SCHEME OF EXAMINATION

And

SYLLABUS

For

Bachelors of Vocation (B. Voc.)

In

ELECTRICAL

Offered by

COMMUNITY COLLEGE OF SKILL DEVELOPMENT

J. C. Bose University of Science & Technology, YMCA Sector-6,

Mathura Road, Faridabad,

Haryana, India

2024-25

ABOUT THE PROGRAM

A Bachelor of Vocation (B. Voc.) in Electrical is a vocational undergraduate degree program that focuses on providing practical skills and knowledge in the field of electrical engineering. This program is designed to equip students with the necessary skills and competencies required for various roles in the electrical industry. This program is an outcome of industry and student demand. Only Degree program in Electrical with more than 80% Practical to make you more employable and outshine your career. This program is designed to introduce the students to the operation of today's complex electricity and power nature by giving them a comprehensive understanding from basic to advanced, of various electrical technologies like power generation, transmission and distribution, electrical wiring, electrical machine, measuring instruments, electrical & electronics, etc. Students under this program will acquire the necessary skills to Construct, Install, maintain, and process electrical systems. Vocational training programs have been created with the aim of imparting industry-specific skills in students. These programs are crafted in such a way that the students acquire skills, which will lead them to employment in the respective sector.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1: To equip graduates with the practical skills and knowledge needed to excel in electrical installation, maintenance, and troubleshooting roles in the industry.
PEO2: To instill a strong sense of safety awareness and ethical conduct, ensuring that graduates work responsibly and prioritize the well-being of themselves and others.
PEO3: To prepare graduates to adapt to evolving technologies and industry practices, fostering a commitment to lifelong learning and professional development.
PEO4: To develop graduates' communication and teamwork skills, enabling them to collaborate effectively with colleagues and professionals in the electrical field.

PROGRAM OUTCOMES

After completing the program, students will be able to:

1. Have a strong understanding of electrical systems, circuits, and components, including the ability to analyse, design, and troubleshoot them effectively.
2. Proficient in electrical installation, maintenance, and repair tasks, applying industry-standard practices and safety protocols.
3. Operate and maintain various electrical equipment and tools, ensuring proper functioning and safety.
4. Aware of safety regulations and codes related to electrical work, ensuring that their activities adhere to industry standards and legal requirements.
5. Effectively communicate with team members and clients, as well as maintain accurate records and documentation related to electrical projects.
6. Skilled in diagnosing electrical problems and finding effective solutions, applying critical thinking, and troubleshooting techniques.
7. Open to learning and adopting new technologies and industry trends as they emerge.
8. Demonstrate professionalism, ethical behaviour, and a strong work ethic in their interactions with clients, colleagues, and employers.

9. Encouraged to apply their electrical skills for the betterment of the community, participating in projects that address local needs and challenges.

PROGRAM SPECIFIC OUTCOMES (PSOs)

To impart State-of-Art knowledge in the field of Electrical and hand on application based practical training with regular Academic and Industry interaction. B. Voc. in Electrical encompass graduates' proficiency in electrical installation, maintenance, and equipment operation, as well as their ability to troubleshoot and solve electrical problems.

SCHEME OF EXAMINATION

FIRST SEMESTER

Subject Code	Subject Name	L-T-P	Credits	Marks Weightage		Course Type
				Internal	External	
BSC-105EL	English Literacy	3-0-0	3	25	75	BSC
BSC-106	Typography and Computer Application	3-0-0	3	25	75	BSC
EL-101	Electrical Technology	3-0-0	3	25	75	PCC
EL-102	Fundamental of Electromagnetism	3-0-0	3	25	75	PCC
EL-104	Electrical Workshop - I	0-0-5	5	30	70	SDP
MAC-101 to 103	Mandatory Audit Course	3-0-0	3	25	75	MAC
Total		**15-0-5**	**20**	**155**	**445**	

SECOND SEMESTER

Subject Code	Subject Name	L-T-P	Credits	Marks Weightage		Course Type
				Internal	External	
BSC-201M	Mathematics	3-0-0	3	25	75	BSC
BSC-204BS	Behavioral Skills	3-0-0	3	25	75	BSC
EL-201	Electrical Wiring	3-0-0	3	25	75	BSC
EL-202	Electrical Vehicle	3-0-0	3	25	75	PCC
EL-203	Electrical Machine - I	3-0-0	3	25	75	PCC
EL-205	Electrical Workshop - II	0-0-5	5	30	70	SDP
Total		**15-0-5**	**20**	**155**	**445**	

THIRD SEMESTER

Subject Code	Subject Name	L-T-P	Credits	Marks Weightage		Course Type
				Internal	External	
BSC-302ES	Employability Skills	3-0-0	3	25	75	BSC
EL-301	Power Plant Engineering	3-0-0	3	25	75	PCC
EL-302	Transmission and Distribution of Electrical Power	3-0-0	3	25	75	PCC
EL-303	Electrical Machine - II	3-0-0	3	25	75	PCC
EL-304	Basic Electronics	3-0-0	3	25	75	PCC
EL-306	Electrical Workshop - III	0-0-5	5	30	70	SDP
Total		**15-0-5**	**20**	**155**	**445**	

FOURTH SEMESTER

Subject Code	Subject Name	L-T-P	Credits	Marks Weightage		Course Type
				Internal	External	
EL-401	Industrial Electronics and control of drives	3-0-0	3	25	75	PCC
EL-402	Basics of Measuring Instruments	3-0-0	3	25	75	PCC
EL-404	PLC Workshop	0-0-5	5	30	70	SDP
BSC-401P	Project	3-0-0	3	30	70	SDP
OEC-401 to 404	Open Elective Course	3-0-0	3	25	75	OEC
PEC-EL-401 to 404	Program Elective Course	3-0-0	3	25	75	PEC
Total		**15-0-5**	**20**	**160**	**440**	

FIFTH SEMESTER

Subject Code	Subject Name	Credits	Marks Weightage		Course Type
			Internal	External	
EL-501	On Job Training (OJT)/ Internship	20	150	350	OJT
Total		**20**	**150**	**350**	

SIXTH SEMESTER

Subject Code	Subject Name	Credits	Marks Weightage		Course Type
			Internal	External	
EL-601	On Job Training (OJT)/ Internship	20	150	350	OJT
Total		**20**	**150**	**350**	

LIST OF MANDATORY AUDIT COURSES

Course Code	Course Name
MAC-101	Human Value and Professional Ethics
MAC-102	Balanced Diet and Nutrition
MAC-103	Environmental Science

LIST OF OPEN ELECTIVE COURSES

Course Code	Course Name
OEC-401	Entrepreneurship
OEC-402	Trends in Technology
OEC-403	Waste Management
OEC-404	Industry 4.0

LIST OF PROGRAM ELECTIVE COURSES

Course Code	Course Name
PEC-EL-401	Restructured Power System
PEC-EL-402	Network Analysis and Synthesis
PEC-EL-403	Waste to Energy
PEC-EL-404	Special Purpose Machines

DETAILED SCHEME AND SYLLABUS

FIRST SEMESTER

Subject Code	Subject Name	L-T-P	Credits	Marks Weightage		Course Type
				Internal	External	
BSC-105EL	English Literacy	3-0-0	3	25	75	BSC
BSC-106	Typography and Computer Application	3-0-0	3	25	75	BSC
EL-101	Electrical Technology	3-0-0	3	25	75	PCC
EL-102	Fundamental of Electromagnetism	3-0-0	3	25	75	PCC
EL-104	Electrical Workshop - I	0-0-5	5	30	70	SDP
MAC-101 to 103	Mandatory Audit Course	3-0-0	3	25	75	MAC
Total		**15-0-5**	**20**	**155**	**445**	

LIST OF MANDATORY AUDIT COURSES

Course Code	Course Name
MAC-101	Human Value and Professional Ethics
MAC-102	Balanced Diet and Nutrition
MAC-103	Environmental Science

ENGLISH LITERACY
BSC-105EL

Total credits: 3

L	T	P
3	0	0

Theory: 75

Sessional: 25

Course Objectives:
The objective of studying this course is to acquire knowledge on the Basic English grammar starting from speeches to synaptic category going forward with tenses and its types. To comprehend voices, narration and sentence making.

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

- CO1: Demonstrate a comprehensive understanding of the fundamental parts of speech and their functions in communication.
- CO2: Analyse the usage and placement of prepositions, conjunctions, and interjections to enhance the coherence and flow of written and spoken language.
- CO3: Interpret the nuances of different tenses, including present, past, and future, to accurately convey temporal relationships and meanings in writing and speech.
- CO4: Evaluate the effectiveness of various sentence formation techniques, such as active and passive voice, direct and indirect narration, and different sentence structures, in achieving specific communicative goals.

Unit-I
Parts of Speech: Noun, Pronoun, Verb, Adverb, Adjective.

Unit-II
Literacy Skills: Preposition, Conjunction, Interjection.

Unit-III
Fragment of Tenses: Present tense, Past Tense, Future Tense.

Unit-IV
Sentence Formation: Active and Passive voice, Direct and Indirect Narration, Simple Sentences, Compound Sentences, Complex Sentences, Compound-Complex Sentences.

Practical Exercises:
The learners are required to

1. Participate in a discussion where you identify and categorize different parts of speech used in each paragraph
2. Select sentences from a text and prepare exercises where you replace nouns with pronouns to enhance clarity and cohesion.
3. Conduct a group activity where each participant creates sentences using various prepositions and conjunctions to demonstrate their understanding of literacy skills.
4. Estimate the correct tense for a series of sentences and analyse how the choice of tense impacts the meaning and tone of each sentence.
5. Compare sentences written in active and passive voice, then conduct a writing exercise where you rewrite sentences from one voice to the other to understand the differences in tone and emphasis.

Suggested Readings:

1. Wren and Martin. High School English Grammar and Composition. New Delhi: RRP, 2007.
2. Murphy, Raymond. Essential English Grammar. New Delhi: Cambridge, 2017.

TYPOGRAPHY AND COMPUTER APPLICATION
BSC-106

Total credits: 3

L	T	P
3	0	0

Theory: 75

Sessional: 25

Course Objectives:
The course aims to familiarize students with Microsoft Office applications for efficient productivity. It covers MS Windows basics and control panel operations, emphasizes document creation and advanced features in MS Word, delves into data manipulation and analysis in MS Excel, and introduces effective presentations and database management in MS PowerPoint and MS Access.

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

- CO1: Demonstrate proficiency in navigating and utilizing basic components such as icons, taskbar, and desktop in MS Windows.
- CO2: Evaluate the effectiveness of MS Word features for document management, including file handling and printing capabilities.
- CO3: Interpret advanced features such as pivot tables, conditional formatting, and what-if analysis to facilitate data management and decision-making.
- CO4: Prepare engaging presentations using MS PowerPoint, incorporating various slide manipulation techniques and multimedia elements.

Unit-I
MS Windows: Basic components of windows, icons, types of icons, taskbar, activating windows, using desktop, title bar, running applications, exploring computer, managing files and folders, copying and moving files and folders. Control panel – display properties, adding and removing software and hardware, setting date and time, screensaver and appearance using windows accessories.

Unit-II
Documentation Using MS Word: Introduction to word processing interface, Toolbars, Menus, Creating & Editing Document, Formatting Document, Finding and replacing text, Format painter, Header and footer, drop cap, Auto-text, Autocorrect, Spelling and Grammar Tool, Document Dictionary, Page Formatting, Bookmark, Previewing and printing document, Advance Features of MS-Word-Mail Merge, Macros, Tables, File Management, Printing, Styles, linking and embedding object, Template.

Unit-III
Electronic Spreadsheet using MS Excel: Introduction to MS-Excel, Cell, cell address, Creating & Editing Worksheet, Formatting and Essential Operations, Moving and copying data in excel, Header and footer, Formulas and Functions, Charts, Cell referencing, Page setup, Macros, Advance features of MS-Excel-Pivot table & Pivot Chart, Linking and Consolidation, Database Management using Excel-Sorting, Filtering, Validation, What if analysis with Goal Seek, Conditional formatting, Collaborating with Other Users, Analysing and Presenting Complex data.

Unit-IV
Presentation using MS PowerPoint: Presentations, Creating, Manipulating & Enhancing Slides, Organizational Charts, Excel Charts, Word Art, layering art Objects, Animations and Sounds, Inserting Animated Pictures or Accessing through Object, Inserting Recorded Sound Effect or In-, lllBuilt Sound Effect., Introduction to MS Access: creating database creating

and manipulating tables, forms, queries, reports, modules, importing and exporting of data.

