanpat Rai andSons. Otter, Job Dan, Programmable Logic Controller, P.H. International, Inc, USA*
- *Dunning Gary, Introduction to PLCs, Tata McGraw Hill*
- *John B Peatman, Design with Micro Controller, Tata McGrawHill*
- *Udayashankara V. and Mallikarjunaswamy M.S., 8051 Microcontroller Hardware, Software and Applications, TataMcGraw Hill Education Pvt. Ltd., (2010)*
- *A K. Ray & K M Bhurchandi. (2000) Advanced Microprocessor and peripherals. McGraw Hill.*

SEMESTER- V

Course Title: POWER SYSTEM-I (APPARATUS AND MODELING) LAB
Course Code: BEE5304

L	T	P	Credits
0	0	2	1

Total hours: 15

Course Outcomes: On successful completion of this course, the students will be able to**:**

1. Perform hardware based experiments on various power system components including renewable energy sources.
2. Simulate, analyze and evaluate different transmission lines parameters.
3. Simulate, analyze a network under balanced and unbalanced fault conditions and interpret the results.
4. Simulate and analyze the reactive power requirement of lines, voltage profile along the line and VAR compensation.

Course Content **15 Hours**

Suggested List of Experiments:

1. Introduction to different types of cables, insulators and substation layout and arrangement in power system.
2. To observe the voltage distribution across an insulator string and evaluate string efficiency
3. Performance and Analysis of Short Transmission line
4. Performance and Analysis of Medium Transmission line
5. To validate and compensate Ferranti effect on an unloaded transmission line
6. Simulation of performance analysis of transmission line for shunt compensation
7. Simulation of performance analysis of transmission line for series compensation
8. Simulation and Analysis of Symmetrical Faults
9. Simulation and Analysis of Symmetrical Components
10. Simulation and Analysis of Unsymmetrical Faults
11. To test Polarity, Ratio and magnetization characteristics of CT/PT
12. Floating Neutral of a unbalanced three-phase distributing systems
13. Performance of Solar PV modules in series and parallel configurations
14. Ground Constant of Circuit Breaker 15. Visit to substation, power station, solar, wind power installations or related firm /industry

SEMESTER- V

Course Title: CONTROL SYSTEM LABORATORY
Course Code: BEE5305

L	T	P	Credits
0	0	2	1

Total hours: 15

Course Outcomes: On successful completion of this course, the students will be able to**:**

1. To understand the basics concepts of MATLAB software.
2. To introduce variety of control system strategies.
3. To comment about the stability of designed systems.
4. Understand to 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 7 Experiments.

1. Familiarization with MATLAB control system toolbox, MATLAB Simulink toolbox and PSPICE.
2. Determination of step response for first order and second order system with unity feedback. Calculation and verification of time constant, peak overshoot, setting time etc. from the response.
3. Simulation of step response and impulseresponsefortype-0, type-1and type-2 systems with unity feedback using MATLAB.
4. Determination of Root Locus, Bode-Plot, Nyquist Plot using MATLAB-Control system toolbox for 2nd order system.
5. Determination of different control system performance indices from the plots.
6. Experimental determination of approximate transfer function from Bode plot.
7. Evaluation of steady state error, settling time, percentage peak overshoot, gain margin, phase margin, with addition of lead compensator and by compensator in forward path transfer function for unity feedback control system.
8. Design of a second order linear time invariant control system and study of system response with unit step input.
9. To design a Lag compensator and test its performance characteristics.

SEMESTER- V

Course Title: MICROCONTROLLER AND PLC LAB

Course Code: BEE5306

L	T	P	Credits
0	0	2	1

Total hours: 15

Course Outcomes: On successful completion of this course, the students will be able to**:**

1. Familiar with microprocessor and microcontroller kits.
2. Become familiar with the microcontrollers and PLCs.
3. Prepare assembly language programs.
4. Become familiar with the use of PLCs in industry.

Course Content **15 Hours**

Suggested List of Experiments:

1. To study 8085 and 8086A based microprocessor system
2. To study 8051 Microcontroller kit/simulator.
3. Write a program to perform Addition of given numbers.
4. Write a program to perform Subtraction of given numbers.
5. Write a program to perform multiplication of given numbers
6. Write a program to perform division of given numbers
7. To develop and run a program for finding out the largest number from a given set of numbers.
8. To develop and run a program for finding out the smallest number from a given set of numbers.
9. To develop and run a program for arranging in ascending/ descending order of a set of numbers
10. Write a program to split a byte in two nibbles and show the two nibbles on display.
11. Write a program to find a factorial of a given number.
12. Write a program to Generate Fibonacci Series
13. Write a program to Sum up a finite series
14. Write a program of flashing LED connected to port 1 of the micro-controller
15. Write a program to develop rolling display
16. Implementation of different gates using PLC.
17. Implement basic logic operations, motor start and stop operation using
    (i) Timers (ii) Counters
18. Implement a PLC based traffic light control.

