Three-Year Undergraduate Programme

Diploma in Electrical Engineering

Faculty of Engineering & Technology
Parul University
Vadodara, Gujarat, India

Faculty of Engineering & Technology
Diploma in Electrical Engineering

1. Vision of the Department

Pioneering excellence in electrical engineering education, our vision is to shape adept professionals equipped with innovative skills and a global perspective to meet the challenges of an ever-evolving technological landscape.

2. Mission of the Department

M1 Empower future electrical engineers with cutting-edge education and practical skills for industry relevance.

M2 Cultivate a global mindset, fostering innovation and ethical responsibility in electrical engineering practices.

M3 Strive for academic excellence, leveraging expert faculty and state-of-the-art laboratories to meet evolving industry demands.

3. Program Educational Objectives

The statements below indicate the career and professional achievements that the Diploma Electrical Engineering curriculum enables graduates to attain.

PEO 1	**Preparation**	To prepare students to succeed in employment/profession and/or to pursue under graduate educations in civil Engineering discipline in particular and allied Engineering discipline in general.
PEO 2	**Core Competence**	To provide students with a solid foundation in mathematical, scientific and engineering fundamentals required to formulate, analyse and solve engineering problems requiring knowledge of civil Engineering.
PEO 3	**Breadth**	To prepare students with engineering breadth to innovate, design, and develop products and to contribute in providing solutions related to multidisciplinary real-life problems.
PEO 4	**Professionalism**	To inculcate in students professional and ethical attitude, effective communication skills and team work to become a successful professional.
PEO 5	**Learning Environment**	To provide students with an academic environment that makes them aware of excellence and lifelong learning in emerging technologies.

4. Program Learning Outcomes

Program Learning outcomes are statements conveying the intent of a program of study.

PLO 1	**Basic and Discipline specific knowledge**	Application of knowledge of basic mathematics, science and engineering fundamentals and engineering specialization to solve the engineering problems.
PLO 2	**Problem analysis**	Identify and analyse well-defined engineering problems using codified standard methods.
PLO 3	**Design / development of solutions**	Design solutions for well-defined technical problems and assist with the design of systems components or processes to meet specified needs.
PLO 4	**Engineering Tools, Experimentation and Testing**	Execution of modern engineering tools and appropriate technique to conduct standard tests and measurements.
PLO 5	**Engineering practices for society, sustainability and environment**	Apply appropriate technology in context of society, sustainability, environment and ethical practices.
PLO 6	**Project management**	Use engineering management principles individually, as a team member or a leader to manage projects and effectively communicate about well-defined engineering activities.
PLO 7	**Life-long learning**	Ability to analyse individual needs and engage in updating in the context of technological changes.

5. Program Specific Learning Outcomes

PSO 1	**Proficient in Electrical System Design**	should be able to understand the concepts of designing electrical systems, including power distribution networks and electronic circuits, incorporating principles of safety, reliability, and efficiency.
PSO 2	**Software skill**	Test any apparatus and system with appropriate usage of software tools, and gather data for modelling system.

6. Credit Framework

Semester wise Credit distribution of the programme	
Semester-1	16
Semester-2	19
Semester-3	22
Semester-4	22
Semester-5	25
Semester-6	23
Total Credits:	**127**

Category wise Credit distribution of the programme	
Category	**Credit**
Major Core	62
Minor Stream	20
Multidisciplinary	24
Ability Enhancement Course	4
Skill Enhancement Courses	2
Value added Courses	0
Summer Internship	2
Research Project/Dissertation	13
Total Credits:	**127**

7. Program Curriculum

Semester 1						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**
1	03602107	Applied Chemistry	3	3	0	0
2	03602108	Applied Chemistry Lab	1	0	2	0
3	03605101	Environmental Science	0	2	0	0
4	03605104	Elements of Civil Engineering Lab	1	0	2	0
5	03606102	Introduction to IT Systems Lab	2	0	4	0
6	03609101	Engineering Graphics	1	1	0	0
7	03609102	Engineering Graphics Lab	2	0	4	0
8	03609154	Engineering Workshop Practice	2	0	4	0
9	03691101	Mathematics - I	3	2	0	1
10	03693103	Communication Skills - I	1	1	0	0
		Total	**16**	**9**	**16**	**1**
Semester 2						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**

11	03605151	Engineering Mechanics	3	3	0	0
12	03605152	Engineering Mechanics Lab	1	0	2	0
13	03607151	Fundamentals of Electrical and Electronics Engineering	3	2	0	1
14	03607152	Fundamentals of Electrical and Electronics Engineering Lab	1	0	2	0
15	03609155	Introduction to Mechanical Engineering	1	1	0	0
16	03609156	Introduction to Mechanical Engineering Lab	1	0	2	0
17	03691151	Mathematics-II	4	3	0	1
18	03692154	Basic Physics Lab	1	0	2	0
19	03692155	Basic Physics	3	3	0	0
20	03693153	Communication Skills - II	1	1	0	0
		Total	**19**	**13**	**8**	**2**
Semester 3						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**
21	03600201	Entrepreneurship and Start-ups	1	1	0	0
22	03607201	Non-Renewable and Renewable Electric Energy Generation System	3	3	0	0
23	03607202	Non-Renewable and Renewable Electric Energy Generation System Lab	1	0	2	0
24	03607203	Electrical Circuits	3	2	0	1
25	03607204	Electrical Circuits Lab	1	0	2	0
26	03607205	Electric Motors and Transformers	3	2	0	1
27	03607206	Electric Motors and Transformers Lab	1	0	2	0
28	03607207	Electrical and Electronic Measurements	3	2	0	1
29	03607208	Electrical and Electronic Measurements Lab	1	0	2	0
30	03608211	Fundamental of Digital Electronics	3	2	0	1
31	03608212	Fundamental of Digital Electronics Lab	1	0	2	0
32	03693203	Professional Communication and Critical Thinking	1	1	0	0
		Total	**22**	**13**	**10**	**4**
Semester 4						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**
33	03600251	Essence of Indian Knowledge and Tradition	0	2	0	0
34	03607251	Fundamentals of Power Electronics	3	3	0	0

35	03607252	Fundamentals of Power Electronics Lab	1	0	2	0
36	03607253	Induction, Synchronous and Electrical Machines	3	2	0	1
37	03607254	Induction, Synchronous and Electrical Machines Lab	1	0	2	0
38	03607255	Electric Power Transmission and Distribution	3	3	0	0
39	03607256	Electric Power Transmission and Distribution Lab	1	0	2	0
40	03607260	Minor Project	1	0	2	0
41	03693251	Employability Skills	1	1	0	0
42		PE-I	3	3	0	0
43		PE-I-LAB	1	0	2	0
44		PE-II	3	3	0	0
45		PE-II-LAB	1	0	2	0
		Total	**22**	**17**	**12**	**1**

PE-I

Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut
1	03607281	Illumination Practices	3	3	0	0
2	03607283	Electrical Estimation and Contracting	3	3	0	0
3	03607285	Solar Power Technologies	3	3	0	0

PE-I-LAB

Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut
1	03607282	Illumination Practices Lab	1	0	2	0
2	03607284	Electrical Estimation and Contracting Lab	1	0	2	0
3	03607286	Solar Power Technologies Lab	1	0	2	0

PE-II

Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut
1	03607287	Biomass and Micro Hydro Power Plants	3	3	0	0
2	03607289	Wind Power Technologies	3	3	0	0
3	03607291	Industrial Instrumentation and Condition Monitoring	3	3	0	0