Practical Exercises:

The learners are required to

1. Participate in an exercise to select and customize desktop icons, exploring different types and arranging them according to preference.
2. Prepare a document formatting exercise by selecting and applying different styles, headers, and footers to create a polished document.
3. Conduct a data analysis exercise by estimating and comparing the results of applying different formulas and functions to a given dataset.
4. Estimate the time required to prepare and conduct a presentation by selecting and arranging slides, including animations and transitions.
5. Compare the presentation of data using different chart types in Excel by preparing and conducting a chart creation exercise with the same dataset.

Suggested Readings:

1. V. Rajaraman, Computer Fundamentals.
2. Ashok Arora, Fundamentals of Computer Systems.
3. Russell A Stultz, Fundamentals of Computer Systems.

Note:

1. Only the latest editions of the above books are recommended.

ELECTRICAL TECHNOLOGY
EL-101

Total credits: 3

L	T	P
3	0	0

Theory: 75
Sessional: 25

Course Objectives:
This course aims to provide students with a foundational understanding of electrical concepts and circuits, covering both direct current (DC) and alternating current (AC) systems. Students will learn the principles and applications of basic electrical components, circuit analysis techniques, and the characteristics and maintenance of electric cells. Through theoretical knowledge and practical applications, the course will prepare students to analyse and solve electrical circuit problems.

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

- CO1: Demonstrate the historical development of electrical and the fundamental electrical quantities.
- CO2: Demonstrate the ability to analyse various DC circuits.
- CO3: Analyse the properties and functions of various types of electric cells and demonstrate proper techniques for their maintenance and care.
- CO4: Design circuits involving series and parallel combinations of capacitors and inductors and calculate the energy stored in these components.

Unit-I
Introduction: History and evolution of electrical, Definition of Charge, Resistance, Voltage, Current, Power, Energy and their units, Difference between alternating current and direct current, Ohm's Law, Independent and dependent sources, Active and passive elements in the circuit, ac sources, Electrical Symbols.

Unit-II
D.C. Circuits: Series resistance circuits, Parallel resistance circuits, Series – parallel resistance circuits, calculation of equivalent resistance, Star-delta transformation, Kirchhoff's Laws, and their applications.

Unit-III
Electric Cells: Primary cell, wet cell, dry cell, battery, Series and parallel connections of cells, Secondary cells, Lead Acid Cell, Li-ion battery, Discharging and recharging of cells, preparation of electrolyte, care and maintenance of secondary cells.

Unit-IV
AC Circuits: Representation of sinusoidal waveforms, peak, average and RMS values, Series and parallel RLC circuit, real power, reactive power.
Capacitors: Definition, Series and parallel connection of capacitors, Energy stored in a capacitor.
Inductors: Definition, Series and parallel connection of inductors, Energy stored in an inductor.

Practical Exercises:
The learners are required to

1. Identify and label the different electrical quantities and their units using a predefined circuit component.
2. Demonstrate Ohm's Law by measuring voltage and current across a resistor and

calculate the resistance.

3. Analyse a given DC circuit using Kirchhoff's Voltage and Current Laws. Verify the theoretical calculations with experimental measurements.
4. Identify various types of cells and batteries. Document their characteristics and typical applications.
5. Design a circuit with series and parallel capacitors. Measure the total capacitance and energy stored in the circuit.
6. Evaluate the energy stored in inductors connected in series and parallel.

Suggested Readings:

1. D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill,2010.
2. E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.
3. L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.
4. A. K. Theraja and S. G. Tarnekar, "Electrical Technology", S. Chand, 2000.

Note:

1. Only the latest editions of the above books are recommended

FUNDAMENTAL OF ELECTROMAGNETISM
EL-102

Total credits: 3

L	T	P
3	0	0

Theory: 75
Sessional: 25

Course Objectives:
The objective of this course is to provide students with a comprehensive understanding of the fundamental principles of electrostatics, magnetism, electromagnetism, and electromagnetic induction. This course aims to introduce the core concepts and laws governing electrostatics and magnetism and develop an understanding of the interaction between electric currents and magnetic fields.

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

- CO1: Describe and explain the fundamental principles of electrostatics and magnetism.
- CO2: Utilize the laws of electromagnetism to solve practical problems involving electric and magnetic fields.
- CO3: Analyse magnetic and electric circuits, comparing their properties and behaviour, and evaluate the effects of electromagnetic phenomena on various materials and systems.
- CO4: Evaluate the impact of hysteresis and eddy current losses in magnetic materials and design strategies to minimize these losses in practical applications.

Unit-I
Electrostatics: Coulomb's Law, Electric field Intensity, Electric flux Density, Electric field, electric potential, electrical field intensity due to point charges, electric potential due to point charges, Gauss's law.

Unit-II
Introduction to Magnetism: Magnets, Classification of materials, Magnetic polarity, Laws of magnetic force, Magnetic field, Magnetic Induction, Magnetic flux, Magnetic flux density, Magnetic intensity or magnetizing force, Permeability, Relation between B and H, Intensity of magnetism (J or I), Susceptibility, Relation between B, H, I and K.

Unit-III
Electromagnetism: Electromagnetism, Magnetic effect of electric current, Direction of magnetic lines of force, Typical electromagnetic fields, Electromagnet, Current carrying conductor placed in magnetic field, Work law and its applications, Biot-Savart law, Application of Biot-Savart law, Force between two parallel current carrying conductors, Magnitude of mutual force, one ampere, Magnetic circuit and its analysis, Comparison between magnetic and electric circuits, Ampere-turns calculations, series and parallel magnetic circuit, leakage flux, Magnetization or B-H curve, Magnetic Hysteresis, Hysteresis loss, Magnitude of Hysteresis loss, Importance of Hysteresis loss.

Unit-IV
Electromagnetic Induction: Electromagnetic Induction, Faraday's law of Electromagnetic Induction, Direction of Induced EMF, Induced EMF, Dynamically and statically induced EMF, Self and mutual inductance and their expressions, Co-efficient of coupling, Inductance in series and parallel, Energy stored in a magnetic field, Magnetic energy stored per unit volume, lifting power of a magnet, closing and opening of an inductive circuit, Rise and decay of current in an inductive circuit, Eddy current loss.

Practical Exercises:

1. Demonstrate Coulomb's Law to calculate the force between two-point charges at varying distances and charge magnitudes.
2. Measure the electric field intensity and potential due to a point charge and verify the results with theoretical calculations.
3. Identify and classify materials based on their magnetic properties. Document the differences between diamagnetic, paramagnetic, and ferromagnetic materials.
4. Measure the magnetic field around a bar magnet using a magnetic field sensor. Plot the magnetic flux density (B) and compare with theoretical values.
5. Construct an electromagnet and measure the magnetic field intensity around it for different current levels. Use the Biot-Savart law to calculate the expected field and compare with measurements.
6. Demonstrate Faraday's law by moving a magnet through a coil and measuring the induced EMF. Investigate the effects of changing the speed of motion and the number of coils turns.

Suggested Readings:

1. Matthew N. O. Sadiku, "Elements of Electromagnetic", Oxford University Press, 3rd Edition, 2001.
2. Nathan Ida, "Engineering Electromagnetics", Springer (India) Pvt. Ltd., New Delhi, 2nd Edition, 2001.
3. Edward Mills Purcell, "Electricity and Magnetism", Cambridge University Press, 2011.

Note:

1. Only the latest editions of the above books are recommended

ELECTRICAL WORKSHOP – I
EL-104

Total credits: 5

L	T	P
0	0	5

Theory: 70

Sessional: 30

Course Objectives:

The objective of this course is to equip students with practical skills in using electrical trade tools, understanding and creating electrical joints, soldering, measuring resistance, verifying fundamental electrical laws, and installing electrical accessories. This hands-on course will prepare students to effectively work with electrical components and circuits in real-world applications.

Course Outcomes:

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

- CO1: Identify and use various trade hand tools, screws, nuts, bolts, and other electrical components, ensuring proper care, maintenance, and application in practical scenarios.
- CO2: Perform electrical cable preparation techniques, including skinning, joint practice, and crimping, to ensure effective and safe electrical connections.
- CO3: Demonstrate and verify the fundamental principles of electrical circuits, including Ohm's Law, Kirchhoff's Laws, and the laws governing series and parallel circuits, using appropriate measuring tools and techniques.
- CO4: Install and Overhaul common electrical accessories such as switches, holders, and plugs, and understand the concept of wiring and switching in practical applications.

Practical

1. Demonstration of Trade hand tools.
2. Identification of simple types of screws, nuts & bolts, chassis, clamps, rivets etc. Use, care & maintenance of various hand tools.
3. Practice in using cutting pliers, screwdrivers etc. skinning the cables, and joint practice on a single strand.
4. Demonstration & Practice on bare conductor's joints such as Britannia, straight, Tee, Western union Joints.
5. Practice in soldering.
6. Measurement of Resistance and Measurement of specific Resistance. Application of Wheatstone bridge in measurement of Resistance.
7. Demonstration and identification of types of cables. Demonstration & practice on using standard wire gauge. Practice on crimping thimbles, Lugs. Examination and checking of cables and conductors and verification of materials according to the span.
8. Verification of Ohm's Law, Verification of Kirchhoff's Laws. Verification of laws of series and parallel circuits.
9. Verification of open circuit and closed-circuit network. Measuring unknown resistance using Wheatstone bridge.
10. Practice on installation and overhauling common electrical accessories.
11. Fixing of switches, holder plugs etc. in T.W. boards. Identification and use of wiring accessories concept of switching.

Suggested Readings:

1. "Electrical Wiring: Residential" by Ray C. Mullin and Phil Simmons.
2. "Electrical Installation Work" by Brian Scaddan.

3. "Electricity 1: Devices, Circuits, and Materials" by Thomas Kubala

Note:

1. Only the latest editions of the above books are recommended

HUMAN VALUE AND PROFESSIONAL ETHICS
MAC-101

Total credits: 3

L	T	P
3	0	0

Theory: 75
Sessional: 25

Course Objectives:
The course aims to instil the significance of value education, emphasizing holistic living, ethical values, harmony in relationships, and understanding human rights. It addresses personal and societal responsibilities, fosters environmental balance, and tackles social evils through critical thinking and problem-solving skills for a well-rounded, responsible citizenry.

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

- CO1: Understand the significance of value education, holistic living, and the balance of body, mind, and intellect in contemporary life.
- CO2: Analyse the essential values for life such as truth, integrity, empathy, and teamwork, and apply them to personal growth.
- CO3: Evaluate harmony in family and society, understanding human relationships, and the role of trust and respect in fostering unity.
- CO4: Apply knowledge of human rights and social evils to promote peace, non-violence, and social welfare, addressing contemporary societal challenges.

Unit-I
Introduction: Value education-its purpose and significance in the present world, Value system, the role of culture and civilization, Holistic living, Balancing the outer and inner - Body, Mind and Intellectual level- Duties and responsibilities.

Unit-II
Salient values for life: Truth, commitment, honesty and integrity, forgiveness and love, empathy and ability to sacrifice, care, unity, and inclusiveness, Self-esteem and self-confidence, punctuality - Time, task and resource management, Problem solving and decision-making skills- Interpersonal and Intra personal relationship, Team work, Positive and creative thinking.

Unit-III
Understanding Harmony: Harmony in Family and Society-How to owe responsibilities in family, Understanding Values in Human- Human relations, Role of Trust and Respect, Samman (Respect) for all, Akhand Samaj (A United Society).
Harmony in Nature: Understanding the Harmony in Nature, making sure your contribution is in harmony with nature, Interconnectedness and mutual fulfilment, Environment and Ecological balance.

Unit-IV
Human Right and Social Evils: Human Rights: Universal Declaration of Human Rights National Integration - Peace and non-violence - Dr. APJ Kalam's ten points for enlightened citizenship - Social Values and Welfare of the citizen - The role of media in value building - Human Rights violations - Social Evils: Corruption, Cybercrime, Terrorism, Alcoholism, Drug addiction, Dowry, Domestic violence, Untouchability, female infanticide, atrocities against women and how to tackle them.

Practical Exercises:

The learners are required to

1. Create a personal value system chart, detailing your key values and their significance in daily life and decision-making.
2. Analyze a case study on integrity, identifying challenges faced and strategies used to maintain honesty and commitment.
3. Evaluate the harmony within your family relationships, identifying areas of improvement for fostering trust, respect, and unity.
4. Design a community project that promotes environmental harmony, ensuring sustainable practices and ecological balance.
5. Develop a plan to raise awareness on human rights and tackle social evils, incorporating strategies from Dr. APJ Kalam's ten points for citizenship.