Semester - V

Course Title: ELECTRICAL MACHINE DESIGN
Course Code: BEE5307

L	T	P	Credits
4	0	0	4

Total hours: 60

Course Outcomes: On successful completion of this course, the students will be able to:

1. Identify and list, limitations, modern trends in design, manufacturing of electrical machines and properties of materials used in the electrical machines.
2. Derive the output equation of DC machine, discuss selection of specific loadings and magnetic circuits of DC machines, design the field windings of DC machine, and design stator and rotor circuits of a DC machine.
3. Derive the output equations of transformer, discuss selection of specific loadings, estimate the number of cooling tubes, no load current and leakage reactance of core type transformer.
4. Develop the output equation of induction motor, discuss selection of specific loadings and magnetic circuits of induction motor, design stator and rotor circuits of an induction motor.

Course Content

UNIT-I **15 Hours**

Fundamental Aspects of Electrical Machine Design:
Design of Machines, Design Factors, Limitations in design, Modern Trends in design, manufacturing Techniques.

Electrical Engineering Materials:
Desirabilities of Conducting Materials, Comparison of Aluminium and Copper wires. Ferromagnetic Materials: Soft Magnetic materials – Solid Core Materials, Electrical Sheet and Strip, Cold Rolled Grain Oriented Steel. Insulating Materials: Desirable Properties, Temperature Rise and Insulating Materials, Classification of Insulating materials based on Thermal Consideration.

UNIT-II **15 Hours**

Design of DC Machines:
Output Equation, Choice of Specific Loadings and Choice of Number of Poles, Main Dimensions of armature, Design of Armature Slot Dimensions, Commutator and Brushes. Estimation of Ampere Turns for the Magnetic Circuit. Dimensions of Yoke,

Main Pole and Air Gap. Design of Shunt and Series Field Windings.

UNIT-III **15 Hours**

Design of Transformers:

Output Equations of Single Phase and Three Phase Transformers, Choice of Specific Loadings, Expression for Volts/Turn, Determination of Main Dimensions of the Core, Estimation of Number of Turns and Conductor Cross Sectional area of Primary and Secondary Windings, No Load Current. Expression for the Leakage Reactance of core type transformer with concentric coils, and calculation of Voltage Regulation. Design of Tank and Cooling (Round and Rectangular) Tubes.

UNIT-IV **15 Hours**

Design of Three Phase Induction Motors: Output Equation, Choice of Specific Loadings, Main Dimensions of Stator. Design of stator slots and Winding, Choice of Length Air Gap, Estimation of Number of Slots for Squirrel Cage Rotor. Design of Rotor Bars and End Ring. Design of Slip Ring rotor. Estimation of No Load Current and Leakage Reactance.

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 course in Electrical Machine design A.K.Sawhney DhanpatRai 6th Edition, 2013*
- *Performance and Design of Alternating Current Machines M.G. Say CBS Publisher 3rd Edition, 2002*
- *Design Data Handbook A. Sanmugasundaram Et al New Age International 1st Edition, 2011*

Semester - V

Course Title: POWER PLANT ENGINEERING
Course Code: BEE5308

L	T	P	Credits
4	0	0	4

Total hours: 60

Course Outcomes: On successful completion of this course, the students will be able to:

1. Find out 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. Explain major types of hydro power and wind power turbines.
4. Clarify the basic principal 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 **15 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 **15 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 **15 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)

Semester - V

Course Title: SIGNALS AND SYSTEMS
Course Code: BEE5309

L	T	P	Credits
4	0	0	4

Total hours: 60

Course Outcomes: On successful completion of this course, the students will be able to:

1. Understand the concepts of continuous time and discrete time systems.
2. Analyze systems in complex frequency domain.
3. Understand sampling theorem and its implications.
4. Understand mathematical tools to be able to apply in state variable modeling

Course Content

UNIT-I **15 Hours**

Introduction to Signals and Systems

Signals and systems as seen in everyday life, and in various branches of engineering and science. Signal properties: periodicity, absolute integrability, determinism and stochastic character. Some special signals of importance: the unit step, the unit impulse, the sinusoid, the complex exponential, some special time-limited signals; continuous and discrete time signals, continuous and discrete amplitude signals. System properties: linearity: additivity and homogeneity, shift- invariance, causality, stability, realizability examples.

UNIT-II **15 Hours**

Behavior of continuous and discrete-time LTI systems

Impulse response and step response, convolution, input-output behavior with aperiodic convergent inputs, cascade interconnections. Characterization of causality and stability of LTI systems. System representation through differential equations and difference equations. State- space Representation of systems. State-Space Analysis, Multi-input, multi-output representation. State Transition Matrix and its Role. Periodic inputs to an LTI system, the notion of a frequency response and its relation to the impulse response.

UNIT-III **15 Hours**

Fourier, Laplace and *z*- Transforms

Fourier series representation of periodic signals, Waveform Symmetries, Calculation of Fourier Coefficients. Fourier Transform, convolution /multiplication and their effect in the frequency domain, magnitude and phase response, Fourier domain duality. The Discrete-Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT). Parseval's Theorem. Review of the Laplace Transform for continuous time signals and systems, system functions, poles and zeros of system functions and signals, Laplace domain analysis, solution to differential equations and system behavior. The z-Transform for discrete time signals and systems, system functions, poles and zeros of systems and sequences, z-domain analysis.