PE-II-LAB

Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut

1	03607288	Biomass and Micro Hydro Power Plants Lab	1	0	2	0
2	03607290	Wind Power Technologies Lab	1	0	2	0
3	03607292	Industrial Instrumentation and Condition Monitoring Lab	1	0	2	0
Semester 5						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**
46	03607301	Fundamentals of Electrical Switchgear	3	3	0	0
47	03607306	Summer Internship	2	0	0	0
48	03607308	Major Project-I	6	0	12	0
49	03608314	Microcontroller and Applications Lab	1	0	2	0
50	03608315	Microcontroller and Applications	2	2	0	0
51		Open Elective-I	3	3	0	0
52		PE-III	3	3	0	0
53		PE-III-LAB	1	0	2	0
54		PE-IV	3	3	0	0
55		PE-IV-LAB	1	0	2	0
		Total	**25**	**14**	**18**	**0**
Open Elective-I						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**
1	03606287	Fundamental of Internet of Things	3	3	0	0
PE-III						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**
1	03607331	Electrical Testing 0and Commissioning	3	3	0	0
2	03607333	Electric Vehicles	3	3	0	0
PE-III-LAB						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**
1	03607332	Electrical Testing and Commissioning Lab	1	0	2	0
2	03607334	Electric Vehicles Lab	1	0	2	0
PE-IV						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**
1	03607335	Electrical Traction	3	3	0	0
2	03607337	Industrial Automation and Control	3	3	0	0

PE-IV-LAB						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**
1	03607336	Electrical Traction Lab	1	0	2	0
2	03607338	Industrial Automation and Control Lab	1	0	2	0
Semester 6						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**
56	03600351	Indian Constitution	0	2	0	0
57	03607351	Building Electrification	3	3	0	0
58	03607352	Building Electrification Lab	1	0	2	0
59	03607354	Power System Protection Lab	1	0	2	0
60	03607355	Industrial Drives	3	3	0	0
61	03607356	Industrial Drives Lab	1	0	2	0
53	03607357	Energy Conservation Technique and Audit	3	3	0	0
54	03607358	Energy Conservation Technique and Audit Lab	1	0	2	0
55	03607359	Power System Protection	2	2	0	0
56	03607360	Software Practice Lab	2	0	4	0
57	03607364	Major Project-II	6	0	12	0
		Total	**23**	**13**	**24**	**0**
		Total	**127**			

8. Detailed Syllabus

Semester 1

(1)

a. **Course Name:** Applied Chemistry
b. **Course Code:** 03602107
c. **Prerequisite:** Understanding of Basic knowledge of science for the application.
d. **Rationale:** Science is fundamental to technician courses, aiming to cultivate scientific inquiry and cause-and-effect reasoning in students. Chemistry, as applied science, plays a crucial role. Studying chemical concepts like bonding, corrosion, and organic chemistry, along with engineering materials such as polymers and lubricants, enhances understanding of engineering subjects. Chemistry focuses on the changes in matter's structure and properties, forming the basis of engineering processes. Teaching should foster aptitude and predictive skills. A strong science foundation aids students' self-development and adaptability to evolving innovations.

e. **Course Learning Objective:**

CLOBJ 1	Understand the concept of existence of material in nature
CLOBJ 2	Acquaint with the various mechanisms of natural phenomena.
CLOBJ 3	Explain the characteristics of materials, substances, and compounds.
CLOBJ 4	Develop skills to conduct experiments.
CLOBJ 5	Apply analytical techniques to solve engineering problems and perform material performance analysis.

f. Course Learning Outcomes:

CLO 1	Understand the concept of Existence of material in nature.
CLO 2	Acquainted with the various Mechanism of natural phenomenon.
CLO 3	Explain the characteristic of Material, Substances and Compounds.
CLO 4	Develop skills to do experiments.
CLO 5	Apply analytical techniques to solve the engineering problem and performance analysis of material.

g. Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes	
CLO 1	Understand the concept of Existence of material in nature.
CLO 2	Acquainted with the various Mechanism of natural phenomenon.
CLO 3	Explain the characteristic of Material, Substances and Compounds.
CLO 4	Develop skills to do experiments.
CLO 5	Apply analytical techniques to solve the engineering problem and performance analysis of material.

h. Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Outcomes:

CLOs	PLOs							PSO	
	1	2	3	4	5	6	7	1	2
CLO 1	1.00	2.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00
CLO 2	2.00	1.00	2.00	1.00	2.00	1.00	1.00	1.00	1.00
CLO 3	2.00	2.00	2.00	1.00	1.00	2.00	1.00	-	2.00
CLO 4	2.00	1.00	2.00	2.00	1.00	2.00	1.00	-	1.00
CLO 5	2.00	1.00	2.00	2.00	1.00	2.00	1.00	-	1.00
Weighted Average	1.75	1.50	2.00	1.25	1.25	1.50	1.00	0.50	1.25

i. Teaching and Examination Scheme:

i) Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	-	3	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

Course Content:

Sr No	Topic	Weightage	Teaching Hrs.
1	**Chemical Bandings and Catalysis**: 1. Rutherford model of atom, Bohr's theory, Heisenberg uncertainty principle, Quantum numbers – orbital concept. 2. Shapes of s,p and d orbitals, Pauli's exclusion principle, Hund's rule of maximum multiplicity Aufbau rule, electronic configuration. 3. Theory Of Valency 4. Electronic Configuration 5. Types of chemical bonds i. Electrovalent bond, & its characteristics ii. Covalent bond & its characteristics iii. Co- ordinate bond iv. Hydrogen bond, its types and Significance v. Metallic bond, Explanation of Metallic properties.	10	6

	vi. Electron Sea Model 6. Intermolecular force of attraction 7. Vander Waals force of attraction 8. Catalysis, i. Types of catalysis ii. Theory ofCatalysis iii. Characteristics of Catalyst 9. Types of Catalyst i. Positive Catalyst ii. Negative Catalyst iii. Auto-catalyst Catalytic Promoter and Catalytic inhibitor Industrial Application of Catalyst		
2	**Concepts of ElectroChemistry**: 1. Introduction 2. Arrhenius theory of ionization. 3. Degree of ionization i. Factors affecting the degree of ionization 4. Definition of pH i. pH of acid, base and neutral solution ii. pH calculations of acid, base and salt solution at different concentration iii. Importance of pH in various fields. 5. Definition of buffer solution. i. Buffer Action & Types of buffer Solution. ii. Application of buffer solutions. 6. Electrolytes and non-electrolytes i. Types of electrolytes Definition the term ` Electrode ' the Types of Electrodes Inert electrode, Working electrode & Reference electrode; with suitable Illustrations. Construction & working of reference electrode: 1. Hydrogen electrode 2. Calomel electrode 3. Quinhydrone electrode 4. Glass electrode 5. Ag/ Agcl/ Kcl electrode • Kohlrausch Law of independent Migration of ions. 7. Construction and working of electrochemical cell 8. Standard conditions 9. Standard hydrogen electrodes 10. Nernst theory of single electrode potential & Nernstequation 11. Electrochemical series, galvanic series	**20**	**8**

	12. Electrolysis, Faradays laws of electrolysis 13. Industrial application of Electrolysis 14. conductance of solution (a) Conductivity (b)Specific Conductivity (c) Equivalent conductivity (d) Molar conductivity		
3	**Corrosion of metals & its prevention**: . Definition of corrosion 1. Types of corrosion i. Dry corrosion: Oxidation corrosion mechanism corrosion-mechanism , Nature of oxide film ii. Wet corrosion-mechanism iii. Concentration cell corrosion 2. Pitting corrosion 3. Waterline corrosion 4. Crevice corrosion 5. Stress Corrosion 6. Erosion Corrosion 7. Factors affecting the rate of corrosion,- Nature of film, Nature of Environment, PH of Solution, Area of cathode anode and, Temperature ,Moisture, Purity of metal 8. Methods of prevention of corrosion- 9. Modification of environment, 10. Modification of the properties of metal, 11. Use of protective coatings. 12. Anodic and cathodic protection, Modification in design and choice of material	**10**	**5**
4	**Water Treatment**: Graphical presentation of water distribution on Earth (pie or bar diagram) . Hard water and soft water. 1. Types of hardness of water i. Salts producing hardness of water. ii. Method to express the hardness of water. 2. Estimation of total hardness by EDTA Method i. Examples to calculate the hardness 3. Effect of hard water in Boiler operation i. Scale and sludge formation and its Prevention ii. Priming and foaming and its prevention. 4.4.3. Caustic embrittlement and it's prevention. Corrosion and it's prevention. 1. Softening of Water i. Soda-Lime process ii. Permutit process	**20**	**7**