Suggested Readings:

1. R. R. Gaur, R Sangal, G P Bagaria, 2009, A Foundation Course in Human Values and Professional Ethics.
2. Prof. K. V. Subba Raju, 2013, Success Secrets for Engineering Students, Smart Student Publications, 3rd Edition.
3. Ivan IIIich, 1974, Energy & Equity, The Trinity Press, Worcester, and HarperCollins, USA.

Note:

1. Only the latest editions of the above books are recommended

BALANCED DIET AND NUTRITION
MAC-102

Total credits: 3

L	T	P
3	0	0

Theory: 75
Sessional: 25

Course Objectives:
The course aims to provide a comprehensive understanding of food nutrition, covering the meaning of nutrition, nutritional requirements, and food components. It explores macronutrients (carbohydrate, fat, protein) and micronutrients (vitamins, minerals), emphasizing their sources, functions, and effects on the body. Additionally, it addresses balanced diet planning and yogic concepts of diet and nutrition.

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

- CO1: Analyse nutritional requirements and food components for planning balanced diets, applying knowledge of macronutrients and micronutrients.
- CO2: Evaluate the selection, preparation, and nutritive value of food groups to make informed dietary choices, demonstrating critical thinking skills.
- CO3: Synthesize key concepts of energy metabolism and factors affecting energy expenditure, demonstrating understanding and application of physiological principles.
- CO4: Apply yogic principles to dietary practices, integrating traditional texts and holistic approaches to promote overall health and well-being

Unit-I
Concepts and Components of Food Nutrition: Meaning of nutrition, Basic definition regarding nutritional requirements, Nutritional need of human; Concept of food, Acceptance of food, Function of food, Components of food and their classification; Macronutrients – Carbohydrate, Fat, Protein (source, function and effect on the body); Micronutrients – Vitamins, Mineral, Water, roughage (source, function and effect on body); Planning Balanced Diet.

Unit-II
Food Group: Cereals and Millet – Selection, Preparation and Nutritive value; Pulses, Nuts and Oilseeds- Selection, Preparation and Nutritive value; Milk and Milk production - Selection, Preparation and Nutritive value; Vegetable and Fruits - Selection, Preparation and Nutritive value; Fatty oil and Sugar, Jaggery - Selection, Preparation and Nutritive value.

Unit-III
Food and Digestion: Energy – Key concepts, Definition and Components of energy requirements.; Energy – Imbalance concepts of metabolism, anabolism and catabolism; Calorie requirement – BMR, SDA; Physical activity – carbohydrates, lipids and protein metabolism; Factors affecting energy- requirement and expenses; Factors affecting BMR; Factors influencing energy expenditure in physical activity; Methods and requirements for estimating energy expenditure.

Unit-IV
Yogic concepts of Diet and Nutrition: General introduction to diet concepts, concepts of mitahara, Definition and classification, yogic diet according to traditional yoga texts; Concepts of diet according to GherandSamhita and Hathpradeepika; Satvik, Rajsik and Tamasik diet as describe in Bhagwadgeeta; Pathya and Apathya food according to the texts of Yoga; Role of yogic diet in healthy living; Diet according to nature of the body – Vata,

Pitta and Kapha.

Practical Exercises:

The learners are required to

1. Analyse food labels to identify macronutrient and micronutrient content, applying knowledge of nutritional requirements and classification of food components.
2. Plan a balanced diet menu incorporating various food groups, considering selection, preparation methods, and nutritive values.
3. Calculate Basal Metabolic Rate (BMR) and estimate energy expenditure for different physical activities, applying metabolic concepts.
4. Evaluate the nutritive value of different food items using food composition tables, considering their impact on energy balance and metabolism.
5. Compare and contrast traditional yogic dietary principles with modern nutritional recommendations, discussing their implications for health and well-being.

Suggested Readings:

1. Bakhru, H. K., 1991, A Complete Handbook of Nature Cure.
2. Kumar Neeraj, Nagendra, 2014, Mera Aahar Mera Swasthya.

Note:

1. Only the latest editions of the above books are recommended

ENVIRONMENTAL SCIENCE
MAC-103

Total credits: 3

L	T	P
3	0	0

Theory: 75
Sessional: 25

Course Objectives:
The course aims to explore environmental studies, emphasizing its multidisciplinary nature, the significance of resource management, understanding ecosystem dynamics, and conserving biodiversity. It highlights the importance of public awareness, sustainable practices, and conservation strategies to address environmental challenges globally and locally.

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

- CO1: Understand the multidisciplinary nature of environmental studies and its importance by defining key concepts and discussing their relevance.
- CO2: Analyse the challenges associated with renewable and non-renewable resources, proposing sustainable conservation strategies for forest, water, mineral, food, energy, and land resources.
- CO3: Explore ecosystem dynamics by describing the structure, function, and types of ecosystems, including energy flow and ecological succession.
- CO4: Evaluate biodiversity conservation methods by identifying genetic, species, and ecosystem diversity, discussing threats, and recommending in-situ and ex-situ conservation measures.

Unit-I
Understanding Environmental Studies: Exploring the multidisciplinary nature of environmental studies, defining its scope, and highlighting its importance. Emphasizing the need for public awareness in addressing environmental issues.

Unit-II
Natural Resource Management: Analyzing renewable and non-renewable resources and associated challenges. Studying forest, water, mineral, food, energy, and land resources, along with their exploitation and conservation strategies.

Unit-III
Ecosystem Dynamics: Understanding the structure and function of ecosystems, including producers, consumers, and decomposers. Exploring energy flow, ecological succession, and various ecosystem types such as forests, grasslands, deserts, and aquatic ecosystems.

Unit-IV
Biodiversity Conservation: Defining genetic, species, and ecosystem diversity. Examining the value of biodiversity at global, national, and local levels. Identifying threats to biodiversity and discussing conservation measures, both in-situ and ex-situ.

Practical Exercises:
The learners are required to

1. Assess local environmental issues by identifying and discussing their multidisciplinary nature, highlighting the need for public awareness.
2. Examine the impact of overexploitation on a selected natural resource, proposing sustainable conservation strategies based on case studies.
3. Categorize various ecosystem components by mapping producers, consumers, and

decomposers, illustrating energy flow and ecological succession.

4. Conduct a field study to evaluate the biodiversity of a local habitat, identifying species and assessing conservation needs.
5. Develop an in-situ and ex-situ conservation plan for an endangered species, considering genetic, species, and ecosystem diversity.

Suggested Readings:

1. "Perspectives in Environmental Studies" by A. Kaushik and C. P. Kaushik, New age international publishers.
2. "Environmental Studies by Benny Joseph", Tata McGraw Hill Co, New Delhi
3. "Environmental Science towards a sustainable future" by Richard T. Wright. 2008 PHL Learning Private Ltd. New Delhi.
4. "Environmental Engineering and science" by Gilbert M. Masters and Wendell P. Ela 2008 PHI Learning Pvt Ltd.
5. "Fundamentals of Ecology" by Odum, E.P., Barrick, M. and Barret, G.W. Thomson Brooks/Cole Publisher, California, 2005.

Note:

1. Only the latest editions of the above books are recommended.

SECOND SEMESTER

Subject Code	Subject Name	L-T-P	Credits	Marks Weightage		Course Type
				Internal	External	
BSC-201M	Mathematics	3-0-0	3	25	75	BSC
BSC-204BS	Behavioural Skills	3-0-0	3	25	75	BSC
EL-201	Electrical Wiring	3-0-0	3	25	75	BSC
EL-202	Electrical Vehicle	3-0-0	3	25	75	PCC
EL-203	Electrical Machine - I	3-0-0	3	25	75	PCC
EL-205	Electrical Workshop - II	0-0-5	5	30	70	SDP
Total		**15-0-5**	**20**	**155**	**445**	

MATHEMATICS
BSC-201M

Total credits: 3

L	T	P
3	0	0

Theory: 75

Sessional: 25

Course Objectives:
This course aims to develop a solid foundation in trigonometry, matrices and determinants, differentiation and integration, and complex numbers. Students will learn to apply mathematical concepts and techniques to solve problems, analyse mathematical functions, and interpret results in both theoretical and practical contexts.

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

- CO1: Understand and apply trigonometric functions and identities to solve problems involving angles and triangles.
- CO2: Analyse and solve linear equations using matrices and determinants, employing methods such as Cramer's rule and the inverse matrix method.
- CO3: Differentiate and integrate algebraic, trigonometric, and logarithmic functions, applying these techniques to evaluate real-world problems.
- CO4: Operate with Complex Numbers in various forms, including polar and rectangular, and apply these operations to solve mathematical problems.

Unit-I
Trigonometry: Introduction to trigonometric functions: Radian and degree measure, right triangle trigonometry, trigonometric functions of any angle, applications using right triangles; Graphs of sine and cosine functions, transformation of graphs of the sine and cosine functions, Trigonometric Identities, Quadrant Rule, Sum and difference identities for cosine, sine, and tangent, Double-angle identities, half-angle identities, Verifying trigonometric identities, Ratios of Complementary Angles.

Unit-II
Matrices and Determinants: Definition and Properties of Determinants, Definition and Types of Matrices, Transpose of a Matrix, Symmetric, Skew Symmetric Matrices, Orthogonal matrices, Hermitian and Skew Hermitian, Minors and Cofactors, Adjoint and Inverse of a Matrix, Cramer's Rule, Solution of Simultaneous Linear Equations by Inverse Matrix Method.

Unit-III
Differentiation and Integration: Introduction to Derivatives, Product Rule, Quotient Rule, Chain Rule, Derivatives of Algebraic Function, Derivative of trigonometric functions, Derivative of inverse trigonometric functions, evaluation of simple differentials. Concepts of integration, integration of trigonometric functions, exponential and logarithmic functions, integration by parts, evaluation of simple integrals.

Unit-IV
Complex Numbers: Definition of Complex Number, Operations on Complex Number (Add., Sub., Multiplication, Division), Conjugate Complex Number, Modulus and Amplitude of a Complex Number, Polar form of a Complex Number.

Practical Exercises:
The learners are required to

1. Verify trigonometric identities such as the sum and difference identities for sine and

cosine, and apply them to solve complex trigonometric equations.
2. Perform operations on matrices, including addition, subtraction, and multiplication, and calculate determinants. Use these operations to solve systems of linear equations using Cramer's rule.
3. Differentiate algebraic and trigonometric functions using the product, quotient, and chain rules.
4. Integrate trigonometric and logarithmic functions using integration by parts.
5. Perform arithmetic operations on complex numbers, including addition, subtraction, multiplication, and division.

Suggested Readings:

1. G.B. Thomas and R.L. Finney, “Calculus and Analytic geometry”, Pearson, 2002.
2. Advanced Engineering Mathematics by R.K. Jain.
3. A Basic course in Mathematics by Nabjyoti Dutta.
4. Skills in mathematics by Amit M Aggarwal.
5. Applied Mathematics for Polytechnics by H.K. Dass.
6. N.P. Bali and Manish Goyal, “A textbook of Engineering Mathematics”, Laxmi Publications, Reprint, 2010

Note:

1. Only the latest editions of the above books are recommended

BEHAVIORAL SKILLS
BSC-204BS

Total credits: 3

L	T	P	Theory: 75
3	0	0	Sessional: 25

Course Objectives:
The course aims to enhance communication skills by addressing barriers and solutions, refine writing abilities through various formal and business documents, develop essential soft skills including group discussions and paraphrasing, and improve literacy skills focusing on reading, writing, listening, and speaking, with an emphasis on telephonic communication and reading techniques like skimming and scanning.

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

- CO1: Analyze communication barriers and propose solutions to enhance clarity in various types of communication settings using problem-solving skills.
- CO2: Compose formal and business letters, reports, and resumes with correct format and structure, demonstrating proficiency in professional writing skills.
- CO3: Demonstrate effective group discussion techniques and paraphrasing skills, emphasizing the importance and application of soft skills in professional contexts.
- CO4: Apply advanced reading strategies such as skimming and scanning, and improve telephonic communication, to enhance overall literacy and comprehension abilities.

Unit-I
Communication Skills: Meaning of Communication, Importance, Function, Types, Communication barriers and its solutions.

Unit-II
Writing Skills: Letter writing- Formal letter, application letter, covering letter and business letter. Report writing- Academic report, Business report, technical report, News report. Mail writing and resume.