UNIT-IV **15 Hours**

Sampling and Reconstruction

The Sampling Theorem and its implications. Spectra of sampled signals. Reconstruction: ideal interpolator, zero-order hold, first-order hold. Aliasing and its effects. Relation between continuous and discrete time systems. Introduction to the applications of signal and system theory: modulation for communication, filtering, feedback control 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:

- *V. Oppenheim, A.S. Willsky & S.H. Nawab, "Signals and systems", Prentice Hall, 1997.*
- *G. Proakis and D. G. Manolakis, "Digital Signal Processing: Principles, Algorithms, and Applications", Pearson, 2006.*
- *P. Hsu, "Signals and systems", Schaum's series, McGraw Hill Education, 2010.*
- *S. Haykin and B. V. Veen, "Signals and Systems", John Wiley and Sons, 2007.*
- *V. Oppenheim and R. W. Schafer, "Discrete-Time Signal Processing", Prentice Hall,2009.*

Semester - V

Course Title: COMPUTER ARCHITECTURE
Course Code: BEE5310

L	T	P	Credits
4	0	0	4

Total hours: 60

Course Outcomes: On successful completion of this course, the students will be able to:

1. To learn the basic structure and operations of a computer
2. To learn the arithmetic and logic unit and implementation of fixed-point and floating point arithmetic unit.
3. To learn the basics of pipelined execution.
4. To understand parallelism and multi-core processors.
5. To understand the memory hierarchies, cache memories and virtual memories, also the different ways of communication with I/O devices.

Course Content

UNIT-I **10 Hours**

BASIC STRUCTURE OF A COMPUTER SYSTEM

Functional Units – Basic Operational Concepts – Performance – Instructions: Language of the Computer – Operations, Operands – Instruction representation – Logical operations – decision making – MIPS Addressing.

UNIT-II **20 Hours**

ARITHMETIC FOR COMPUTERS

Addition and Subtraction – Multiplication – Division – Floating Point Representation – Floating Point Operations – Subword Parallelism

UNIT-III **15 Hours**

PROCESSOR AND CONTROL UNIT

A Basic MIPS implementation – Building a Datapath – Control Implementation Scheme – Pipelining – Pipelined datapath and control – Handling Data Hazards & Control Hazards – Exceptions.

UNIT-IV **15 Hours**

PARALLELISIM

Parallel processing challenges – Flynn‘s classification – SISD, MIMD, SIMD, SPMD,

and Vector Architectures – Hardware multithreading – Multi-core processors and other Shared Memory Multiprocessors

MEMORY & I/O SYSTEMS

Memory Hierarchy – memory technologies – cache memory – measuring and improving cache performance – virtual memory, TLB's – Accessing I/O Devices – Interrupts – Direct Memory Access – Bus structure – Bus operation.

Transaction Mode

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

Suggested Readings:

- *William Stallings, Computer Organization and Architecture – Designing for Performance, Eighth Edition, Pearson Education, 2010.*
- *John P. Hayes, Computer Architecture and Organization, Third Edition, Tata McGraw Hill, 2012.*
- *M. Morris Mano , Computer. System. Architecture, Third edition. Englewood Cliffs, NJ : Prentice Hall ,2019*
- *John L. Hennessey and David A. Patterson, Computer Architecture – A Quantitative Approach‖, Morgan Kaufmann / Elsevier Publishers, Fifth Edition, 2012*

SEMESTER- VI

Course Title: POWER SYSTEMS - II (PROTECTION)
Course Code: BEE6351

L	T	P	Credits
3	0	0	3

Total hours: 45

Course 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 **10 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 **10 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 **15 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.*

SEMESTER- VI

Course Title: GENERATION & ECONOMICS OF ELECTRICAL POWER
Course Code: BEE6352

L	T	P	Credits
4	0	0	4

Total hours: 60

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

1. Describe the working of hydroelectric, steam, nuclear power plants and state functions of major equipment of the power plants.
2. Classify various substations and explain the functions of major equipments in substations.
3. Explain the types of grounding and its importance.
4. Infer the economic aspects of power system operation and its effects.
5. Explain the importance of power factor improvement.

Course Content

UNIT-I **15 Hours**

Hydroelectric Power Plants:

Hydrology, run off and stream flow, hydrograph, flow duration curve, Mass curve, reservoir capacity, dam storage. Hydrological cycle, merits and demerits of hydroelectric power plants, Selection of site. General arrangement of hydel plant, elements of the plant, Classification of the plants based on water flow regulation, water head and type of load the plant has to supply. Water turbines – Pelton wheel, Francis, Kaplan and propeller turbines. Characteristic of water turbines Governing of turbines, selection of water turbines. Underground, small hydro and pumped storage plants. Choice of size and number of units, plant layout and auxiliaries.

UNIT-II **15 Hours**

Steam Power Plants:

Introduction, Efficiency of steam plants, Merits and demerits of plants, selection of site. Working of steam plant, Power plant equipment and layout, Steam turbines, Fuels and fuel handling, Fuel combustion and combustion equipment, Coal burners, Fluidized bed combustion, Combustion control, Ash handling, Dust

collection, Draught systems, Feed water, Steam power plant controls, plant auxiliaries.

Diesel Power Plant:
Introduction, Merits and demerits, selection site, elements of diesel power plant, applications.