	iii. Ion Exchange process iv. Reverse Osmosis process 2. Treatment of Drinking water i. Sedimentation ii. Coagulation iii. Filtration iv. Sterilization of water by chlorination Break-point chlorination-Graph v. enlist Indian standard specification of drinking water		
5	**Lubricants**: 1. Introduction and definition of lubricants and lubrication 2. function of lubricants 3. Types of lubrication i. Fluid film lubrication. ii. Boundary lubrication 4. Classification of lubricants i. Solid lubricants ii. Semi-solid lubricants iii. Liquid lubricants iv. Synthetic oils 5. Physical Properties of lubricants and their significance like i. Viscosity and viscosity index ii. Flash point and fire point iii. Pour point and cloud point iv. oiliness 6. Chemical Properties of lubricants like i. Soaponification value ii. Neutralization number iii. Emulsification number 7. Selection of lubricants for i. Gears ii. Cutting tools iii. Steam turbine	**10**	**5**
6	**Polymer, Elastomers & Adhesives**: Introduction and Definition of Polymer and Monomer Classification of Polymer on basis of Molecular structure as Linear, Branch and Cross-linked polymers Classification on basis of monomers homopolymer andcopolymer) Classification of Polymers on of Thermal behavior(Thermoplastics& Thermosetting)	**20**	**6**

	Types polymerization Reaction Addition Polymerization Condensation Polymerization Synthesis, properties and application of Polyethylene Polypropylene Polyvinyl chloride iv. Teflon v. Polystyrene vi. Phenol formaldehyde vii. Acrylonitrile viii. Epoxy Resin Define the term:- elastomers Natural rubber and its properties vulcanization of rubber Synthetic rubber,Synthesis,properties and uses Buna-S Rubber Buna-N Rubber Neoprene Rubber Definition of adhesives and Examples i. Characteristics of adhesives ication of adhesives and theiruses.		
7	**Chemistry of Fuels :** 7.1 Definition of fuel and combustion of fuel, 7.2 classification of fuels, calorific values (HCV and LCV), Bomb Calorimeter 7.3 calculation of HCV and LCV using Dulong's formula. 7.4 Proximate analysis of coal and Ultimate Analysis of coal 7.5 solid fuel petrol and diesel - fuel rating (octane and cetane numbers), Chemical composition, calorific values and 7.6 applications of LPG, CNG, water gas, coal gas, producer gas and biogas.	**10**	**5**

Reference Books:

1. ENGINEERING CHEMISTRY by JAIN & JAIN; DHANPAT RAI
2. A Text Book of Polytechnic Chemistry V.P. Mehta; Jain Brothers
3. A Text Book of Applied Chemistry. J. Rajaram Engineering Chemistry S S. Dara

(2)

a. Course Name: Applied Chemistry Lab

b. Course Code: 03602107

c. Prerequisite: Understanding of Basic knowledge of science for the application.

d. Rationale: Science is fundamental to technician courses, aiming to cultivate scientific inquiry and cause-and-effect reasoning in students. Chemistry, as applied science,

plays a crucial role. Studying chemical concepts like bonding, corrosion, and organic chemistry, along with engineering materials such as polymers and lubricants, enhances understanding of engineering subjects. Chemistry focuses on the changes in matter's structure and properties, forming the basis of engineering processes. Teaching should foster aptitude and predictive skills. A strong science foundation aids students' self-development and adaptability to evolving innovations.

e. Course Learning Objective:

CLOBJ 1	Understand the concept of Existence of material in nature.
CLOBJ 2	Acquainted with the various Mechanism of natural phenomenon.
CLOBJ 3	Explain the characteristic of Material, Substances and Compounds.
CLOBJ 4	Develop skills to do experiments.
CLOBJ 5	Apply analytical techniques to solve the engineering problem and performance analysis of material.

f. Course Learning Outcomes:

CLO 1	Discriminate knowledge of different Chemical reactions.
CLO 2	Understand the different types of titration.
CLO 3	Identify industrially important chemical reations.
CLO 4	Explain the effects of temperature on lubricating oils.
CLO 5	Calculate the hardness in water.

g. Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes	
CLO 1	Discriminate knowledge of different power plant.
CLO 2	Understand the different types of titration.
CLO 3	Identify industrially important chemical reactions.
CLO 4	Explain the effects of temperature on lubricating oils.
CLO 5	Calculate the hardness in water.

h. Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Outcomes:

CLOs	PLOs							PSO	
	1	2	3	4	5	6	7	1	2
CLO 1	1.00	2.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00
CLO 2	2.00	1.00	2.00	1.00	2.00	1.00	1.00	1.00	1.00
CLO 3	2.00	2.00	2.00	1.00	1.00	2.00	1.00	-	2.00
CLO 4	2.00	1.00	2.00	2.00	1.00	2.00	1.00	-	1.00
CLO 5	2.00	1.00	2.00	2.00	1.00	2.00	1.00	-	1.00
Weighted Average	1.75	1.50	2.00	1.25	1.25	1.50	1.00	0.50	1.25

i. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
0	-	2	1	-	-	50	-	-	50

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination.

h. Experiment List with Course

List of Practical/Activities: (To perform minimum 10 Practical)

1. Determine the strength of given acidic solution using standard solution of base
2. Standardize KMnO4 solution by preparing standard oxalic acid and to estimate ferrous ions.
3. Standardize Na2S2O3 solution by preparing standard potassium dichromate and to estimate percentage of copper from brass.
4. Determine the viscosity of given lubricating oil by using Red-wood Viscometer
5. Determine PH-Values of given samples of Solution by using Universal Indicator and PH-meter
6. To Determine molecular weight of a polymer using Ostwald viscometer
7. Preparation of (any one) polystyrene, urea formaldehyde, phenol formaldehyde and its Characterisation.
8. To Determine Acid Value of given lubricating Oil
9. Determine of the percentage of moisture in a given sample of coal by proximate analysis
10. To Determine of saponification value of a lubricating oil
11. Study of corrosion of metals in medium of different Ph
12. To Determine the COD of given water sample
13. Determine Flash & Fire point of given lubricating oil.

14. Study of Corrosion of Metals in the different Mediums.

(3)

a. **Course Name:** Environmental Science
b. **Course Code:** 303106201
c. **Prerequisite:** Zeal to learn the subject
d. **Rationale:** The course is designed to give developers a general awareness of these and related issues so that every student will start acting as a responsible citizen to make the country and the world a better place to live in.
e. **Course Learning Objective:**

CLOBJ 1	Understanding Ecosystem Structure and Describe the components of an ecosystem, including both biotic and abiotic factors and understand the significance of these cycles in maintaining ecosystem balance.
CLOBJ 2	Evaluate air and noise pollution sources, effects, and control measures, considering both natural and anthropogenic factors. Studying Air and Noise Pollution and Identify common air pollutants and their sources. Evaluate noise pollution sources, measurement techniques, and regulatory measures
CLOBJ 3	Analyze characteristics such as turbidity, pH, BOD, and COD in water. Examine primary, secondary, and tertiary methods of wastewater treatment. Investigate causes, effects, and preventive measures of soil pollution.
CLOBJ 4	Explore the basics of solar energy and different solar technologies and Evaluate biomass as an energy source, including its thermal characteristics and biogas production. Investigate new energy sources like hydrogen, ocean energy, tidal energy, and geothermal energy.
CLOBJ 5	Understand the principles of the 3Rs (Reduce, Reuse, Recycle) in solid waste management. Evaluate methods of energy recovery and disposal, including sanitary landfill for municipal solid waste.

f. **Course Learning Outcomes:**

CLO 1	Understand the ecosystem and terminology and solve various engineering problems applying
CLO 2	Ecosystem knowledge to produce eco – friendly products.
CLO 3	Understand the suitable air, the extent of noise pollution, and control measures and acts.
CLO 4	Understand the water and soil pollution, and control measures and acts.
CLO 5	Understand different renewable energy resources and efficient process of harvesting.

g. Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes	
CLO 1	Understand the ecosystem and terminology and solve various engineering problems applying
CLO 2	Ecosystem knowledge to produce eco – friendly products.
CLO 3	Understand the suitable air, the extent of noise pollution, and control measures and acts.
CLO 4	Understand the water and soil pollution, and control measures and acts.
CLO 5	Understand different renewable energy resources and efficient process of harvesting.

h. Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Outcomes:

i. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	-	0	20	20	-	-	-	40

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

j. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**Ecosystem:** Structure of ecosystem, Biotic & Abiotic components, Food chain and food web Carbon, Nitrogen, Sulphur, Phosphorus cycle. Global warming -Causes, effects, process, Green House Effect, Ozone depletion.	15%	3
2	**Air and Noise Pollution:** Definition of pollution and pollutant, Natural and manmade sources of air pollution (Refrigerants, I.C., Boiler). Air Pollutants: Types, Particulate Pollutants: Effects and control (Bag filter, Cyclone separator, Electrostatic Precipitator). Gaseous Pollution Control: Absorber, Catalytic Converter, Effects of air pollution due to Refrigerants, I.C., Boiler, Noise pollution: sources of pollution, measurement of pollution level, Effects of Noise	22%	6

	pollution, Noise pollution (Regulation and Control) Rules, 2000.		
3	**Water and Soil Pollution:** Sources of water pollution, Types of water pollutants, Characteristics of water pollutants Turbidity, pH, total suspended solids, total solids BOD and COD: Definition, calculation. Waste Water Treatment: Primary methods: sedimentation, froth floatation, Secondary methods: Activated sludge treatment, Trickling filter, Bioreactor, Tertiary Method: Membrane separation technology, RO (reverse osmosis), Causes, Effects and Preventive measures of Soil Pollution: Causes-Excessive use of Fertilizers, Pesticides and Insecticides, Irrigation, E-Waste.	**24%**	**8**
4	**Renewable Sources of energy:** Solar Energy: Basics of Solar energy. Flat plate collector (Liquid & Air). Theory of flat plate collector. Importance of coating. Advanced collector. Solar pond. Solar water heater, solar dryer. Solar stills. Biomass: Overview of biomass as energy source. Thermal characteristics of biomass as fuel. Anaerobic digestion. Biogas production mechanism. Utilization and storage of biogas. Wind energy: Current status and future prospects of wind energy. Wind energy in India. Environmental benefits and problem of wind energy. New Energy Sources: Need of new sources. Different types new energy sources. Applications of (Hydrogen energy, Ocean energy resources, Tidal energy conversion.) Concept, origin and power plants of geothermal energy.	**24%**	**8**
5	**Solid Waste management:** Solid waste generation- Sources and characteristics of: Municipal solid waste, E- waste, biomedical waste. Metallic wastes and Non-Metallic wastes (lubricants, plastics, rubber) from industries. Collection and disposal: MSW (3R, principles, energy recovery, sanitary landfill), Hazardous waste.	**15%**	**3**

k. Text Book and Reference Book:

1. "Principles of Solar Engineering" By Yogi Goswami D., Frank Kreith, Jan F. Kreider | Taylor & Francis, 2003 | Second.
2. "Environmental Studies" By M.P. Poonia, S.C. Sharma | Khanna Publishing House, NewDelhi | 2017.
3. "Renewable Energy Sources" By Twidell J.W. and Weir. A | EFN Spon Ltd"Linear Systems and Signals" by B.P. Lathi.
4. "Environmental Sciences", By Daniel B Botkin & Edward A Keller, | John Wiley

& Sons
5. “Air Pollution”, By M. N. Rao and H. V. N. Rao | Tata McGraw-Hill Publishing Company
6. “Environmental Pollution Control Engineering”, By Rao C.S | 2nd edition“Solid Waste Treatment and Disposal”, By G. Tchabanoglous | McGraw Hill Pub.

(5)

a. **Course Name:** Introduction to IT Systems Lab
b. **Course Code:** 03606102
c. **Prerequisite:** Basic knowledge of Computer.
d. **Rationale:** This course aims to teach students basics of computer including hardware and software.
e. **Course Learning Objective:**

CLOBJ 1	Understand functional units and components of computer
CLOBJ 2	Familiarize the students with basic functions Internet applications.
CLOBJ 3	Enable the students in preparing documents and presentations.
CLOBJ 4	Students can create HTML pages

f. **Course Learning Outcomes:**

CLO 1	Know about different computer components& different types of memory.
CLO 2	Create excel sheet, power point, word, access database etc.
CLO 3	Use internet effectively.
CLO 4	Create dynamic webpages including style sheet.
CLO 5	Comfortably work on computer, install and configure OS, assemble a PC and connect it to external devices, write documents, create worksheets, prepare presentations, protect information and computers from basic abuses/attacks

g. **Mapping of Course Learning Outcomes and Bloom’s Taxonomy:**

Course Learning Outcomes	
CLO 1	Know about different computer components& different types of memory.
CLO 2	Create excel sheet, power point, word, access database etc.
CLO 3	Use internet effectively.
CLO 4	Create dynamic webpages including style sheet.
CLO 5	Comfortably work on computer, install and configure OS, assemble a PC and connect it to external devices, write documents, create worksheets, prepare presentations, protect information and computers from basic abuses/attacks

h. Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Outcomes:

CLOs	PLO							PSO	
	1	2	3	4	5	6	7	1	2
CLO 1	3.00	3.00	2.00	1.00	1.00	1.00	2.00	1.00	1.00
CLO 2	3.00	2.00	2.00	1.00	2.00	2.00	2.00	1.00	2.00
CLO 3	3.00	3.00	2.00	1.00	1.00	3.00	2.00	2.00	3.00
CLO 4	3.00	2.00	2.00	2.00	1.00	2.00	1.00	2.00	3.00
CLO 5	2.00	1.00	3.00	3.00	2.00	1.00	2.00	2.00	2.00
Weighted Average	2.75	2.25	2.25	1.50	1.50	1.75	1.25	1.50	2.25

i. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
0	-	4	2	-	-	100	-	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

j. Text Book and Reference Book:

1. "Basic Computer Course Made Simple", by Satish Jain | BPB Publication
2. "Basic Computer Engineering" By Sanjay Silakari and Rajesh K Shukla | Wiley India Pvt. Limited, Pub. Year 2011
3. "Computer Fundamentals", By P.K. Sinha | BPB Publications.
4. "HTML & CSS: The Complete Reference", By Thomas A. Powell | McGraw Hill

k. Mapping of Experiment List with Course Learning Outcomes:

Exp. No.	Name of the Experiment
1	Study practical of computer components.
2	Study practical of different OS installation (Windows, Linux, Ubuntu).
3	Write a script for basic OS commands.
4	Write a script for basic operators in OS.

Exp. No.	Name of the Experiment
5	Study practical of Internal structure and components of storage devices(Hard disk components).
6	Study practical of input working devices (Keyboard, Mouse, scanner).
7	Study practical of output working devices (Monitor, Printer).
8	Write a HTML code to display hello world .
9	Write a HTML code to create a table for student marksheet.
10	Write a HTML code to create a simple registration form.
11	Write a CSS to create user define tag.
12	Write an HTML code to create static website using CSS
13	Study practical of evolution and working of internet.
14	Study practical of surfing techniques in internet
15	Create your Gmail account and use different services provided by Google like Google drive, sharable sheet etc.
16	Perform various DOS commands
17	Develop an excel sheet which has record of 50 students result of 5 subjects and make following analysis 1) Fetch the data of the student who has distinction 2) Fetch the data of students with minimum marks in each subject. 3) Sort the data based on percentage
18	Create a presentation of your favorite movie using animation
19	Create a word file for your resume
20	Create library management database in access with minimum 5 tables in it.