Unit-III
Soft Skills: Definition and significance of soft skills, Group Discussions, basic knowledge of translator and Paraphrasing.

Unit-IV
Speaking and Reading Skills: Importance of Literacy skills (Reading, Writing, Listening, Speaking), telephonic communication skill, Levels of reading skills, process of skimming and scanning.

Practical Exercises:
The learners are required to

1. Identify and resolve communication barriers through role-playing exercises, demonstrating effective solutions for enhancing message clarity and understanding.
2. Compose a formal letter and business report using proper formats, showcasing the application of advanced writing skills in professional contexts.
3. Facilitate a group discussion, focusing on applying soft skills, paraphrasing techniques, and evaluating effective communication strategies.
4. Conduct telephonic conversations using role-plays to practice and improve telephonic communication skills and active listening.

5. Apply skimming and scanning techniques to various texts, evaluating different levels of reading skills for efficient information extraction.

Suggested Readings:

1. "Digital Body Language: How to Build Trust and Connection, No Matter the Distance" by Erica Dhawan
2. "Effective Communication Skills: How to Enjoy Conversations, Build Assertiveness, & Have Great Interactions for Meaningful Relationships" by Keith Coleman
3. "Talk Like TED: The 9 Public-Speaking Secrets of the World's Top Minds" by Carmine Gallo
4. Mishra. B, Sharma. S (2011) Communication Skills for Engineers and Scientists. PHI Learning Pvt. Ltd.
5. Chaturvedi P. D, Chaturvedi M. (2011) Business Communication: Concepts, Cases and Applications. Pearson Education India.

Note:

1. Only the latest editions of the above books are recommended

ELECTRICAL WIRING
EL-201

Total credits: 3

L	T	P
3	0	0

Theory: 75
Sessional: 25

Course Objectives:
The objective of this course is to provide students with a comprehensive understanding of electrical wiring systems, including relevant standards, safety regulations, tools, and accessories used in both domestic and industrial settings. The course aims to cover the basics of electrical wiring systems and the National Electrical Code (NEC), develop proficiency in various wiring methods and impart knowledge of cutting tools and fasteners.

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

- CO1: Describe the fundamental principles of electrical wiring systems.
- CO2: Implement domestic and industrial wiring methods, ensuring compliance with safety standards and regulations.
- CO3: Analyse and diagnose general faults in electrical installations and perform necessary tests as per Indian Electricity Rules.
- CO4: Evaluate the types and functions of various electrical accessories and choose appropriate tools and fasteners for specific electrical installations.

Unit-I
Introduction: Definition, Selection of the wiring system, Material Required for Wiring, Wiring Safety and Precautions, Preparation/ Planning for wiring, Indian Electricity Rules, Indian Standards for electrical wiring, National Electrical Code (NEC), Scope of the National Electrical Code,
Electrical Tools: Pliers, combination, side cutting, round nose, long nose, Screw drivers, connectors, electrical knife, neon tester, test lamp, Symbols used in electrical technology, reading of electrical drawing.

Unit-II
Domestic and Industrial Wiring: Megger, Domestic Wiring Methods, Advantages, Disadvantages, Uses and Precautions Regarding various Domestic wirings, Tests for wiring as per I.E. Rules before and after supplying mains.
Printed Circuit Board: Introduction, types, and testing.

Unit-III
Cutting tools and Fasteners: Gauges, limit gauges and fixed gauges, Drilling, Uses of drilling machines, Safety with drill machines, Hand Drilling Machines, Fasteners, Threaded, non-threaded fasteners and adhesives, Fastener safety, Hand taps, Care in tapping, Threads, different types of threads, measuring threads.

Unit-IV
Electrical Accessories: Switches and their types, Wiring switches in series and parallel, Bulbs and their types, Lamp holders and their types, Ceiling Rose and their types, Pin Plug, Socket and Adapter, Fuse outlets and their types.

Practical Exercises:

1. Identify and draw electrical wiring symbols per Indian Standards and NEC.
2. Demonstrate the correct use of pliers, screwdrivers, and neon testers in electrical wiring.

3. Plan and install a domestic wiring system, testing it according to I.E. Rules.
4. Design and test a simple printed circuit board (PCB) for functionality and safety.
5. Operate hand and bench drilling machines safely, adhering to best practices.
6. Install and test switches, sockets, and lamp holders in series and parallel configurations.

Suggested Readings:

1. Frederic P. Hartwell and H. P Richter; Practical Electrical Wiring: Residential, Farm, Commercial, and Industrial, Park Publishing, 2014.
2. A. J. Coker and W. Turner, "Electric Wiring Domestic", Newnes, 10th Edition.
3. Electrical Wiring Commercial, 17E Ry C. Mullin, Phil Simmons NEC 2020.
4. Rex Cauldwell; Wiring a House, Published by The Taunton Press, 2002.

Note:

1. Only the latest editions of the above books are recommended

ELECTRICAL VEHICLE
EL-202

Total credits: 3

L	T	P
3	0	0

Theory: 75
Sessional: 25

Course Objectives:
The objective of this course is to provide students with a comprehensive understanding of electric vehicles, including their architecture, major components, energy storage systems, and charging technologies. The course aims to equip students with the knowledge and practical skills necessary to compare EVs with internal combustion engine vehicles, understand hybrid electric vehicle configurations, evaluate various energy storage systems, and analyse EV charging systems and technologies.

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

- CO1: Explain the architecture and major components of electric and hybrid electric vehicles.
- CO2: Demonstrate the principles of battery charging and regenerative braking in EVs.
- CO3: Evaluate the parameters for selecting traction motors and the dynamics affecting EV performance.
- CO4: Assess various EV charging technologies, identifying potential faults, and implementing safety precautions.

Unit-I
Introduction: Definition of Electric vehicle, Need of Electric Vehicles, Electric vehicle Architecture, Major components of electric vehicle, Comparison between an IC engines derived vehicle and an electric vehicle, Essential factors for the growth of EV.
Hybrid Electric vehicles: Concept and architecture of HEV drive train (Series, parallel and series parallel), Modes of operation of HEV's.

Unit-II
Energy Storage Systems: Battery Parameters, Battery Charging, regenerative braking, Introduction to energy storage requirements in Hybrid and Electric vehicles, battery-based energy storage and its analysis, Fuel cell-based energy storage and its analysis, Ultracapacitor-based energy storage and its analysis

Unit-III
Introduction to Components in EV: Traction controller, Traction Motors, Parameters responsible for selection of traction motors: Vehicle resistance, Tire rolling resistance, aerodynamic drag, grading resistance, acceleration force, vehicle mass, vehicle power output, vehicle speed, gear ratio; Vehicle dynamics.

Unit-IV
EV Charging System: EV Charger, On-board charger, off-board charger, Main components of EV Charger, EV charging technologies, Classification of EV charging technologies, Power levels of vehicle charging, Plug-In charging system, Wireless charging system, EV charging system faults, Safety precautions for EV charging.

Practical Exercises:

1. Identify and compare the components and performance characteristics of EVs and internal combustion engine vehicles.
2. Analyse the series, parallel, and series-parallel architectures of hybrid electric vehicle

drive trains.
3. Measure and evaluate battery parameters, including capacity, voltage, and state of charge, in an EV battery system.
4. Demonstrate the principles of regenerative braking and its impact on energy storage in EVs.
5. Calculate and analyse the selection criteria for traction motors based on vehicle dynamics and resistance factors.
6. Evaluate different EV charging technologies (plug-in, wireless) and identify common faults and safety measures.

Suggested Readings:

1. Iqbal Husain; Electric and Hybrid Vehicles: Design Fundamentals, Third Edition, CRC Press, 2021.
2. Ali Emadi, Mehrdad Ehsani and John M. Miller; Vehicular Electric Power Systems: Land, Sea, Air and Space Vehicles, First Edition, Marcel Dekker, 2004.

Note:

1. Only the latest editions of the above books are recommended

ELECTRICAL MACHINE - I
EL-203

Total credits: 3

L	T	P
3	0	0

Theory: 75
Sessional: 25

Course Objectives:
The objective of this course is to provide students with a thorough understanding of electrical machines, including motors, generators, transformers, and induction motors. The course aims to equip students with knowledge of the working principles, construction, characteristics, and applications of these machines. Students will also gain practical skills in testing and analysing the performance and faults of various electrical machines.

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

- CO1: Explain the working principles, construction, and differences between motors and generators.
- CO2: Conduct tests and analyse the performance of single-phase and three-phase transformers.
- CO3: Evaluate the characteristics and speed control methods of DC motors.
- CO4: Assess the working principles, construction, and applications of single-phase induction motors.

Unit-I
Introduction to Electrical Machines: Definition of motor and generator, Generalized Model of an Electric Machine, Torque development due to alignment of two fields, Electro-magnetically induced emf, Elementary concept of an electrical machine, Comparison of generator and motor.

Unit-II
Single Phase Transformer: Working principle and Constructional features of a transformer and parts of transformer, Practical Transformer on No-Load, Equivalent Circuit Diagram of a Transformer, Losses in Transformer, Transformer Tests, Auto- transformer, Working of Auto-Transformer, Saving of Copper, Types of Transformers,
Three Phase Transformer: Construction of three phase transformer and accessories of transformers such as Conservator, breather, Buchholtz Relay, Tap Changer (off load and on load), Three phase transformer Connection i.e., delta-delta, delta-star, star-delta and star-star, Star delta connections (relationship between phase and line voltage, phase and line current) Conditions for parallel operation of 3 phase Transformer.

Unit-III
DC Machines: Construction of a DC Machine, Armature and Commutator, Types of DC Machine, Emf Equation Significance of Back Emf, Torque Developed, DC Motor Characteristics, Speed control of DC Motor, Starters of DC Motor, Application of DC Motor, Faults in DC Machines.

Unit-IV
Single Phase Induction Motor: Introduction to single phase induction motor, working principle and construction of single-phase IM, Capacitor Start IM, Capacitor Start- Capacitor Run IM, Shaded Pole Single phase IM and Universal motor and applications of single-phase IM.

Practical Exercises:

1. Demonstrate the construction and compare the working principles of a motor and a generator.
2. Conduct a no-load test on a single-phase transformer and analyse the equivalent circuit diagram.
3. Evaluate different three-phase transformer connections and observe voltage and current relationships.
4. Analyse the characteristics of a DC motor and perform speed control experiments using various methods.
5. Identify common faults in DC machines and demonstrate troubleshooting techniques.
6. Evaluate the performance of a capacitor start induction motor and compare it with a capacitor start-capacitor run IM.

Suggested Readings:

1. “Electric Machines” by Ashfaq Husain.
2. P. S. Bimbhra, “Electrical Machines - I”, Khanna Book Publishing, 2019.
3. D. P. Kothari and I. J. Nagrath, “Electric Machine”, The McGraw Hill companies, Third Edition.

Note:

1. Only the latest editions of the above books are recommended

ELECTRICAL WORKSHOP – II
EL-205

Total credits: 5

L	T	P
0	0	5

Theory: 70

Sessional: 30

Course Objectives:

The objective of this course is to provide students with in-depth knowledge and practical skills in analysing and testing electrical machines, particularly single-phase transformers and DC machines. Students will learn to derive important equations, perform standard tests, and analyse the performance characteristics and operational requirements of these machines.

Course Outcomes:

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

- CO1: Derive and explain the EMF equation of a single-phase transformer and understand its significance in transformer design and operation.
- CO2: Perform and analyse no-load, short-circuit, and Sumpner's tests on transformers to determine their efficiency and equivalent circuit parameters.
- CO3: Establish and verify the conditions necessary for the parallel operation of transformers, ensuring their proper functioning in power systems.
- CO4: Test and evaluate the performance of DC machines, including load tests, field tests, and speed control techniques, to understand their operational characteristics.

Practical

1. To derive the EMF equation of a single-phase transformer.
2. To perform no load and short circuit test on a single-phase transformer.
3. To perform Sumpner's test on transformers.
4. To derive necessary conditions for parallel operation of a single phase and three phase transformers.
5. Describe the functions of individual parts of DC machines.
6. Practicing dismantling and assembling in D.C. Machine.
7. Load test on dc shunt motor to draw speed – torque and horsepower – efficiency characteristics.
8. Field test on dc series machines.
9. Speed control of dc shunt motor by armature and field control.
10. Swinburne's test on dc motor.
11. Retardation test on dc series motor.
12. Regenerative test on dc shunt machines.