Gas Turbine Power Plant:
Introduction Merits and demerits, selection site, Fuels for gas turbines, Elements of simple gas turbine power plant, Methods of improving thermal efficiency of a simple steam power plant, Closed cycle gas turbine power plants. Comparison of gas power plant with steam

UNIT-III **15 Hours**

Nuclear Power Plants:
Introduction, Economics of nuclear plants, Merits and demerits, selection of site, Nuclear reaction, Nuclear fission process, Nuclear chain reaction, Nuclear energy, Nuclear fuels, Nuclear plant and layout, Nuclear reactor and its control, Classification of reactors, power reactors in use, Effects of nuclear plants, Disposal of nuclear waste and effluent, shielding.

UNIT-IV **15 Hours**

Substations:
Introduction to Substation equipment; Transformers, High Voltage Fuses, High Voltage Circuit Breakers and Protective Relaying, High Voltage Disconnect Switches, Lightning Arresters, High Voltage Insulators and Conductors, Voltage Regulators, Storage Batteries, Reactors, Capacitors, Measuring Instruments, and power line carrier communication equipment. Classification of substations – indoor and outdoor, Selection of site for substation, Bus-bar arrangement schemes and single line diagrams of substations.

Transaction Mode

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

Suggested Readings:

- *Power Plant Engineering P.K. Nag McGrawHill 4th Edition, 2014*
- *Generation of Electrical Energy B.R.Gupta S. Chand 2015*
- *Electrical power Generation, Transmission and Distribution S.N. Singh PHI 2nd Edition, 2009*

Semester - VI

Course Title: UTILIZATION OF ELECTRICAL ENERGY

Course Code: BEE6353

L	T	P	Credits
4	0	0	4

Total hours: 60

Course Outcomes: On successful completion of this course, the students will be able to**:**

1. Understand 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.

Course Content

UNIT-I **15 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-II **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.

UNIT-III **15 Hours**

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 **15 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:

- *S. Borlase,* **"***Smart Grids, Infrastructure, Technology and Solutions***"***, CRC Press, 1st Edition, 2013***.**
- *G. Masters,* **"***Renewable and Efficient Electric Power System***"***, Wiley–IEEE Press, 2nd Edition, 2013***.**

Reference Books:

- *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.*
- *VedamSubrahmanyam(2008) Electrical Drives: Concept and applications. THM*

SEMESTER- VI

Course Title: FUNDAMENTALS OF ARTIFICIAL INTELLIGENCE
Course Code: BEE6354

L	T	P	Credits
4	0	0	4

Total hours: 60

Course Outcomes: On successful completion of this course, the students will be able to:

1. Understand the informed and uninformed problem types and apply search strategies to solve them.
2. Apply difficult real-life problems in a state space representation so as to solve those using AI techniques like searching and game playing.
3. Apply machine learning techniques in the design of computer systems
4. To differentiate between various categories of ML algorithms

Course Content

UNIT-I **15 Hours**

Introduction to AI, Problem Solving as State Space Search, Uninformed Search

Problem Solving by Search I: Heuristic Search, Informed Search, Constraint Satisfaction Problems.

Problem Solving by Search II: Searching and/or graphics, game playing, minimax Alpha-beta.

UNIT-II **15 Hours**

Knowledge Representation and Reasoning I: Introduction to knowledge representation, propositional logic, First order logic

Knowledge Representation and Reasoning II: First order logic II, Inference in First order logic I.

Knowledge Representation and Reasoning III: Inference in First order logic II, answer extraction, procedural control of reasoning.

UNIT-III **15 Hours**

Introduction to planning, plan space planning, planning graph and graph plan, Planning and Decision Making, Practical Planning and Acting, Sequential Decision Problems, Making Complex Decisions.

UNIT-IV **15 Hours**

Machine learning concepts, Introduction to Generative AI, Reinforcement Learning from Human Feedback (RLHF), Applications of Generative AI in Various Fields: Art and Creativity, Image and Video Generation, Text Generation, Healthcare.

Transaction Mode

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

Suggested Readings:

- *Russell, S. and Norvig, P, Artificial Intelligence: A Modern Approach, Third Edition, Prentice Hall, 2010.*
- *MACHINE LEARNING An Algorithmic Perspective 2nd Edition, Stephen Marsland, 2015, by Taylor & Francis Group, LLC.*
- *Artificial Intelligence, Elaine Rich, Kevin Knight, Shivasankar B. Nair, The McGraw Hill publications, Third Edition, 2009. 2. George F. Luger,*
- *Artificial Intelligence: Structures and Strategies for Complex Problem Solving, Pearson Education, 6th ed., 2009.*
- *Introduction to Machine Learning, Second Edition, Ethem Alpaydın, the MIT Press, Cambridge, Massachusetts, London, England.*
- *Machine Learning, Tom M. Mitchell, McGraw-Hill Science, ISBN: 0070428077*
- *Understanding Machine Learning: From Theory to Algorithms, c 2014 by Shai Shalev- Shwartz and Shai Ben-David, Published 2014 by Cambridge University Press.*

Semester - VI

Course Title: POWER SYSTEMS-II (PROTECTION) LABORATORY
Course Code: BEE6355

L	T	P	Credits
0	0	2	1

Total hours: 15

Course Outcomes: On successful completion of this course, the students 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.