(6)

a. **Course Name:** Engineering Graphics
b. **Course Code:** 03609101
c. **Prerequisite:** Drawing basic knowledge
d. **Rationale:** Engineering drawing is an effective language of engineers. It is the foundation block which strengthens the engineering & technological structure. It is the transmitting link between ideas and realization. It is an attempt to develop fundamental Understanding and application of engineering drawing. It covers knowledge & application of drawing instruments & also familiarizes the learner about Bureau of Indian standards.

e. Course Learning Objective:

CLOBJ 1	The course is aimed at developing Basic Graphic skills.
CLOBJ 2	Develop Skills in Preparation of Basic Drawings.
CLOBJ 3	Skills in Reading and Interpretation of Engineering Drawings.

f. Course Learning Outcomes:

CLO 1	Engineering drawing is an effective language of engineers.
CLO 2	It is the foundation block which strengthens the engineering & technological structure. Moreover, it is the transmitting link between ideas and realization.
CLO 3	It is an attempt to develop fundamental understanding and application of engineering drawing.
CLO 4	It covers Knowledge & application of drawing instruments & also familiarizes the learner about Bureau of Indian Standards.
CLO 5	The curriculum aims at developing the ability to draw and read various drawings, curves & Projections.
CLO 6	Select and construct appropriate drawing scales, use drawing equipment's, and understand Indian Standards of engineering drawing.
CLO 7	Draw views of given object and components
CLO 8	Sketch orthographic projections into isometric Projections and vice versa.

g. Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes	
CLO 1	Engineering drawing is an effective language of engineers.
CLO 2	It is the foundation block which strengthens the engineering & technological structure. Moreover, it is the transmitting link between ideas and realization.
CLO 3	It is an attempt to develop fundamental understanding and application of engineering drawing.
CLO 4	It covers Knowledge & application of drawing instruments & also familiarizes the learner about Bureau of Indian Standards.
CLO 5	The curriculum aims at developing the ability to draw and read various drawings, curves & Projections.
CLO 6	Select and construct appropriate drawing scales, use drawing equipment's, and understand Indian Standards of engineering drawing.
CLO 7	Draw views of given object and components
CLO 8	Sketch orthographic projections into isometric Projections and vice versa.

h. Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Outcomes:

CLOs	PLOs												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CLO 1	2.00	2.00	1.00	2.00	1.00	1.00	2.00	2.00	3.00	2.00	1.00	3.00	2.00	2.00
CLO 2	3.00	2.00	1.00	1.00	1.00	2.00	1.00	3.00	2.00	2.00	1.00	3.00	1.00	2.00
CLO 3	2.00	3.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00	2.00	1.00	3.00	2.00	3.00
CLO 4	2.00	2.00	2.00	1.00	3.00	1.00	2.00	1.00	1.00	1.00	1.00	3.00	1.00	1.00
CLO 5	2.00	2.00	1.00	2.00	1.00	1.00	2.00	2.00	3.00	2.00	1.00	3.00	2.00	2.00
CLO 6	3.00	2.00	1.00	1.00	1.00	2.00	1.00	3.00	2.00	2.00	1.00	3.00	1.00	2.00
CLO 7	2.00	3.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00	2.00	1.00	3.00	2.00	3.00
CLO 8	2.00	2.00	2.00	1.00	3.00	1.00	2.00	1.00	1.00	1.00	1.00	3.00	1.00	1.00
Weighted Average	2.25	2.25	1.25	1.25	1.50	1.25	1.50	1.75	2.00	1.75	1.00	3.00	1.50	2.00

i. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
1	-	0	1	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

j. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**Drawing equipment's, instruments and materials.** Equipment's-types, specifications, method to use them, applications. Instruments-types, specifications, methods to use them and applications. Pencils-grades, applications, types of points and applications. Other materials-types and applications.	4	1
2	**Planning, Layout and Scaling Of Drawing** Follow and apply standard practice as per bureau of I.S. for planning and layout, Choose appropriate scale factor for the drawing as per given situation	4	0
3	**Lines, Lettering and dimensioning:** Different types of lines. Vertical capital and lower-case letters. Inclined	4	0

	capital and lower-case letters. Numerals and Greek alphabets. Dimensioning methods. Aligned method. Unilateral with chain, parallel, progressive and combined dimensioning.		
4	**Geometric Construction:** Geometric construction related with line like bisecting a line, to draw perpendicular with a given line, divide a line, etc. Geometric construction related with angle like bisect an angle, trisect an angle, etc. To construct polygon. Triangle, Square / Rectangle, Pentagon with special method. d: Hexagon with special method. To draw tangents. Geometric construction related with circle & arc.	**7**	**2**
5	**Engineering Curves:** Conic sections: Concept and understanding of focus, directory, vertex and eccentricity and drawing of conic sections. Using various methods, understand construction of: Ellipse. Parabola. Hyperbola. Cycloidal Curves (Cycloid, Epicycloid, Hypocycloid) Involutes. Involutes of a circle, Involutes of a polygon, Spiral (Archimedean spiral only).	**22**	**3**
6	Projection Of Points, Lines and Planes Reference planes, orthographic projections. Concept of quadrant.1st angle and 3rd angle projection and their symbols. Projection of points. Projection of lines – determination of true length and inclinations for following cases. Line parallel to one or both the plane. Line perpendicular to one of the planes. Line inclined to one plane and parallel to another. Line inclined to both the planes. Projection of Planes: Types of planes, Projection of planes parallel to one of the reference planes, Projection of plane inclined to one reference plane and perpendicular to another, Projection of planes inclined to both reference planes.	**25**	**2**
7	**Orthographic Projections:** Types of projections- orthographic, perspective, isometric and oblique: concept and applications. Various term associated with orthographic projections. Theory of projection, Methods of projection, Orthographic projection, Planes of projection. Conversion of simple pictorial views into Orthographic views. Illustrative problems on orthographic projection B.I.S. code of practice	**22**	**3**
8	**Isometric Projections:** Isometric axis, lines and planes. Isometric scales. Isometric view and isometric drawing. Difference between isometric projection and isometric drawing. Illustrative problems limited to objects containing lines, circles and arcs shape only.	**12**	**3**

k. Text Book and Reference Book:

1. "ENGINEERING GRAPHICS" By P. J. Shah | S. Chand & Co., New Delhi Publications.
2. "A Text Book of Engineering Graphics" By P.J. Shah | S. Chand & Company Ltd., New Delhi
3. "Engineering Drawing" By P.J. Shah. | S. Chand, New Delhi

(7)

a. Course Name: Engineering Graphics Lab

b. Course Code: 03609102

c. Prerequisite: Zeal to learn the subject

d. Rationale: Engineering Drawing is an effective language of engineers. It is the foundation block which strengthens the engineering & technological structure. Moreover, it is the transmitting link between ideas and realization.

e. Course Learning Objective:

CLOBJ 1	Instruct the utility of drafting & modeling packages in orthographic and isometric drawings.
CLOBJ 2	Train the usage of 2D and 3D modeling.
CLOBJ 3	Instruct graphical representation of machine components.

f. Course Learning Outcomes:

CLO 1	Select and construct appropriate drawing scales, use drawing equipment's, and understand Indian Standards of engineering drawing.
CLO 2	Draw views of given object and components.
CLO 3	Sketch orthographic projections into isometric projections and vice versa.
CLO 4	Apply computer aided drafting tools to create 2D engineering drawings.

g. Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes	
CLO 1	Select and construct appropriate drawing scales, use drawing equipment's, and understand Indian Standards of engineering drawing.
CLO 2	Draw views of given object and components.
CLO 3	Sketch orthographic projections into isometric projections and vice versa.
CLO 4	Apply computer aided drafting tools to create 2D engineering drawings.

h. Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Outcomes:

CLOs	PLOs												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CLO 1	3.00	3.00	2.00	1.00	1.00	1.00	2.00	1.00	1.00	3.00	1.00	3.00	1.00	1.00
CLO 2	3.00	2.00	2.00	1.00	2.00	2.00	2.00	1.00	3.00	3.00	1.00	3.00	1.00	2.00
CLO 3	3.00	3.00	2.00	1.00	1.00	3.00	2.00	2.00	2.00	2.00	2.00	3.00	2.00	3.00
CLO 4	3.00	2.00	2.00	1.00	2.00	2.00	2.00	1.00	3.00	3.00	1.00	3.00	1.00	2.00
Weighted Average	3.00	2.5	2.00	1.00	1.5	2.00	2.00	1.20	2.25	2.75	1.25	3.00	1.25	2.00

i. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
0	-	4	2	-	-	100	-	0	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

j. Text Book and Reference Book:

1. Engineering Drawing Practice for Schools and Colleges By Bureau of Indian Standards | Government of India, Pub. Year 1998
2. Engineering Drawing By N. D. Bhatt | Charotar Publishing House, Pub. Year 2010
3. Engineering Graphics & Design By Jain & Gautam | Khanna Publishing House
4. Engineering Drawing By D. A. Jolhe | Tata McGraw Hill Edu
5. Engineering Drawing By R. K. Dhawan | S. Chand and Company

k. Mapping of Experiment List with Course Learning Outcomes:

Exp. No.	Name of the Experiment
1	USE OF DRAWING INSTRUMENTS
2	GEOMETRIC CONSTRUCTION
3	ENGINEERING CURVES – I
4	ENGINEERING CURVES – II
5	PROJECTIONS OF POINTS AND LINE
6	PROJECTIONS OF PLANE
7	ORTHOGRAPHIC PROJECTIONS
8	ISOMETRIC DRAWINGS

(8)

a. **Course Name:** Engineering Workshop Practice
b. **Course Code:** 03609154
c. **Prerequisite:** Learn about fundamental of mechanical and electrical engineering
d. **Rationale:** Workshop practice is the backbone of the real industrial environment which helps to develop and enhance relevant technical hand skills required by the technician working in the various engineering industries and workshops. This course intends to impart basic know-how of various hand tools and their use in different sections of manufacturing. Irrespective of branch, the use of workshop practices in day to day industrial as well domestic life helps to dissolve the problems. The workshop experiences would help to build the understanding of the complexity of the industrial job, along with time and skills requirements of the job. Workshop curricula build the hands-on experiences which would help to learn manufacturing processes and production technology courses in successive semesters. Workshop practice is also important since only practice can make the man perfect
e. **Course Learning Objective:**

CLOBJ 1	To develop general machining skills in the students.
CLOBJ 2	To develop a skill in dignity of labour, precision, safety at work place, team working and development of right attitude.
CLOBJ 3	The Engineering Workshop Practice for engineers is a training lab course spread over entire semester. The modules include training on different trades like Fitting, Carpentry, Black smithy etc… which makes the students to learn how various joints are made using wood and other metal pieces

f. **Course Learning Outcomes:**

CLO 1	Acquire skills in basic engineering practice to identify, select and use various marking, measuring, and holding, striking and cutting tools & equipment's and machines.
CLO 2	Understand job drawing and complete jobs as per specifications in allotted time.
CLO 3	Inspect the job for the desired dimensions and shape.
CLO 4	Operate, control different machines and equipment's adopting safety practices.

g. **Mapping of Course Learning Outcomes and Bloom's Taxonomy:**

Course Learning Outcomes	
CLO 1	Acquire skills in basic engineering practice to identify, select and use various marking, measuring, and holding, striking and cutting tools & equipment's and machines.

CLO 2	Understand job drawing and complete jobs as per specifications in allotted time.
CLO 3	Inspect the job for the desired dimensions and shape.
CLO 4	Operate, control different machines and equipment's adopting safety practices.

h. Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Outcomes:

CLOs	**PLOs**												**PSO**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CLO 1	3.00	2.00	2.00	2.00	1.00	2.00	1.00	2.00	2.00	3.00	3.00	3.00	2.00	3.00
CLO 2	3.00	2.00	2.00	1.00	2.00	2.00	2.00	1.00	3.00	3.00	1.00	3.00	1.00	2.00
CLO 3	3.00	3.00	2.00	1.00	1.00	3.00	2.00	2.00	2.00	2.00	2.00	3.00	2.00	3.00
CLO 4	3.00	2.00	2.00	1.00	2.00	2.00	2.00	1.00	3.00	3.00	1.00	3.00	1.00	2.00
Weighted Average	3.00	2.50	2.00	1.25	1.25	2.00	1.75	1.50	2.00	2.75	1.75	3.00	1.50	2.25

i. Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
0	**-**	**4**	**2**	**-**	**-**	**100**	**-**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

j. Text Book and Reference Book:

1. Mechanical workshop practice By K.C. John
2. A Textbook of Electrical Workshop Practices By Dr. Umesh Rathore | S.K. Kataria & Sons
3. A Course in Workshop Technology By Raghuwamsi B S | Dhanpat Rai and Sons, 1682 Nai Darak, New Delhi., Pub. Year 1982
4. Workshop Practice Manual By K. Venkat Reddy | BS Publications
5. Elements of Workshop Technology Vol. I By Hajra Chaudhary S.K. | Asia Publishing House
6. Comprehensive Workshop Techno By S.K. Garg | Laxmi publications

k. Mapping of Experiment List with Course Learning Outcomes:

Exp. No.	Name of the Experiment
1	To A Perform a Job in Carpentry Shop.
2	To A Perform a Job in Tim Smithy.
3	To Perform a Job on Fitting Practice.
4	To Perform a Job on Soldering.
5	To Perform a Job on Welding.
6	To Perform a Job on plumbing.
7	To Perform a Job on Sheet Metal Practice.
8	Identify Different symbol used in electrical installation and prepare sheet.
9	Identify the different tools used in electrical installation.
10	Demonstration of measuring instrument Voltmeter, Ammeter, Wattmeter.
11	Demonstration of testing instruments: Multi meter, Clip-on meter, Megger, Line tester.
12	Demonstration of different cables used in electrical installation.
13	Demonstration of different switches used in electrical installation.
14	Demonstration of protective devices: fuse, MCB, ELCB.
15	Identify different types of domestic wirings.

(9)

a. **Course Name:** Mathematics I
b. **Course Code:** 03691101
c. **Prerequisite:** Knowledge of basic concept studied till 10th std.
d. **Rationale:** The study of mathematics is an important requirement for the understanding and development of any branch of engineering. The purpose of teaching mathematics to diploma engineering students is to impart them basic knowledge of mathematics which is needed for full understanding and study of engineering subjects**.**
e. **Course Learning Objective:**

CLOBJ 1	Apply logarithm in engineering calculation
CLOBJ 2	Analyze rational fraction into sum of partial fraction in engineering problems
CLOBJ 3	Learn trigonometric functions and its graph for engineering
CLOBJ 4	Understand the concepts of complex numbers in engineering
CLOBJ 5	Understand the use of limit and functions in engineering
CLOBJ 6	Learn Differentiation of different functions in engineering

f. **Course Learning Outcomes:**

CLO 1	Understand the concepts logarithm with different examples
CLO 2	Understand rational fraction into sum of partial fraction in engineering
CLO 3	Understand trigonometric functions and its graph with different examples
CLO 4	Understand the concepts of complex numbers by using examples
CLO 5	Apply limit to functions by using examples
CLO 6	Apply derivative to different functions with examples

g. Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes	
CLO 1	Understand the concepts logarithm with different examples
CLO 2	Understand rational fraction into sum of partial fraction in engineering
CLO 3	Understand trigonometric functions and its graph with different examples
CLO 4	Understand the concepts of complex numbers by using examples
CLO 5	Apply limit to functions by using examples
CLO 6	Apply derivative to different functions with examples

h. Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Outcomes:

CLOs	**PLOs**												**PSO**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CLO 1	3.00	3.00	2.00	2.00	2.00	2.00	2.00	1.00	1.00	-	-	-	2.00	2.00
CLO 2	3.00	3.00	2.00	2.00	2.00	1.00	2.00	1.00	1.00	-	-	-	2.00	2.00
CLO 3	3.00	3.00	2.00	2.00	2.00	2.00	2.00	1.00	1.00	-	-	-	2.00	2.00
CLO 4	3.00	2.00	2.00	2.00	2.00	2.00	2.00	1.00	1.00	-	-	-	2.00	2.00
CLO 5	3.00	2.00	2.00	2.00	2.00	2.00	2.00	1.00	1.00	-	-	-	2.00	2.00
CLO 6	3.00	3.00	2.00	2.00	2.00	2.00	2.00	1.00	1.00	-	-	-	2.00	2.00
Weighted Average	3.00	2.60	2.00	2.00	2.00	1.80	2.00	1.00	1.00				2.00	2.00

i. Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
2	**1**	**0**	**3**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

j. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**Logarithms:** Definition, Logarithm as a transformation, Antilogarithm, Rules of Logarithms and examples, use logarithmic functions for simplifying arithmetic computations. **Partial fractions:** Definition of partial fractions. Types of partial fraction (Denominator containing non-repeated linear factors, repeated linear factors and irreducible non-repeated quadratic factors).	**17%**	**4**
2	**Trigonometry:** Concept of angles, measurement of angles in degrees, grades and radians and their conversions, T-Ratios of Allied angles (without proof), Trigonometric identities, Sum, difference formulae and their applications (without proof). Product formulae (Transformation of product to sum, difference and vice versa). T- Ratios of multiple angles, sub-multiple angles (2A, 3A, A/2). Graphs of all trigonometric functions	**23%**	**7**
3	**Permutations and Combinations:** Value of nPr and nCr with related examples, First principal of Mathematical Induction (without proof) **Binomial theorem:** Binomial theorem (without proof) for positive integral index (expansion and general form); binomial theorem for rational index (expansion without proof) first and second binomial approximation with applications to engineering problems	**9%**	**3**
4	**Complex Numbers:** Definition of a complex number, real and imaginary parts of a complex number, Polar and Cartesian representation of complex number, Conjugate of complex number, Geometric representation of complex numbers and their operations, Modules and Amplitude form, De Moivre's Theorem, Root of Complex Number, Use of De Moivre's Theorem to simplify mathematical expressions.	**17%**	**4**
5	**Calculus:** Definition of function; Concept of limits and standard forms of limits $\lim_{x\to a}\frac{x^n-a^n}{x-a}$, $\lim_{x\to 0}\frac{sinx}{x}$, $\lim_{x\to a}\frac{a^x-1}{x}$, $\lim_{x\to a}(1+x)^{\frac{1}{x}}$ And Definition of continuous function and examples.	**34%**	**10**

	Definition of derivative, differentiation of standard function by first principle, Rule of Differentiation, Differentiation of algebraic, trigonometric, Exponential, Logarithmic, Implicit functions and Composite functions, Higher order derivatives.		

k. Text Book and Reference Book:

1. Higher Engineering Mathematics, B.S. Grewal, Khanna Publishers, New Delhi
2. Engineering Mathematics (Diploma Stream), H.K. Dass, S. Chand Publishing
3. Mathematics for Polytechnic, S.P. Deshpande, Pune Vidyarthi Griha Prakashan.
4. Polytechnic Mathematics (Made Easy) (Applied Mathematics), Manjeet Singh

(10)

a. Course Name: COMMUNICATION SKILLS-I

b. Course Code: 03693103

c. Prerequisite: Basic Knowledge of English

d. Rationale: Communication confidence laced with knowledge of English grammar is essential for all engineers.

e. Course Learning Objective:

CLOBJ 1	Encourage students to analyze information, evaluate arguments, and develop reasoned conclusions.
CLOBJ 2	Foster the ability to identify and solve complex problems through logical reasoning and creativity.
CLOBJ 3	Develop effective written, verbal, and non-verbal communication skills to express ideas clearly and persuasively.
CLOBJ 4	Teach students to work effectively in teams, valuing diverse perspectives and contributing positively to group efforts.
CLOBJ 5	Cultivate imaginative thinking and the ability to generate original ideas and solutions.
CLOBJ 6	Equip students with the skills to locate, evaluate, and ethically use information from various sources.

f. Course Learning Outcomes:

CLO 1	Analyze complex issues, evaluate evidence, and develop reasoned arguments to support their conclusions.
CLO 2	Identify problems, explore potential solutions, and implement strategies to address challenges effectively.

CLO 3	Articulate ideas clearly and persuasively in written, verbal, and non-verbal forms, adapting their communication style to different audiences and purposes.
CLO 4	Locate and critically evaluate information from various sources, demonstrating information literacy skills to support their learning and decision-making.

g. Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes	
CLO 1	Analyze complex issues, evaluate evidence, and develop reasoned arguments to support their conclusions.
CLO 2	Identify problems, explore potential solutions, and implement strategies to address challenges effectively.
CLO 3	Articulate ideas clearly and persuasively in written, verbal, and non-verbal forms, adapting their communication style to different audiences and purposes.
CLO 4	Locate and critically evaluate information from various sources, demonstrating information literacy skills to support their learning and decision-making.

h. Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Outcomes:

CLOs	**PLOs**												**PSO**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CLO 1	2.00	2.00	1.00	2.00	1.00	1.00	2.00	2.00	3.00	2.00	1.00	3.00	2.00	2.00
CLO 2	3.00	2.00	1.00	1.00	1.00	2.00	1.00	3.00	2.00	2.00	1.00	3.00	1.00	2.00
CLO 3	2.00	3.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00	2.00	1.00	3.00	2.00	3.00
CLO 4	2.00	2.00	2.00	1.00	3.00	1.00	2.00	1.00	1.00	1.00	1.00	3.00	1.00	1.00
Weighted Average	2.25	2.25	1.25	1.25	1.50	1.25	1.50	1.75	2.00	1.75	1.00	3.00	1.50	2.00

i. Teaching & Examination Scheme:

Teaching Scheme			**Credit**	**Examination Scheme**					**Total**
Lect. Hrs/ Week	**Tut Hrs/ Week**	**Lab Hrs/**		**External**		**Internal**			
				T	**P**	**T**	**CE**	**P**	
1	0	-	1	-	-	-	100	-	100

Lect. - Lecture, **Tut** - Tutorial, **Lab** - Lab, **T** - Theory, **P** - Practical, **CE** – Continuous Evaluation

Note: 15 Hours of additional sessions will be taken (within the semester) to match up 30 hours content.

j. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**Ice breaker + Introducing your friend**: • This is one activity which will build the bond between the students i the class and work as a team in the task given tothem. The students will be asked to introduce their new best friend in the class. This will ensure that the bond being created here will stay strongand also breaks the ice between them.	05%	01
2	**Picture connector**: • In this class the students will be trained to form a logical connection between a set of pictures which will be shared withthem. • This geared towards building creativity and presentation skills.	05%	01
3	**Crazy Scientist**: • The students will be taught the importance of invention and innovation using some examples that changed the world theway it worked.	05%	01
4	**Shopping role play**: • This activity topic gears towards making students do role playbased on shopping scenarios. • It involves giving them a scenario and asking them to further develop the idea in a very interesting manner, then going on toenact it.	05%	01
5	**Grammar** • Parts of speech, Active and Passive voice, Tenses	20%	10
6	**Communication: Theory & Practice** Basics of communication: Introduction ,meaning, definition , Process ofcommunication Types of communication: Formal, Informal , Verbal / Non verbal andWritten barriers to effective communication 7 Cs of effective communication: (considerate ,concrete concise , clear, complete , correct and courteous)	12%	05

	Technical Communication :		
7	**Soft Skills** for Professional excellence I**ntroduction** :Soft skills and hard skills , Inportance of Soft Skills	12%	02
8	**Debate**: • Students are trained to let go of inhibitions and come forwardand speak openly on passionate topics. • The students will be divided into teams and made to share theirideas and views on the topics.	05%	01
9	**Extempore**: • To change the average speakers in the class to some of thebest Orator. • This will be done by making the students give variety ofimpromptu speeches in front of the class.	05%	01
10	**Letter Writing** • Types of letters-Inquiry letter, Order letter, Complaint letter,Adjustment, Request letter, Recommendation letter • Format of letters	12%	02
11	**Reading Comprehension**: • Dabbawalahs • A Snake in the grass • Internet – Dr. Jagdish Joshi	14%	05
	Total	**100**	**60**