Suggested Readings:

1. "Electric Machines" by Ashfaq Husain.
2. P. S. Bimbhra, "Electrical Machines - I", Khanna Book Publishing, 2019.
3. D. P. Kothari and I. J. Nagrath, "Electric Machine", The McGraw Hill companies, Third Edition.

Note:

1. Only the latest editions of the above books are recommended

THIRD SEMESTER

Subject Code	Subject Name	L-T-P	Credits	Marks Weightage		Course Type
				Internal	External	
BSC-302ES	Employability Skills	3-0-0	3	25	75	BSC
EL-301	Power Plant Engineering	3-0-0	3	25	75	PCC
EL-302	Transmission and Distribution of Electrical Power	3-0-0	3	25	75	PCC
EL-303	Electrical Machine - II	3-0-0	3	25	75	PCC
EL-304	Basic Electronics	3-0-0	3	25	75	PCC
EL-306	Electrical Workshop - III	0-0-5	5	30	70	SDP
Total		**15-0-5**	**20**	**155**	**445**	

EMPLOYABILITY SKILLS
BSC-302ES

Total credits: 3

L	T	P
3	0	0

Theory: 75
Sessional: 25

Course Objectives:
This course aims to provide students with a comprehensive understanding of behaviour skills, including soft skills development, body language proficiency, teamwork, leadership, effective communication, and writing skills for professional and personal growth in various contexts.

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

- CO1: Analyse the importance and significance of soft skills in professional settings and evaluate personal development progress through measurable criteria.
- CO2: Demonstrate proficiency in body language, effective presentation techniques, and group discussion strategies for impactful communication and collaboration.
- CO3: Apply teamwork, leadership, conflict management, and decision-making skills to foster productive relationships and resolve interpersonal conflicts efficiently.
- CO4: Create well-structured and professional written communication, including letters, reports, and resumes, demonstrating effective writing skills for diverse contexts.

Unit-I
Behaviour Skills: Introduction, Definition and Significance of Soft Skills, Process, Importance and Measurement of Soft Skill Development.

Unit-II
Body Language: Gesture, Posture, Facial Expression, Group Discussion-Giving up of PREP, REP Technique.
Presentation Skills: How to make a PowerPoint Presentation and body language during presentation.

Unit-III
Teamwork and PDP: Teamwork Skills, Leadership Skills, Personality Development, Conflict Management, Decision-Making and Problem-Solving Skills.

Unit-IV
Writing Skills: Letter Writing, Business Letter, Application Letter, Covering Letter, Formal Mail, Report Writing, Academic Report, Business Report, Technical Project Report, Job Application and Resume Writing.

Practical Exercises:
The learners are required to

1. Practice active listening and feedback skills in group discussions to improve communication and understanding of diverse viewpoints.
2. Conduct role-playing exercises to enhance body language awareness and presentation skills for effective public speaking engagements.
3. Engage in team-building activities to develop teamwork, leadership, and conflict resolution skills within a collaborative environment.
4. Compose various types of letters and reports, including business correspondence and technical project reports, to enhance writing proficiency.
5. Construct and critique resumes and job applications to refine writing skills and

effectively showcase qualifications and experiences.

Suggested Readings:

1. Wren and Martin. High School English Grammar and Composition. New Delhi:RRP, 2007.
2. Murphy, Raymond. Essential English Grammar. New Delhi: Cambridge, 2017.
3. Malhotra, Prerna and Halder, Deb. Communication Skills: Theory and Practice.

Note:

1. Only the latest editions of the above books are recommended.

POWER PLANT ENGINEERING
EL-301

Total credits: 3

L	T	P
3	0	0

Theory: 75
Sessional: 25

Course Objectives:
This course aims to provide students with a comprehensive understanding of power systems, including the principles of power generation, transmission, and distribution. Students will explore various energy sources, both conventional and non-conventional, and gain insights into the design, operation, and combined working of different types of power plants. The course will equip students with the knowledge necessary to evaluate the merits and demerits of different power generation methods and understand the coordination required in power systems.

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

- CO1: Define and explain the key concepts in power generation, transmission, and distribution, and identify the various sources of energy.
- CO2: Describe the operational principles, design, site selection, and environmental impacts of hydroelectric, thermal, and nuclear power plants.
- CO3: Discuss the principles, advantages, and challenges of generating power from solar, wind, tidal, geothermal, and biodiesel sources.
- CO4: Explain the advantages of combined working of different types of power plants and the need for coordination in power systems, including the roles of base load and peak load stations.

Unit-I
Introduction to Power System: Power System, Definition of Generation, transmission and distribution, various sources of energy, Conventional and Non-Conventional Methods of Power Generation.

Unit-II
Conventional Source of Power Generation
Hydro-Electric Power Station: Schematic Arrangement of Hydroelectric Power station, Selection of sites for Hydroelectric power plant, Constituent of Hydroelectric Power Plant, Merits and Demerits of Hydroelectric power plant, Classification of Hydroelectric Power Plant.
Thermal power plant: Schematic Arrangement of Thermal Power Plant, combustion, problem of ash disposal, circulating water schemes, choice of pressure of steam generation and steam temperature, economizer, air preheater, feed water heaters and dust collection.
Nuclear Power Plant: Nuclear Reactor, radioactive decay, Moderator, Schematic Arrangement of Nuclear Power Plant, Merits and Demerits of Nuclear Power Plants, Selection of sites for Nuclear Power Plant.

Unit-III
Non-Conventional Source of Power Generation: Introduction, Concept of Solar Power Generation, Wind Energy, Tidal Energy, Geothermal Energy, Biodiesel Energy.

Unit-IV
Combined Working of Power Plants: Advantages of combined working of different types of power plants, Need for coordination of various types of power plants in power systems, base load stations and peak load stations.

Practical Exercises:

The learners are required to

1. Introduce students to the basic components and structure of a power system.
2. Understand the design and operation of hydroelectric power plants.
3. Analyse the components and processes in a thermal power plant.
4. Explore the functioning of nuclear power plants and understand nuclear reactions.
5. Examine non-conventional energy sources, focusing on solar and wind energy.
6. Understand the coordination required in power systems with multiple types of power plants.

Suggested Readings:

1. Electrical power system, Subir Roy, Prentice Hall.
2. Power System Engineering, Nagrath & Kothery, TMH.
3. Elements of power system analysis, C.L Wadwa, New age international.
4. Electrical Power System, Ashfaq Hussain, CBS Publishers & Distributors

Note:

1. Only the latest editions of the above books are recommended

TRANSMISSION AND DISTRIBUTION OF ELECTRICAL POWER
EL-302

Total credits: 3

L	T	P
3	0	0

Theory: 75

Sessional: 25

Course Objectives:
The objective of this course is to provide students with a solid foundation in the principles and practices of electrical transmission and distribution systems. The course emphasizes the design, construction, and protection of power lines, both overhead and underground, and equips students with the skills to analyse, evaluate, and troubleshoot these systems. Students will also gain knowledge of fault detection and protection mechanisms to ensure the reliability and safety of power systems.

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

- CO1: Understand and explain the basic concepts of overhead and underground transmission systems, including the materials used and the construction of underground cables.
- CO2: Analyse different distribution system configurations, including radial and ring main systems, and evaluate their advantages and disadvantages in various scenarios.
- CO3: Apply knowledge of electrical and mechanical design principles to address issues like corona effect, sag, and conductor bundling in transmission lines.
- CO4: Evaluate and Design protection systems using various types of relays and circuit breakers to ensure the safety and reliability of power systems.

Unit-I
Overhead and Underground Transmission System: Transmission, Overhead and underground transmission system, Advantages and Disadvantages of Overhead Line, Advantages and Disadvantages of underground lines, Materials used in transmission Lines, transmission line parameters, Symmetrical system and unsymmetrical system, Construction of Under-ground Cables.

Unit-II
Distribution System: Introduction, radial and ring main distribution, A.C. distributors fed from one end and both ends, Construction of distribution lines i.e. erection of pole, fixing of insulators and conductors, testing, operation and maintenance of lines.

Unit-III
Electrical and Mechanical design of lines: Corona effect, Reason of Corona Formation, Corona loss, Advantage and disadvantages of corona, Factors Responsible for Corona, How to Reduce the Corona Effect; Sag, Bundling of conductor, Skin effect.

Unit-IV
Faults and Protection: Requirement of power system protection, Methods for protection, relay, Overcurrent relay, directional overcurrent relay, differential relay, distance relay, Circuit breakers: Operating principle, arc phenomena, arc extinction, duties of circuit breaker; Isolator.

Practical Exercises:
The learners are required to

1. Compare overhead and underground transmission systems.

2. Understand the construction and materials used in underground cables.
3. Design a simple distribution system and perform basic testing.
4. Investigate the corona effect and methods to reduce it.
5. Design and implement a basic fault detection and relay protection system.
6. Understand the operating principles of circuit breakers and arc extinction methods.

Suggested Readings:

1. Electrical power system, Subir Roy, Prentice Hall.
2. Power System Engineering, Nagrath & Kothari, TMH.
3. Elements of power system analysis, C.L Wadwa, New age international.
4. Electrical Power System, Ashfaq Hussain, CBS Publishers & Distributors

Note:

1. Only the latest editions of the above books are recommended.

ELECTRICAL MACHINE - II
EL-303

Total credits: 3

L	T	P
3	0	0

Theory: 75

Sessional: 25

Course Objectives:
This course aims to equip students with a thorough understanding of various types of electric machines, including induction motors, synchronous machines, DC generators, and special-purpose machines. Students will learn the principles of operation, constructional features, performance characteristics, and practical applications of these machines. Additionally, students will gain hands-on experience in testing, controlling, and analysing the performance of these machines under various conditions.

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

- CO1: Understand and explain the construction, operation, and performance characteristics of 3-phase induction motors, including the significance of slip and torque-slip relationships.
- CO2: Analyse and evaluate the operation of synchronous machines, including excitation methods, voltage regulation, and the conditions for parallel operation.
- CO3: Apply the principles of DC generators to explain their construction, magnetic circuit, winding types, and commutation methods.
- CO4: Investigate and compare the construction and working principles of special-purpose machines such as linear induction motors, stepper motors, and Schrage motors, and understand their applications.

Unit-I
Induction Motors: Salient constructional features of squirrel cage and slip ring 3-phase induction motors, Principle of operation, slip and its significance, Locking of rotor and stator fields, Rotor resistance, inductance, emf and current, Relationship between copper loss and the motor slip, Power flow diagram of an induction motor, Factors determining the torque, Torque-slip curve, Effect of rotor resistance upon the torque slip relationship, Starting of 3-phase induction motors, DOL, star-delta, auto transformer, Causes of low power factor of induction motors, Testing of 3- phase motor on no load rotor test and find efficiency, Speed control of induction motor.

Unit-II
Synchronous Machines: Main constructional features of commutator and brushless excitation system, Generation of three phase emf, Production of rotating magnetic field in a three-phase winding, Concept of distribution factor and coil span factor and emf equation Armature reaction on unity, lag and lead power factor, Operation of single synchronous machine independently supplying a load - Voltage regulation by synch-impedance method, Need and necessary conditions of parallel operation of alternators Synchronizing an alternator (Synchroscope method) with the bus bars, Operation of synchronous machine as a motor –its starting methods, Effect of change in excitation of a synchronous motor, Cause of hunting and prevention, Rating and cooling of synchronous machines, Applications of synchronous machines (as an alternator, as a synchronous condenser).

Unit-III
DC Generator: Basic structure of DC Generator, Construction and Magnetic circuit of DC Generator, Lap and Wave winding, Commutation, Methods of Improving Commutation,

Characteristics of DC Generators.

Unit-IV

Special Purpose Machines: Construction and working principle of linear induction motor, stepper motor, Schrage motor, DC Generator.

Practical Exercises:

The learners are required to

1. Analyse the performance characteristics of a 3-phase induction motor.
2. Compare different starting methods for 3-phase induction motors.
3. Understand the process of synchronizing an alternator with the power grid.
4. Study the effect of armature reaction on synchronous machines.
5. Investigate the performance characteristics of DC generators.
6. Explore the operation and applications of special-purpose machines.

Suggested Readings:

1. "Electric Machines" by Ashfaq Husain.
2. P. S. Bimbhra, "Electrical Machines - I", Khanna Book Publishing, 2019.
3. D. P. Kothari and I. J. Nagrath, "Electric Machine", The McGraw Hill companies, Third Edition.