Semester- VI

Course Title: ELECTRICAL DRIVES
Course Code: BEE6356

L	T	P	Credits
4	0	0	4

Total hours: 60

Course Outcomes: On successful completion of this course, the students 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 **15 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 **20 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.*

Semester - VI

Course Title: DIGITAL SIGNAL PROCESSING
Course Code: BEE6357

L	T	P	Credits
4	0	0	4

Total hours: 60

Course Outcomes: On successful completion of this course, the students will be able to:

1. Interpret, represent and process discrete/digital signals and systems.
2. Thorough understanding of frequency domain analysis of discrete time signals.
3. Ability to design & analyze DSP systems like FIR and IIR Filter etc
4. Practical implementation issues such as computational complexity, hardware resource limitations as well as cost of DSP systems or DSP Processors.

Course Content

UNIT-I **15 Hours**

Introduction

Basic elements of DSP system, Advantages and disadvantage of DSP over analog processing, Application of Digital signal processing.

Discrete Time Signal and Systems

Elementary discrete time signals, Manipulation of discrete time signals, Classification of discrete time LTI system using convolution sum method, properties of LTI system, Analysis of LTI system using Difference equation.

UNIT-II **15 Hours**

Z-Transform

Direct Z-Transform and importance of ROC, properties of Z-Transform, Inverse Z-transform methods, system function of LTI systems in Z-domain, Relationship between Z-transform and Fourier transform, one sided Z –Transform.

Discrete Fourier Transform

Frequency domain sampling and reconstruction of discrete time signal, DFT as linear transformation, properties of DFT, use of DFT in linear filtering, fast fourier transform (FFT), decimation in time, decimation in frequency algorithm, Goertzel algorithm.

UNIT-III **15 Hours**

Implementation of Discrete Time System

Structures for realization of discrete time system, Direct form, cascade form, parallel form and lattice form structures for FIR and IIR systems, Representation of numbers, errors resulting for rounding and truncation.

Application in DSP

Digital Audio and instrumentation Digital Audio, Digital Control, Digital frequency oscillator. Telecommunication- Touch tone generator, DTMF detection using Goertzel algorithm.

UNIT-IV **15 Hours**

Design of Digital Filters

Fundamentals of filter design, Design of FIR filter using Window method, Design of IIR filter by Impulse invariance, bilinear transformation and matched Z transform technique, Analog and digital domain frequency transformation.

Transaction Mode

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

Suggested Readings:

- *John G. Proakis and Dimitris G. Manolakis. (2001). Digital Signal Processing Principles, Algorithm and Application. Prentice Hall India Pvt. Ltd.*
- *Emmanuel C. Ifeachor and Barrie W. Jervis. (1999). Digital signal processing. Pearson Education.*

Semester: VI

Course Title: INTRODUCTION TO INDUSTRIAL MANAGEMENT **Course Code: BEE6358**	**L**	**T**	**P**	**Credits**
	4	**0**	**0**	**4**

Total Hours: 60

Course Outcomes: On successful completion of this course, the students will be able to:

1. To introduce the concepts of Industrial Management
2. To provide knowledge about various Costs and Inventory Management
3. To highlight the latest trend in Industrial Management
4. Explain about method study and Use various work measurement methods and draw various statistical quality control charts and Interpret them.

Course Content

UNIT-I **15 Hours**

Concepts of Industrial Management: Introduction: Concept and scope of Industrial Management. Productivity: Definition, measurement, productivity index, types of production system, Industrial Ownership. Functions of Management, Evolution of Management Thought: Taylors Scientific Management, Fayol‟s, Principles of Management, Douglas Mc-Gregors. Theory X and Theory Y, Mayo‟s Hawthorne, Experiments, Hertzberg‟s Two Factor Theory of Motivation, Maslow‟s Hierarchy of Human Needs

Introduction to Human resources management: Nature of HRM, functions and importance of HRM.

UNIT-II **15 Hours**

Designing Organizational Structures: Concept, Importance and characteristics of organization, Types of organization - Project, matrix and informal organization. Span of control, Delegation of authority.

Work Study: Introduction, Definition, Objectives, steps in Work Study, Method Study: Definition, Objectives, Steps of Method Study,

Work Measurement: Purpose, Types of study: Stop Watch Methods-Steps, allowances, Standard Time Calculations, Work Sampling, Production Planning and Control

UNIT-III **15 Hours**

Cost Analysis: Cost classification: Prime cost, Overhead cost, Selling and Distribution Cost, Fixed cost, Variable cost, Implicit cost, Explicit cost, Replacement cost, Opportunity cost, Marginal cost

Inventory Control: Inventory, Cost, Models of inventory control: EOQ, ABC, VED

UNIT-IV **15 Hours**

Quality Control: Statistical Quality Control, Control charts for variables and attributes, Acceptance Sampling- Single sampling- Double sampling plans,

Recent Trends in Industrial Management–Material Requirement Planning (MRP), Enterprise Resource Planning (ERP), Just in Time (JIT), Six Sigma-Concept and benefits.

Transaction Mode

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

Suggested Readings:

- *O.P Khanna, Industrial Engineering.*
- *M.S. Saiyada, „Minappa and Personnel Managements". Tata Mc Graw Hill*
- *C.B. Mamoria, „Personnel Management", Himalaya Publications*
- *Ravi Shankar, „Industrial Engineering", Galgotia*

Semester: VI

Course Title: WASTE TO ENERGY

Course Code: BEE6359

L	T	P	Credits
4	0	0	4

Total Hours: 60

Course Outcomes: On successful completion of this course, the students will be able to:

1. Analyze the various aspects of Waste to Energy Systems
2. Understanding about the operations of Waste to Energy plants.
3. Understand the advantages of waste-to-energy conversion and their difficulties to be implemented
4. Analyze methods for management of e-waste.

Course Content

UNIT-II **10 Hours**

INTRODUCTION:

The Principles of Waste Management and Waste Utilization. Waste Management Hierarchy and 3R Principle of Reduce, Reuse and Recycle. Waste as a Resource and Alternate Energy source

UNIT-II **15 Hours**

WASTE SOURCES

Waste production in different sectors such as domestic, industrial, agriculture, postconsumer, waste etc. Classification of waste – agro based, forest residues, domestic waste, industrial waste (hazardous and non-hazardous). Characterization of waste for energy utilization.

UNIT-III **15 Hours**

TECHNOLOGIES FOR WASTE TO ENERGY

Biochemical Conversion: Energy production from organic waste through anaerobic digestion and fermentation. Thermo-chemical Conversion: Combustion, Incineration and heat recovery, Pyrolysis, Gasification; Plasma Arc Technology and other newer technologies.

UNIT-IV **20 Hours**

WASTE TO ENERGY OPTIONS:

Landfill gas, collection and recovery. Refuse Derived Fuel (RDF) – fluff, briquettes, pellets. Alternate Fuel Resource (AFR) – production and use in Cement plants, Thermal power plants and Industrial boilers. Conversion of wastes to fuel resources for other useful energy applications. Energy from Plastic Wastes – Non-recyclable plastic wastes for energy recovery. Energy Recovery from wastes and optimization of its use, benchmarking and standardization.

Transaction Mode

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

Recommended Text Books:

- *Nicholas P. Cheremisinoff. Handbook of Solid Waste Management and Waste Minimization Technologies. An Imprint of Elsevier, New Delhi (2003).*
- *M. Dutta , B. P. Parida, B. K. Guha and T. R. Surkrishnan. Industrial Solid Waste Management and Landfilling practice. Narosa Publishing House, New Delhi (1999).*
- *Waste-to-Energy in Austria – White Book – Figures, Data Facts, 2nd edition , May 2010*
- *Hagerty, D.Joseph; Pavoni, Joseph L; Heer, John E., "Solid Waste Management", New York, Van Nostrand*

Semester - VII

Course Title: HVDC & EHVAC TRANSMISSION SYSTEMS
Course Code: BEE7400

L	T	P	Credits
4	0	0	4

Total hours: 60

Course Outcomes: On successful completion of this course, the students will be able to:

1. To understand the concept of extra high voltage AC and high voltage DC transmission.
2. To study the behavior of line parameters for extra high voltages.
3. To study the effect of corona, electrostatic field, voltage control at extra high voltage.
4. To understand the basic concepts of HVDC, HVDC converters.
5. To study the effect of harmonics and methods of suppression of harmonics by using filters.

Course Content

UNIT-I **15 Hours**

INTRODUCTION:

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.Line and Ground Reactive Parameters:Line inductance and capacitance – sequence inductances and capacitances – modes of propagation – ground return - Examples.

UNIT-II **15 Hours**

CORONA EFFECTS:

Power loss and audible noise (AN) – corona loss formulae – charge voltage diagram – generation, characteristics - limits and measurements of AN – relation between single phase and three phase AN levels – Examples. Radio interference (RI) Electrostatic Field: Calculation of electrostatic field of EHV AC lines – effect on humans, animals and plants –electromagnetic interference -Examples.

UNIT-III **15 Hours**

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-IV **15 Hours**

HARMONICS&FILTERS:

Harmonics: Generation of Harmonics Characteristics Harmonics, calculation of AC Harmonics, Non- Characteristic harmonics, adverse effects of harmonics – Calculation of voltage & Current harmonics – Effect of Pulse number on harmonics.Filters: Types of AC filters, Design of Single tuned filters –Design of High pass filters.

HVDC BASICS& CONVERTERS:

Necessity of HVDC Transmission. Economics & Terminal equipment of HVDC transmission systems: Types of HVDC Links -Apparatus required for HVDC Systems - Comparison of EHV AC &HVDC Transmission, Application of HVDC Transmission System.Choice of Converter configuration - analysis of Graetz - characteristics of six Pulse converters and twelve pulse converters.

Transaction Mode

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

Recommended Text Books:

1. *EHVAC Transmission Engineering by R. D. Begamudre, New Age International(p) Ltd.*
2. *K. R. Padiyar (2005), HVDC Power Transmission Systems: Technology and system Interactions, 1st edition, New Age International (P) Ltd, New Delhi.*
3. *EHV AC and HVDC Transmission and Distribution Engineering by S. Rao, Khanna Publishers, 3rdedition.*

Semester - VII

Course Title: ELECTRIC AND HYBRID VEHICLES
Course Code: BEE7401

L	T	P	Credits
4	0	0	4

Total hours: 60

Course Outcomes: On successful completion of this course, the students 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 **15 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 **15 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 **15 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.*

Semester - VII

Course Title: INTRODUCTION TO INDUSTRY 4.0
Course Code: BEE7402

L	T	P	Credits
4	0	0	4

Total hours: 60

Course Outcomes: On successful completion of this course, the students will be able to:

1. Cope up with the upcoming demand of the industry.
2. Illustrate the emerging areas of importance like Internet of Things (IoT), Cloud, Big Data, Robotics, Block Chain, Artificial Intelligence (AI), Machine Learning etc.
3. Understanding about the emerging demands of the industry.
4. Develop an insight about the better human-machine interface.