Note:

1. Only the latest editions of the above books are recommended

BASIC ELECTRONICS
EL-304

Total credits: 3

L	T	P	Theory: 75
3	0	0	Sessional: 25

Course Objectives:
The objective of this course is to provide students with a foundational understanding of semiconductor devices, transistors, rectifiers, number systems, Boolean algebra, and digital circuits. The course covers the principles, operations, and applications of these components in electronic systems, with an emphasis on developing skills to design and analyse both combinational and sequential circuits.

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

CO1: Understand and explain the basic concepts of semiconductors, including the structure and operation of diodes and their biasing techniques.
CO2: Analyse the operation and characteristics of PNP and NPN transistors in various configurations, and design basic rectifier circuits.
CO3: Apply knowledge of number systems and Boolean algebra to perform binary arithmetic, logic gate operations, and simplification of logic expressions using K-map methods.
CO4: Design and evaluate combinational and sequential circuits, including adders, subtractors, multiplexers, flip-flops, counters, and state machines.

Unit-I
Basics of Semiconductors: Introduction to semiconductors, anode, cathode, P-type semiconductor, N-type semiconductor, Diode, Structure of diode, operation of diode, Diode biasing, Forward bias and reverse bias.

Unit-II
Transistors and rectifiers: Basic theory and operation of PNP and NPN transistors, characteristics of Common base (CB), Common emitter (CE) and Common Collector (CC) configuration, Base bias, emitter feedback bias, voltage divider bias, load line, operating point, Half wave and full wave rectifiers.

Unit-III
Number System and Boolean algebra: Binary, Octal and Hexadecimal representation and their conversion, BCD, Gray codes and their conversion, Signed binary numbers representation with 1's and 2's complement methods, Binary arithmetic, Various logic gates and their truth tables and circuits, Representation in SOP and POS forms, Minimization of logic expressions by algebraic method, K-map method.

Unit-IV
Combinational and Sequential Circuits: Adder and subtractor circuit, Circuit of Encoder, Decoder, Comparator, Multiplexer, De Multiplexer and parity Generator; Basic memory elements, S-R, J-K, D, and T Flipflop, various types of Registers, Counters & their design, Irregular counter, State table & State transition diagram, Sequential circuit design methodology.

Practical Exercises:
The learners are required to

1. Understand the structure and operation of diodes under different biasing conditions.

2. Analyse the operation of transistors in different configurations.
3. Design and analyse half-wave and full-wave rectifiers.
4. Work with logic gates and simplify Boolean expressions.
5. Design and test combinational circuits like adders, subtractors, and multiplexers.
6. Explore the design and operation of sequential circuits.

Suggested Readings:

1. “Electronic devices and circuit theory” by Boylestad and Nashelsky, Pearson.
2. “Principles of electronics” by V K Mehta and Rohit Mehta, Chand.
3. Fundamentals of Digital Circuits, A. Anand Kumar, PHI.
4. Digital Logic Design, Morries Mano, PHI.

Note:

1. Only the latest editions of the above books are recommended

ELECTRICAL WORKSHOP – III
EL-306

Total credits: 5

L	T	P	Theory: 70
0	0	5	Sessional: 30

Course Objectives:
The objective of this course is to provide students with a comprehensive understanding of the operational principles, performance characteristics, and testing methods of synchronous machines and 3-phase induction motors. Students will learn how to perform essential tests, analyse machine behaviour under various conditions, and apply these skills to real-world applications in electrical engineering.

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

CO1: Analyse the performance of alternators under load conditions and calculate voltage regulation using different methods.
CO2: Conduct essential tests such as no-load, blocked rotor, and slip tests on 3-phase induction motors to determine their operational characteristics.
CO3: Evaluate the short circuit ratio (SCR) of a synchronous machine and its implications on machine stability.
CO4: Demonstrate the synchronization of an alternator with the grid and the construction and operational principles of synchronous motors.

Practical

1. Direct Load test on Alternator.
2. Voltage Regulation of an Alternator by Synchronous Impedance Method.
3. Voltage Regulation of an Alternator by Ampere-turn or MMF method.
4. Voltage Regulation of an Alternator by Zero Power Factor (ZPF) Method.
5. Short Circuit Ratio (SCR) of a Synchronous machine.
6. Slip test on Synchronous machine.
7. Synchronization of an alternator.
8. Construction and Study of Synchronous Motor.
9. V-curves of Synchronous Machine.
10. Direct load test on 3-Phase Induction Motors.
11. No-load test and Blocked rotor test on 3-phase Induction motor

Suggested Readings:

1. “Electric Machines” by Ashfaq Husain.
2. P. S. Bimbhra, “Electrical Machines - I”, Khanna Book Publishing, 2019.
3. D. P. Kothari and I. J. Nagrath, “Electric Machine”, The McGraw Hill companies, Third Edition.

Note:

1. Only the latest editions of the above books are recommended

FOURTH SEMESTER

Subject Code	Subject Name	L-T-P	Credits	Marks Weightage		Course Type
				Internal	External	
EL-401	Industrial Electronics and control of drives	3-0-0	3	25	75	PCC
EL-402	Basics of Measuring Instruments	3-0-0	3	25	75	PCC
EL-404	PLC Workshop	0-0-5	5	30	70	SDP
BSC-401P	Project	3-0-0	3	30	70	SDP
OEC-401 to 404	Open Elective Course	3-0-0	3	25	75	OEC
PEC-EL-401 to 404	Program Elective Course	3-0-0	3	25	75	PEC
Total		**15-0-5**	**20**	**160**	**440**	

LIST OF OPEN ELECTIVE COURSES

Course Code	Course Name
OEC-401	Entrepreneurship
OEC-402	Trends in Technology
OEC-403	Waste Management
OEC-404	Industry 4.0

LIST OF PROGRAM ELECTIVE COURSES

Course Code	Course Name
PEC-EL-401	Restructured Power System
PEC-EL-402	Network Analysis and Synthesis
PEC-EL-403	Waste to Energy
PEC-EL-404	Special Purpose Machines

INDUSTRIAL ELECTRONICS AND CONTROL OF DRIVES
EL-401

Total credits: 3

L	T	P	Theory: 75
3	0	0	Sessional: 25

Course Objectives:
This course aims to provide students with an in-depth understanding of power electronics, focusing on the principles, operation, and applications of thyristors, rectifiers, choppers, inverters, and cyclo-converters. Students will gain practical knowledge of these devices, their characteristics, and how they are used in various power conversion systems.

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

- CO1: Understand and explain the structure, operation, and V-I characteristics of thyristors, including methods of triggering and protection techniques.
- CO2: Analyse the working principles and applications of various types of rectifiers, including both uncontrolled and controlled configurations under different load conditions.
- CO3: Apply knowledge of choppers to describe their types, working principles, and applications in power conversion, including the operation under continuous and discontinuous conduction modes.
- CO4: Design and evaluate the operation of inverters and cyclo-converters, including the structure and applications of voltage source inverters (VSI), current source inverters (CSI), and cyclo-converters.

Unit-I
Introduction to Thyristor: Thyristor or Silicon Controlled rectifier (SCR), Basic structure and operation of a Thyristor, two transistor analogy of Thyristor, V-I characteristics of Thyristor, Methods of triggering a Thyristor, Applications of thyristor, dv/dt and di/dt protection of thyristor, Snubber Circuits and Gate Circuits.

Unit-II
Rectifiers: Introduction, types, Working principles and applications of Rectifiers, Uncontrolled rectifiers, controlled rectifiers, Basic structure and operation of uncontrolled and controlled rectifiers under various loads: resistive, inductive and RL load; Three phase configuration of uncontrolled rectifiers.

Unit-III
Chopper: Introduction, types of choppers and their working principles and applications: Buck converters, Boost Converters, and Buck-boost converters; working of chopper under both continuous and discontinuous conduction mode.

Unit-IV
Inverters: Introduction, Working principles and applications of Inverters, Voltage source inverters (VSI), Current source inverters (CSI), Structure and operation of VSI and CSI.
Cyclo-converters: Introduction, types, Working principles and applications of Cycloconverters.

Practical Exercises:
The learners are required to

1. Understand the operation and characteristics of a thyristor.
2. Design and analyse rectifier circuits for different load types.

3. Explore the working principles of different types of choppers.
4. Understand the operation of voltage source inverters (VSI) and current source inverters (CSI).
5. Investigate the working principles of cyclo-converters.

Suggested Readings:

1. P S Bimbhra, “Power Electronics”, Khanna Publishers.
2. Power Electronics by M.H. Rashid, PHI.
3. Power Electronics by M.D. Singh and K.B. Khanchandani, TMH.

Note:

1. Only the latest editions of the above books are recommended

BASICS OF MEASURING INSTRUMENTS
EL-402

Total credits: 3

L	T	P
3	0	0

Theory: 75

Sessional: 25

Course Objectives:
The objective of this course is to provide students with a comprehensive understanding of electrical measuring instruments, including their construction, operation, and applications. The course covers various instruments used for measuring electrical quantities, their principles of operation, sources of error, and methods of compensation. Students will gain practical knowledge in selecting and using the appropriate instruments for different electrical measurements.

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

- CO1: Understand and explain the basic concepts of measurement and the types of electrical measuring instruments, including their components and operating principles.
- CO2: Analyse and compare the construction, working principles, and applications of ammeters, voltmeters, and wattmeter's, including both analog and digital types.
- CO3: Apply knowledge of energy meters to understand their operation, error compensation, and use in single-phase and three-phase systems.
- CO4: Evaluate and Utilize various specialized measuring instruments such as Meggers, Earth testers, mustimeters, frequency meters, and power factor meters in practical scenarios.

Unit-I
Introduction to Electrical Measuring Instruments: Concept of measurement and instruments, Concept of measurement of electrical quantities and instruments for their Measurements, sources of error. Types of electrical measuring instruments – indicating, integrating and recording type instruments, Essentials of indicating instruments – deflecting, controlling and damping torque.

Unit-II
Ammeters and Voltmeters (Moving coil and moving iron type): Concept of ammeter and voltmeters and difference between them, Construction and working principles of moving Iron and moving coil instruments, Merits and demerits, sources of error and application of these instruments Wattmeter (Dynamometer Type), Construction, working principle, merits and demerits of dynamometer type wattmeter, Digital wattmeter.

Unit-III
Energy meter: Induction Type; Construction, working principle, merits and demerits of single-phase and three-phase energy meters, Errors and their compensation, Simple numerical problems, Construction and working principle of maximum demand indicators, Digital energy meter (diagram, construction, and application).

Unit-IV
Measuring Instruments: Construction, working principle and application of Meggar, Earth tester (analog and digital) Multimeter, Frequency meter (dynamometer type) single phase power factor meter (Electrodynamometer type). Working principle of synchroscope and phase sequence indicator, tong tester (Clamp-on meter).

Practical Exercises:

The learners are required to

1. Understand the essentials of indicating instruments and their operating principles.
2. Analyse the construction and working principles of moving coil and moving iron ammeters and voltmeters.
3. Understand the operation and errors in dynamometer type wattmeter.
4. Calibrate and test single-phase and three-phase energy meters.
5. Explore the construction, operation, and applications of specialized measuring instruments.

Suggested Readings:

1. K. Sawhney & Puneet Sawhney, "A Course in Electrical and Electronic measurements and Instrumentation", 7/e, Dhanpat Rai & Co.(P) Ltd., 2005.
2. Albert D. Helfrick & William D. Cooper, "Modern Electronic Instrumentation and Measurement Technique", Low Price Edition, Pearson Education, 2005.
3. Ernest O. Doebelin, "Measurement Systems Application and Design", 5/e, Tata McGraw – Hill Publishing Company Ltd., 2004.
4. H. S. Kalsi, "Electronic Instrumentation", Technical Education Series, Tata McGraw –Hill Publishing Company Ltd., 2001.
5. Alan S. Morris, "The Essence of Measurement", Eastern Economic Edition, Prentice Hall of India Private Limited., 1997.

Note:

1. Only the latest editions of the above books are recommended

PLC WORKSHOP
EL-404

Total credits: 5

L	T	P
0	0	5

Theory: 70

Sessional: 30

Course Objectives:
To provide students with a comprehensive understanding of Programmable Logic Controllers (PLCs), including their architecture, programming languages, and practical applications, enabling them to develop and implement PLC-based solutions in various real-world scenarios.

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

CO1: Understand and explain the fundamental concepts, architecture, and operational principles of PLCs, including the functions of various modules and components.

CO2: Identify and utilize different PLC programming languages and demonstrate proficiency in using both handheld programmers and computer interfaces for PLC programming.

CO3: Develop and implement ladder diagrams and other PLC programming techniques to control and automate simple processes.