Course Content

UNIT-I **15 Hours**

Various Industry Revolutions:

Define Data, meaning of going digital, Difference between Digitisation & Digitalisation, Interdependence of technologies in the digital world, Role of Digital, Digitisation and Digitalisation in our lives.

Internet of Things (IoT):

Definition and working of IoT, Integration of different components of IoT, Impact of IoT on Industries, Machine to Machine communication (M2M), Limitations of IoT.

UNIT-II **15 Hours**

Cloud:

Definition of cloud computing, Laas, PaaS, SaaS & Bpaas, Importance of cloud, Advantages and disadvantages of cloud, Meaning of a Cloud-based Open IoT Operating System (PaaS).

Big Data:

Difference between data and bigdata, Characteristic of bigdata; Volume, Velocity, Variety, Veracity and Value.

Data Analysis:

Descriptive analysis, Predictive analysis, Prescriptive analysis

Block chain:
Mechanism of Cryptocurrency, working of block chain technology, Mining and miner.

UNIT-III **15 Hours**

Artificial Intelligence (AI):
Tasks of AI: visual perception, speech recognition, decision making, translation between languages, Subfields of Artificial Intelligence, such as; Machine Learning, Neural Network, Deep Learning, Cognitive Computing, Computer vision, Natural Language Processing, Benefits of Artificial Intelligence in Industries.
Machine Learning (ML): Relationship between ML and AI, Importance of ML for individuals and companies, Use of ML for; Interpretation of past customer behaviour, Simplification of product marketing, Accurate sales forecasting, Accurate medical prediction and diagnosis, Simplification in documentation and data entry, Improvement in precision of financial rules and models, Detection of Spam, Increasing the efficiency of predictive maintenance in manufacturing industry, Better customers segmentation and accurate lifetime value prediction,
Recommendation of the right product.

Machine Learning Algorithms Categories: Supervised, Unsupervised and Reinforcement

UNIT-IV **15 Hours**

Plant Integration:
Standardization; Open network Interface, M2M communication, Combination of individual machines in to asynchronized production line, Manage of dark data i.e. Complex data Management.
Virtual Commissioning/Digital Twin:
End-to-end engineering, Mechanical design to electrical layout and automation, Detecting mechanical problems/ software errors at an early stage?
Industrial Edge:
Local and cloud computing/on-premise and off-premise, Industrial Edge and its Benefits to Industry
Transaction Mode

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

Recommended Text Books / Reference Books:

- *Alasdair Gilchrist, "Industry 4.0: The Industrial Internet of Things", Apress Publishers, June 2016.*
- *Sudip Misra, "Introduction to Industry 4.0 and Industrial Internet of Things" SWAYAM Course.*
- *Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat, "Industrial Internet of Things: Cyber manufacturing Systems", Springer*

Semester - VII

Course Title: MATLAB & SIMULINK LABORATORY
Course Code: BEE7403

L	T	P	Credits
0	0	8	4

Total hours: 60

Course Outcomes: On successful completion of this course, the students will be able to:

1. Know about BASIC built in functions of MATLAB and blocks of SIMULINK.
2. They will learn to do various programming operations in MATLAB and develop Simulink models in SIMULINK.
3. They will be able to program curve fitting, numerical differentiation and integration, solution of linear equations in MATLAB and solve electrical engineering problems.
4. They will be able to draw 2-D and 3-D plots in MATLAB.

Course Content

1. Introduction to Fundamentals of MATLAB Programming.
2. To perform Arithmetic and logic operations in MATLAB.
3. To perform branch and loop operations in MATLAB.
4. To use basic built-in function of Matrices in MATLAB.
5. To develop a user defined function file in MATLAB.
6. To plot 2-D & 3-D graphs in MATLAB, such as plots, subplots, logarithmic plots and multiple plots etc.
7. To plot 3-phase AC supply voltage in MATLAB.
8. To develop MATLAB program to calculate ABCD parameters of transmission line.
9. Introduction to commonly used blocks of SIMULINK.
10. To develop Simulink model to show series resonance phenomenon and to plot voltage & current waveforms and frequency vs impedance graph.
11. To develop Simulink model to show parallel resonance phenomenon and plot voltage & current waveforms and frequency vs admittance graph.
12. To develop a Simulink model of symmetrical three phase power system supplying a three phase balanced load and to display the three phase voltage, current, active and reactive power.

13. To develop Simulink model of three phase transformer and to display the primary and secondary voltages and currents.
14. To develop Simulink model for speed control of dc motors.