CO4: Analyse and troubleshoot basic logic operations and PLC-based control systems, ensuring proper functionality and addressing any issues that arise during the programming and operational phases.

Practical

1. To study the basic concept of Programmable Logic Controllers (PLCs), including their purpose and application.
2. To understand the building blocks of a PLC and the function of various blocks.
3. To learn about the PLC architecture, including central processing unit (CPU), input/output modules, power supply, and communication modules.
4. To explore the function of different modules and components within a PLC.
5. To familiarize with different PLC programming languages, including Ladder Logic, Function Block Diagram (FBD), Structured Text (ST), Instruction List (IL), and Sequential Function Chart (SFC).
6. To practice programming basic instructions such as latching, master control self-holding relays, timer instructions (retentive timers, resetting of timers), and counter instructions (up counters, resetting of counters).
7. To introduce step programming language for sequential control processes.
8. To develop ladder diagrams using basic instructions, timers, counters, sequencers, and comparison instructions.
9. To implement and test ladder diagrams on PLC systems to control and automate processes.
10. To practice basic logic operations including AND, NOT, and OR functions in ladder diagrams and other programming languages.

Suggested Readings:

1. “Introduction to Programmable Logic Controllers” by Gary Dunning.
2. “Programmable Logic Controllers: An Introduction” by Frank D. Petruzella.

Note:

1. Only the latest editions of the above books are recommended

PROJECT
BSC-401P

Total credits: 3

L	T	P
0	0	3

Theory: 70

Sessional: 30

Course Objectives:
The aim of this course is to apply the subject knowledge to make a project related to your field.

PROJECT
The student individually works on a specific topic approved by a faculty member who is familiar in this area of interest. The student can select any topic which is relevant to his/her specialization of the programmer. The topic may be experimental or analytical. At the end of the semester, a detailed report on the work done should be submitted which contains a clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work. The students will be evaluated through a viva-voce examination by a panel of examiners including one external examiner.

ENTREPRENEURSHIP
OEC-401

Total credits: 3

L	T	P
3	0	0

Theory: 75
Sessional: 25

Course Objectives:
This course provides a comprehensive understanding of entrepreneurship, covering essential traits of entrepreneurs, industry classification, start up support systems, tax systems, relevant industrial acts, and project report preparation, including ISO 9000 series quality systems, equipping students to effectively launch and manage new ventures

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

- CO1: Explain the essential characteristics of successful entrepreneurs and the classification of industries by size.
- CO2: Identify and utilize support systems for start-ups, including roles of various state and national organizations.
- CO3: Evaluate the impact of tax systems and industrial acts on business operations and compliance requirements.
- CO4: Prepare a comprehensive project report, incorporating ISO 9000 series quality systems and proper format guidelines.

Unit-I
Entrepreneurship and entrepreneur: Entrepreneurship concept and process, Entrepreneur, Essential Characteristics of a good Entrepreneur, Types of entrepreneurs, Industrial Policy, Classification of industries- Micro, small scale, medium scale, large scale, Product identification/ selection, Site selection, Plant layout, Pre-market survey

Unit-II
Entrepreneurship Support System and Start-ups: Introduction to start-up's, Role of District Industries Centre in setting up industry, Function of NSIC, SISI, NISIET, NRDC, SSIC, SIDO, NMTC, KVIC, RSMML, Role of state finance corporation, state electricity corporations, pollution control board, BIS, I.S.O. etc.

Unit-III
Introduction to Tax System, and Acts: Idea of income tax, Goods and Services Tax and custom duty, Introduction to Industrial Acts, factory Act, Workmen's Compensation Act 1923, Apprentices Act 1961, Environmental Protection Act 1986.

Unit-IV
Project Report Preparation: Procedure of preparing a project report, Format of project report, Preparation of project report, Introduction to ISO: 9000 Series of Quality System.

Practical Exercises:
The learners are required to

1. Analyze the characteristics of successful entrepreneurs and identify the types of entrepreneurs in real-world case studies.
2. Investigate and report on the functions of local entrepreneurship support organizations such as NSIC and District Industries Centre.
3. Evaluate the impact of current tax systems on small and medium-sized enterprises through a detailed case study.
4. Review and critique sample project reports to identify best practices and common

pitfalls in report preparation.

5. Develop a comprehensive project report for a hypothetical business, including ISO 9000 series quality system guidelines.

Suggested Readings:

1. Khanka S.S., “Entrepreneurship Development” S. Chand
2. Desai, A N. "Entrepreneur & Environment" Ashish, New Delhi.
3. Drucker, Peter. "Innovation and Entrepreneurship" Heinemann, London.
4. Jain Rajiv. "Planning a Small-Scale Industry: A Guide to Entrepreneurs" S.S. Books, Delhi.
5. Kumar, S A. "Entrepreneurship in Small Industry" Discovery, New Delhi

Note:

1. Only the latest editions of the above books are recommended

TRENDS IN TECHNOLOGY
OEC-402

Total credits: 3

L	T	P	Theory: 75
3	0	0	Sessional: 25

Course Objectives:
The course aims to equip students with comprehensive knowledge of e-commerce, e-banking, e-governance, e-agriculture, and e-learning, focusing on their architectures, functionalities, benefits, and security protocols, while providing practical insights through case studies and real-world applications.

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

- CO1: Analyze the architecture, types, advantages, and payment systems of e-commerce, including smart card technologies.
- CO2: Utilize e-banking transactions and security protocols such as SSL and digital signatures for safe online financial operations.
- CO3: Assess e-governance models and strategies, addressing challenges and implementing effective solutions in various contexts.
- CO4: Develop and utilize e-learning platforms and tools like LMS, video conferencing, and virtual campuses for enhanced education delivery

Unit-I
E-Commerce: Introduction: E-commerce as Business need-commerce, Types, Advantages, Disadvantages, e-Commerce Architecture; Internet Payment Systems, Characteristics, 4C Payment Methods, SET Protocol for Credit Card Payment, E-Cash, E-Check, Overview of Smart Card.

Unit-II
E-mail & Internet: Introduction, E-mail Account & Its Functions, Search Engine, Surfing Webpages, Basics of Social Networking Site. E-Banking Transactions: Inter Banking, Intra Banking, Electronic Payments, (Payment – Gateway Example), Securities in E-banking (SSL, Digital Signatures – Examples), Services Provided: ATM, Smart Card ECS (Electronic Clearing System), e.g., Telephone, Electricity Bills.

Unit-III
E – Governance & E – Agriculture: E –Governance Models: (G2B, G2C, C2G, G2G), Challenges to E – Governance, Strategies and tactics for implementation of E – Governance, Types of Agriculture information (Soil, Water, Seeds, Market rate) & Technique dissemination, Future trade marketing, Corp Management, Query redresses System, (Information Kiosk, IVR, etc.), Case Study.

Unit-IV
E-learning: Models WBT, CBT, Virtual Campus, LMS & LCMS, Video Conferencing, Chatting Bulleting, Building Online Community, Asynchronous / Synchronous Learning, Case Study.

Practical Exercises:
The learners are required to

1. Develop an E-commerce Website: Create a functional e-commerce site with payment systems like E-Cash and E-Check, incorporating smart card transactions.
2. Implement and test an e-banking transaction system, ensuring security with SSL and

digital signatures.

3. Build an e-governance portal with G2C and G2B models, incorporating strategies for overcoming common challenges.
4. Develop a digital platform to disseminate agricultural information such as soil data, water usage, and market rates.
5. Construct an e-learning environment using LMS, virtual campus tools, and synchronous/asynchronous learning methods

Suggested Readings:

1. E–Commerce: C.V.S. Murty.
2. Fire Wall and Internet Security: William Cheswick, Stevens, Aviel, Rubin.
3. The Essential Guide to Knowledge management: Amrit Tiwana.
4. The GIS Book: George B. Karte.
5. Management Information System: Laudon & Laudon

Note:

1. Only the latest editions of the above books are recommended

WASTE MANAGEMENT
OEC-403

Total credits: 3

L	T	P
3	0	0

Theory: 75
Sessional: 25

Course Objectives:
The course aims to provide comprehensive knowledge of solid and hazardous waste management, including regulatory frameworks, waste characterization, storage, transportation, processing technologies, and disposal methods, emphasizing sustainable practices and environmental protection.

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

- CO1: Analyse types and sources of waste, and interpret Indian legislation on waste management and handling.
- CO2: Characterize and reduce waste: Assess physical, chemical, and biological properties of wastes, and implement strategies for waste reduction and recycling.
- CO3: Optimize waste storage and transport: Design effective systems for waste segregation, storage, collection, and transportation, ensuring safety and efficiency.
- CO4: Implement waste processing and disposal: Apply technologies for waste processing and disposal, including composting, incineration, and landfill management, focusing on sustainability.

Unit-I
Sources, Classification and Regulatory Framework: Types and Sources of solid and hazardous wastes, Need for solid and hazardous waste management, Elements of integrated waste management and roles of stakeholders, Salient features of Indian legislations on management and handling of municipal solid wastes, hazardous wastes, biomedical wastes, lead acid batteries, electronic wastes, plastics and fly ash, Financing waste management.

Unit-II
Waste Characterization and Source Reduction: Waste generation rates and variation, Composition, physical, chemical and biological properties of solid wastes, Hazardous Characteristics, TCLP tests, waste sampling and characterization plan, Source reduction of wastes, Waste exchange, Extended producer responsibility, Recycling and reuse Practical Composition of MSW, Determination of Physical and Chemical Properties of MSW.

Unit-III
Storage, Collection and Transport of Wastes: Handling and segregation of wastes at source, storage and collection of municipal solid wastes, Analysis of Collection systems, need for transfer and transport, transfer stations Optimizing waste allocation, compatibility, storage, labelling and handling of hazardous wastes, hazardous waste manifests and transport. Waste Processing Technologies: Objectives of waste processing, material separation and processing technologies, biological &chemical conversion technologies, methods and controls of Composting, thermal conversion technologies, energy recovery, incineration, solidification & stabilization of hazardous wastes- treatment of biomedical wastes

Unit-IV
Waste Disposal: Waste disposal options, Disposal in landfills, Landfill Classification, types and methods, site selection, design and operation of sanitary landfills, secure landfills and

landfill bioreactors, leachate and landfill gas management, landfill closure and environmental monitoring, Rehabilitation of open dumps, landfill remediation

Practical Exercises:

The learners are required to

1. Research and present on Indian waste management laws, highlighting key provisions and their implications.
2. Conduct TCLP tests and analyze waste samples to determine their physical, chemical, and hazardous characteristics.
3. Develop a comprehensive waste management plan for a community, considering storage, collection, and transportation logistics.
4. Simulate waste processing techniques such as composting and incineration, evaluating their efficiency and environmental impact.
5. Design a landfill site, considering classification, operation methods, environmental monitoring, and rehabilitation strategies

Suggested Readings:

1. George Techobanoglous et al, “Integrated Solid Waste Management”, McGraw - Hill, 2014.
2. Manual on Municipal Solid waste Management, CPHEEO, Ministry of Urban Development, Govt. Of. India, New Delhi, 2000

Note:

1. Only the latest editions of the above books are recommended

INDUSTRY 4.0
OEC-404

Total credits: 3

L	T	P
3	0	0

Theory: 75
Sessional: 25

Course Objectives:
To introduce Industry 4.0, Internet of Things (IoT) and related topics. This subject will introduce students about technological and business challenges and opportunities as well as ethical concerns related to IoT.

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

- CO1: Evaluate the principles and challenges of Industry 4.0 implementation.
- CO2: Assess the impact of Industry 4.0 technologies on organizational productivity and value addition.
- CO3: Explain the characteristics and functional blocks of the Internet of Things (IoT).
- CO4: Discuss the foundations, scope, and applications of Artificial Intelligence (AI) in Industry 4.0.

Unit-I
Introduction of Industry 4.0: Industry 4.0 definition, Benefits of Industry 4.0, Industrial Revolutions and Future View, The digital transformation of industry and the fourth industrial revolution, Principles of "Smart Factory", Industry 4.0 strategy and implementation, Industry 4.0 challenges and risks.

Unit-II
Industry 4.0 Technologies: Articulate how key IoT technologies can improve organizational productivity and add value, Human-machine interaction, Advanced robotics and 3-D printing, Lean Manufacturing Touch interfaces, virtual reality and augmented-reality systems, Cloud Computing.

Unit-III
IOT: Defining IoT, Characteristics of IoT, Physical design of IoT, Logical design of IoT, Functional blocks of IoT.