Semester - VII

Course Title: PROJECT
Course Code: BEE7404

L	T	P	Credits
0	0	8	4

Total Hours: 60

Course Outcomes: On successful completion of this course, the students 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.
3. Students will develop Practical Skills and learn the ability to work collaboratively.
4. Students will develop their ability to communicate technical information effectively, both in written and oral forms, through reports, presentations, and other formats.

Course Content

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 the preliminary Analysis, Modelling, Simulation, Experiment, Design and 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.

Semester – VII

Course Title: HIGH VOLTAGE ENGINEERING
Course Code: BEE7405

L	T	P	Credits
4	0	0	4

Total hours: 60

Course Outcomes: On successful completion of this course, the students will be able to:

1. Understand the problem of power system stability and its impact on the system.
2. Analyze linear dynamical systems and use of numerical integration methods.
3. Model different power system components for the study of stability.
4. Understand the methods to improve stability.

Course Content

UNIT-I **15 Hours**

Introduction to Power System Operations:

Introduction to power system stability. Power System Operations and Control. Stability problems in Power System. Impact on Power System Operations and control.

UNIT-II **15 Hours**

Analysis of Linear Dynamical System and Numerical Methods:

Analysis of dynamical System, Concept of Equilibrium, Small and Large Disturbance Stability. Modal Analysis of Linear System. Analysis using Numerical Integration Techniques. Issues in Modeling: Slow and Fast Transients, Stiff System.

UNIT-III **15 Hours**

Modeling of Synchronous Machines and Associated Controllers:

Modeling of synchronous machine: Physical Characteristics. Rotor position dependent model. D-Q Transformation. Model with Standard Parameters. Steady State Analysis of Synchronous Machine. Short Circuit Transient Analysis of a Synchronous Machine. Synchronization of Synchronous Machine to an Infinite Bus. Modeling of Excitation and Prime Mover Systems. Physical Characteristics and Models. Excitation System Control. Automatic Voltage Regulator. Prime Mover Control Systems. Speed Governors.

UNIT-IV **15 Hours**

Modeling of other Power System Components:

Modeling of Transmission Lines and Loads. Transmission Line Physical Characteristics. Transmission Line Modeling. Load Models - induction machine model. Frequency and Voltage Dependence of Loads. Other Subsystems – HVDC and FACTS controllers, Wind Energy Systems.

Enhancing System Stability:

Planning Measures. Stabilizing Controllers (Power System Stabilizers). Operational Measures Preventive Control. Emergency Control.

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, ―Power System Dynamics, Stability and Control‖, B. S. Publications, 2002.*
- *P. Kundur, ―Power System Stability and Control‖, McGraw Hill, 1995.*
- *P. Sauer and M. A. Pai, ―Power System Dynamics and Stability‖, Prentice Hall, 1997.*

SEMESTER- VII

Course Title: ELECTRICAL ENERGY CONSERVATION AND AUDITING
Course Code: BEE7406

L	T	P	Credits
4	0	0	4

Total hours: 60

Course Outcomes: On successful completion of this course, the students will be able to:

1. Understand the current energy scenario and importance of energy conservation.
2. Understand the concepts of energy management.
3. Understand the methods of improving energy efficiency in different electrical systems.
4. Understand the concepts of different energy efficient devices.

Course Content

UNIT-I **15 Hours**

Energy Scenario

Commercial and Non-commercial energy, primary energy resources, commercial energy production, final energy consumption, energy needs of growing economy, long term energy scenario, energy pricing, energy sector reforms, energy and environment, energy security, energy conservation and its importance, restructuring of the energy supply sector, energy strategy for the future, air pollution, climate change. Energy Conservation Act-2001 and its features.

UNIT-II **15 Hours**

Basics of Energy and its various forms

Electricity tariff, load management and maximum demand control, power factor improvement, selection & location of capacitors, Thermal Basics-fuels, thermal energy contents of fuel, temperature & pressure, heat capacity, sensible and latent heat, evaporation, condensation, steam, moist air and humidity & heat transfer, units and conversion.

UNIT-III **15 Hours**

Energy Management & Audit

Definition, energy audit, need, types of energy audit. Energy management (audit) approach understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the

input energy requirements, fuel & energy substitution, energy audit instruments. Material and Energy balance: Facility as an energy system, methods for preparing process flow, material and energy balance diagrams.

UNIT-IV **15 Hours**

Energy Efficiency in Electrical Systems

Electrical system: Electricity billing, electrical load management and maximum demand control, power factor improvement and its benefit, selection and location of capacitors, performance assessment of PF capacitors, distribution and transformer losses. Electric motors: Types, losses in induction motors, motor efficiency, factors affecting motor performance, rewinding and motor replacement issues, energy saving opportunities with energy efficient motors.

Transaction Mode

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

Suggested Readings:

- *Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-1, General Aspects (available online)*
- *Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-3, Electrical Utilities (available online)*
- *S. C. Tripathy, ―Utilization of Electrical Energy and Conservation‖, McGraw Hill, 1991.*
- *Success stories of Energy Conservation by BEE, New Delhi (www.bee-india.org)*

Semester - VII

Course Title: POWER SYSTEM DYNAMICS & CONTROL
Course Code: BEE7407

L	T	P	Credits
4	0	0	4

Total hours: 60

Course Outcomes: On successful completion of this course, the students 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 **15 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 **15 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 **15 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).*