Unit-IV
M2M and Introduction of Artificial Intelligence: Machine to Machine, Difference between IoT and M2M, Software define Network.
Introduction of Artificial intelligence: Foundations, scope, problems, and approaches of AI, Intelligent agents: reactive, deliberative, goal-driven, utility-driven, and learning agents.

Practical Exercises:
The learners are required to

1. Analyse case studies of companies implementing Industry 4.0 strategies, identify key challenges faced during implementation, and propose solutions to address these challenges.
2. Design a conceptual IoT system architecture, including physical and logical designs, and identify the functional blocks required for data acquisition, processing, communication, and control in an IoT environment.

Suggested Readings:

1. Analyze case studies of companies implementing Industry 4.0 strategies, identify key challenges faced during implementation, and propose solutions to address these

challenges.

2. Design a conceptual IoT system architecture, including physical and logical designs, and identify the functional blocks required for data acquisition, processing, communication, and control in an IoT environment.

Note:

1. Only the latest editions of the above books are recommended.

RESTRUCTURED POWER SYSTEM
PEC-EL-401

Total credits: 3

L	T	P
3	0	0

Theory: 75

Sessional: 25

Course Objectives:
The objective of this course is to provide students with an in-depth understanding of the restructuring and deregulation of the power industry, with a focus on economic principles, market models, and congestion management techniques. The course will also explore the specific reforms in the Indian power sector, including regulatory frameworks and market mechanisms.

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

- CO1: Understand and explain the concepts of restructuring and deregulation in the power industry, including the reasons, objectives, and processes involved.
- CO2: Apply fundamental economic principles to analyse consumer and supplier behaviour, market equilibrium, and the costs associated with power production in different market models.
- CO3: Analyse transmission congestion management techniques and the principles of Locational Marginal Pricing (LMP), including their formulation and implementation.
- CO4: Evaluate the reforms in the Indian power sector, including the framework, regulatory changes, and the impact of key initiatives such as the Electricity Act 2003 and the availability-based tariff (ABT).

Unit-I
Introduction: Understanding Restructuring, Reasons for restructuring/ deregulation of power industry, Understanding the restructuring process, Introduction to issues involved in deregulation, Reasons and objectives of deregulation of various power systems across the world.

Unit-II
Fundamental of economics: Introduction, Consumer behaviour, Supplier behaviour, Market equilibrium, Short-run and Long-run costs, Various costs of production, perfectly competitive market, Philosophy of Market Models, Market models based on contractual arrangements, Comparison of various market models, Market architecture.

Unit-III
Transmission Congestion Management and Locational Marginal Prices: Introduction, Classification of congestion management methods, Calculation of ATC, Nonmarket methods, Nodal pricing, Inter-zonal Intra-zonal congestion management, Price area congestion management, Capacity alleviation method, fundamentals of Locational Marginal Pricing (LMP), LMP formulation and implementation, LMP using DCOPF.

Unit-IV
Reforms of Indian Power sector: Introduction, Framework of Indian power sector, Reform initiatives during 1990-1995, The availability-based tariff (ABT), The Electricity Act 2003, Open Access issues, Power exchange.

Practical Exercises:
The learners are required to

1. Understand the restructuring process in the power industry.
2. Apply economic principles to power market models.
3. Analyse and implement congestion management techniques in power transmission.
4. Evaluate the impact of reforms in the Indian power sector.
5. Simulate market equilibrium in a deregulated power market.

Suggested Readings:

1. S. A. Khaparde and A. R. Abhyankar, “Restructured Power Systems”, Alpha Science, U.K., 2011.
2. PRAYAS Energy Group, “Know Your Power, A citizens Primer on the Electricity Sector”, Second Edition, PRAYAS Energy Group, Pune, 2006.
3. S. R. Paranjothi, “Modern Power Systems – The Economics of Restructuring”, 1st Edition, New Age International Pvt. Ltd., 2017.
4. Lo Lei Lai, “Power System Restructuring and Deregulation: Trading, Performance and Information Technology”, Indian Edition, Wiley India Ltd., 2001.
5. Mohammad Shahidehpour, Muwaffaq Alomoush, “Restructured Electrical Power Systems: Operation, Trading and Volatility”, CRC Press, 2001

Note:

1. Only the latest editions of the above books are recommended.

NETWORK ANALYSIS AND SYNTHESIS
PEC-EL-402

Total credits: 3

L	T	P
3	0	0

Theory: 75
Sessional: 25

Course Objectives:
The objective of this course is to provide students with a solid foundation in network analysis and signal processing, focusing on two-port networks, signal classification, and the application of Laplace and Fourier transforms. Students will learn to analyze electrical networks and signals using these mathematical tools and apply them in practical scenarios.

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

- CO1: Analyse two-port networks by determining and converting between Z, Y, Hybrid, ABCD, and T parameters, and understand their interrelationships in series, parallel, and cascade configurations.
- CO2: Classify and characterize different types of signals, including linear and non-linear, periodic and non-periodic, time-variant and time-invariant, causal and non-causal, stable and unstable, static and dynamic signals.
- CO3: Apply the Laplace transform to solve network analysis problems, including the transformation of various functions and the calculation of inverse Laplace transforms.
- CO4: Utilize the Fourier transform for analysing signals in the frequency domain, transforming various functions, and applying inverse Fourier transforms to solve complex network analysis problems.

Unit-I
Two Port Network: Introduction, Two port network parameters: Z parameter, Y parameter, Hybrid Parameter, ABCD parameter and T parameter; Conversion of simple circuit into two port networks, relation between various two port network parameters, series and parallel connection of two port network, cascade connection.

Unit-II
Signal and system: Definition of Signal, Classification of signal: Linear and non-linear signal, periodic and nonperiodic signal, Time variant and time invariant signal, causal and non-causal, stable and unstable, static and dynamic signal; Analysis of various signals.

Unit-III
Laplace Transform: Introduction, Conditions for existence of Laplace transform, properties of Laplace transform, Laplace transform of unit step, unit ramp, parabolic, rectangular, triangular, linear and exponential function, application of Laplace transform in network analysis, Inverse Laplace transform, Inverse Laplace transform of unit step, unit ramp, parabolic, rectangular, triangular, linear and exponential function, Mathematical problems related to inverse Laplace transform

Unit-IV
Fourier Transform: Introduction, Conditions for existence of Fourier transform, properties of Fourier transform, Fourier transform of unit step, unit ramp, parabolic, rectangular, triangular, linear and exponential function, application of Fourier transform in network analysis, Inverse Fourier transform, Inverse Fourier transform of unit step, unit ramp, parabolic, rectangular, triangular, linear and exponential function, Mathematical problems related to inverse Fourier transform.

Practical Exercises:

The learners are required to

1. Determine and analyse the parameters of a two-port network.
2. Classify and analyse different types of signals.
3. Apply the Laplace transform in the analysis of electrical networks.
4. Utilize the Fourier transform for analysing signals in the frequency domain.
5. Compare the applications and effectiveness of Laplace and Fourier transforms in signal and network analysis.

Suggested Readings:

1. K. S. Suresh Kumar, "Electric Circuit Analysis" Pearson Publications, 2013.
2. Ravish R. Singh, "Network Analysis and Synthesis", McGraw-Hill Education, 2013.
3. Chakrabarti, A., "Circuit Theory Analysis and Synthesis", DhanpatRai& Co., Seventh - Revised edition, 2018.
4. S. K. Bhattacharya, "Network Analysis and Synthesis", Pearson Education India.

Note:

1. Only the latest editions of the above books are recommended.

WASTE TO ENERGY
PEC-EL-403

Total credits: 3

L	T	P
3	0	0

Theory: 75
Sessional: 25

Course Objectives:
The objective of this course is to provide students with a comprehensive understanding of waste management principles, the characterization of different types of waste, and the various technologies available for converting waste into energy. Students will explore sustainable practices in waste management, including biochemical and thermo-chemical conversion methods, and learn how waste can be utilized as a resource and an alternative energy source.

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

- CO1: Understand and explain the principles of waste management, the 3R (Reduce, Reuse, Recycle) approach, and the concept of waste as a resource for alternative energy production.
- CO2: Classify and characterize different types of waste based on their origin, such as domestic, industrial, agricultural, and post-consumer waste, and analyze their potential for energy utilization.
- CO3: Apply biochemical conversion techniques such as anaerobic digestion and fermentation, as well as thermo-chemical methods like combustion, pyrolysis, and gasification, to convert waste into energy.
- CO4: Evaluate various waste-to-energy options, including landfill gas recovery, Refuse Derived Fuel (RDF), and the conversion of non-recyclable plastic waste into fuel for industrial applications.

Unit-I
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
Waste Sources & Characterization: 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. Waste Selection criteria.

Unit-III
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
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.

Practical Exercises:

The learners are required to

1. Understand the waste management hierarchy and implement the 3R principles.
2. Classify and characterize waste for potential energy conversion.
3. Apply biochemical conversion methods to produce energy from organic waste.
4. Explore thermo-chemical conversion methods for energy recovery from waste.
5. Evaluate different waste-to-energy options and their applications.

Suggested Readings:

1. Industrial and Urban Waste Management in India, TERI Press.
2. Wealth from Waste: Trends and Technologies by Banwari Lal and Patwardhan, TERI Press.
3. Fundamentals of waste and Environmental Engineering, S.N Mukhopadhyay, TERIPress.

Note:

1. Only the latest editions of the above books are recommended.

SPECIAL PURPOSE MACHINES
PEC-EL-404

Total credits: 3

L	T	P
3	0	0

Theory: 75
Sessional: 25

Course Objectives:
The objective of this course is to provide students with an in-depth understanding of special transformers and electrical machines, including their design, operation, and applications. The course will cover various types of transformers, induction machines, synchronous machines, and special motors used in specific industrial and renewable energy applications.

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

- CO1: Understand and differentiate between various types of special transformers, including their construction, operation, and specific applications in power distribution, welding, audio, and isolation.
- CO2: Analyse the working principles and applications of special induction machines, such as dual winding squirrel cage induction generators, and understand their role in reactive power compensation and soft starting techniques.
- CO3: Evaluate the use of special synchronous machines, including wound rotor and permanent magnet synchronous generators, particularly in renewable energy applications like wind turbines.
- CO4: Identify and Describe the characteristics, operation, and applications of other special motors, including fractional horsepower motors, hysteresis motors, permanent magnet motors, reluctance motors, and servomotors.

Unit-I
Special Transformer: Types Different types of connections of power and distribution transformers, Welding transformers, Isolation transformer, Pulse transformer, Audio transformers and microphone transformers.

Unit-II
Special Induction Machines: Dual winding Squirrel cage induction generator, soft starters, Reactive power compensation.

Unit-III
Special Synchronous Machines: Wound rotor synchronous generators for renewable energy applications, Wound rotor synchronous generators in large and small direct drive wind turbines, Permanent magnet synchronous generators in large and small direct drive wind turbines.

Unit-IV
Other Special Motors: Fractional horse power (FHP) motor, Hysteresis motor, Permanent magnet motor, Reluctance motor, Switched reluctance motor, Servomotors.

Practical Exercises:
The learners are required to

1. Understand and analyse different types of transformer connections.
2. Explore the design and applications of special transformers.
3. Analyse the operation of special induction machines.
4. Evaluate the role of special synchronous machines in renewable energy systems.
5. Identify and characterize various special motors.

6. Compare the performance of special synchronous and induction machines.

Suggested Readings:

1. Electrical Machines by Smarajit Ghosh, Pearson Learning, New Delhi.
2. “Electric Machines” by Ashfaq Husain, Dhanpat Rai and Company, New Delhi.
3. Theory and performance of Electrical Machines by J. B. Gupta, S.K. Kataria and sons, New Delhi.

Note:

1. Only the latest editions of the above books are recommended

FIFTH SEMESTER

Subject Code	Subject Name	Credits	Marks Weightage		Course Type
			Internal	External	
EL-501	On Job Training (OJT)/ Internship	20	150	350	OJT
Total		**20**	**150**	**350**	

Students will go into industries for **On Job Training**. Students will be evaluated **based upon On Job Training (OJT)/Internship** including report and presentation.

SIXTH SEMESTER

Subject Code	Subject Name	Credits	Marks Weightage		Course Type
			Internal	External	
EL-601	On Job Training (OJT)/ Internship	20	150	350	OJT
Total		**20**	**150**	**350**	

Students will go into industries for **On Job Training**. Students will be evaluated **based upon On Job Training (OJT)/Internship** including report and presentation.