***Continuous Evaluation:**

It consists of

1. Phase I Exam-35 Marks(Hybrid or Offline Mode)
2. Phase II Exam -35 Marks (Hybrid or Offline Mode)
3. Activities – (Listening and Speaking) -10+10=20 Marks
4. Attendance -10 Marks

The passing marks for Continous Evaluation will be 40 out of 100.There will not be any re-test.

i. Text Book and Reference Books:

1. Active English –Almas Juneja and Vaseem Qureshi-Macmillan Publishers India Ltd
2. English- Prof. Pradyuman Raj, Prof. Rakhi Moghe, Ms. Anisha Modi
3. Technical Communication –Principles & Practice-IInd Edition by Meenakshi Raman & Sangeeta Sharma.
4. Effective Technical Communication by Dr.Bharti Kukreja & Dr. Anupama Jain
5. J.D.O'Connor. Better English Pronunciation. Cambridge: Cambridge University Press,

1980.
6. Lindley Murray. An English Grammar: Comprehending Principles and Rules. London:Wilson & Sons, 1908.
7. Kulbhushan Kumar, Effective Communication Skills, Khanna Publishing House, New Delhi (Re-visedEdition 2018)
8. Margaret M. Maison. Examine your English. Orient Longman: New Delhi, 1964.
9. M.Ashraf Rizvi. Effective Communication. Mc-Graw Hill: Delhi, 2002.
10. A Ready Reckoner –Dineshbhai J. Shah, Dr.Janakbhai I. Shah,Bhartiben P. Shah.
11. Oxford Dictionary
12. Roget's Theasaurus of English Words and Phrases.

Semester 2

(1)

a. **Course Name:** Engineering Mechanics
b. **Course Code:** 03605151
c. **Prerequisite:** Knowledge of Applied science.
d. **Rationale:** Engineering mechanics is the main subject of mechanical engineering which gives a basic base to other subjects like strength of materials, manufacturing process. The goal of this Engineering Mechanics course is to expose students to problems in mechanics as applied to plausibly real-world scenarios.

e. **Course Learning Objective:**

CLOBJ 1	Identify force systems in diverse engineering scenarios through the application of fundamental mechanics principles.
CLOBJ 2	To impart knowledge about calculate the centroid and center of gravity for various components within engineering systems.
CLOBJ 3	To impart knowledge about force systems and methods to determine resultant.
CLOBJ 4	To impart knowledge about force systems and methods to determine resultant.
CLOBJ 5	Apply the principles of friction across various conditions to achieve practical objectives.
CLOBJ 6	Select appropriate eco-friendly lifting machines for specific purposes, considering relevant factors such as efficiency and sustainability.

f. **Course Learning Outcomes:**

CLO 1	Identify the force systems for given conditions by applying the basics of mechanics.
CLO 2	Find out the centroid and centre of gravity of various components in engineering systems.
CLO 3	Determine unknown force(s) of different engineering systems.

CLO 4	Determine unknown force(s) of different engineering systems.
CLO 5	Apply the principles of friction in various conditions for useful purposes
CLO 6	Select the eco-friendly relevant simple lifting machine(s) for given purposes

g. Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes	
CLO 1	Identify the force systems for given conditions by applying the basics of mechanics.
CLO 2	Find the centroid and centre of gravity of various components in engineering systems.
CLO 3	Determine unknown force(s) of different engineering systems.
CLO 4	Determine unknown force(s) of different engineering systems.
CLO 5	Apply the principles of friction in various conditions for useful purposes
CLO 6	Select the eco-friendly relevant simple lifting machine(s) for given purposes

h. Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	**-**	**0**	**3**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

i. Course Content:

Sr. No.	**Content**	**Weightage**	**Teaching Hours**
1	**Basics of Mechanics:** Significance and relevance of Mechanics, Applied mechanics, Statics, Dynamics. Space, time, mass, particle, flexible body and rigid body. Scalar and vector quantity, Units of measurement (SI units) - Fundamental units and derived units.	**10%**	**2**
2	**Centroid and Centre of Gravity:** Centroid of geometrical plane figures (square, rectangle, triangle, circle, semi-circle, quarter circle) Centroid of composite figures composed of not more than three geometrical figures. Centre of Gravity of simple solids (Cube, cuboids, cone, cylinder, sphere, hemisphere) Centre of Gravity of composite solids composed of not more than two simple solids.	**10%**	**6**
3	**Coplanar Concurrent Forces:** Force – Unit, representation as a vector and by Bow's notation, characteristics and effects of a force, Newton's first, second and third Law of motion	**25%**	**10**

	Principle of transmissibility of force, Principle of superposition of force, Force system and its classification. Lami's Theorem – statement and explanation, Application for various engineering problems. Resolution of a force. Composition of forces – Resultant, analytical method for determination of resultant for concurrent, non-concurrent and parallel co-planar force systems – Law of triangle, parallelogram and polygon of forces.		
4	**Equilibrium and Coplanar Non-Concurrent Forces:** Types of Equilibrium, Equilibrant, Free body and Free body diagram, Analytical and graphical methods of analyzing equilibrium. Moment and couple, Varignon's Theorem. Types of beam, supports (simple, hinged, roller and fixed) and loads acting on beam (vertical and inclined point load, uniformly distributed load, couple), Beam reaction for cantilever, simply supported beam with or without overhang – subjected to combination of Point load and uniformly distributed load. Beam reaction graphically for simply supported beam subjected to vertical point loads only	**25%**	**10**
5	**Friction:** Friction and its relevance in engineering, types and laws of friction, limiting equilibrium, limiting friction, co-efficient of friction, angle of friction, angle of repose, relation between co-efficient of friction and angle of friction. Equilibrium of bodies on level surface subjected to force parallel and inclined to plane. Equilibrium of bodies on inclined plane subjected to force parallel to the plane only. Ladder Friction, Engineering Problems.	**10%**	**6**
6	**Simple Lifting Machine:** Simple lifting machine, load, effort, mechanical advantage, applications and advantages. Velocity ratio, efficiency of machines, Work – work done , force displacement diagram, Power , Engineering Problems Energy – Kinetic & Potential energy and Engineering Problems. Law of machine. Ideal machine, friction in machine, maximum Mechanical advantage and efficiency, reversible and non-reversible machines.	**20%**	**8**

j. Text Book and Reference Book:

1. "Applied Mechanics" by H. J. Shah and S. B. Junarkar.
2. "A Text Book of Engineering Mechanics" by Bansal R K.
3. "Engineering Mechanics" by J.L. Meriam, and L.G.Kraige."
4. Engineering Mechanics" by S.S. Bhavikatti and K. G. Rajashekarappa.

(2)

l. Course Name: Engineering Mechanics Lab

m. Course Code: 03605152

n. **Prerequisite:** Knowledge of Applied science

o. **Rationale:** Engineering mechanics is the main subject of mechanical engineering which gives a basic base to other subjects like strength of materials, manufacturing process. The goal of this Engineering Mechanics course is to expose students to problems in mechanics as applied to plausibly real-world scenarios.

p. Course Learning Objective:

CLOBJ 1	Identify force systems in diverse engineering scenarios through the application of fundamental mechanics principles.
CLOBJ 2	To impart knowledge about calculate the centroid and center of gravity for various components within engineering systems.
CLOBJ 3	To impart knowledge about force systems and methods to determine resultant.
CLOBJ 4	To impart knowledge about force systems and methods to determine resultant.
CLOBJ 5	Apply the principles of friction across various conditions to achieve practical objectives.
CLOBJ 6	Select appropriate eco-friendly lifting machines for specific purposes, considering relevant factors such as efficiency and sustainability.

q. Course Learning Outcomes:

CLO 1	Identify the force systems for given conditions by applying the basics of mechanics.
CLO 2	Find out the centroid and centre of gravity of various components in engineering systems.
CLO 3	Determine unknown force(s) of different engineering systems.
CLO 4	Determine unknown force(s) of different engineering systems.
CLO 5	Apply the principles of friction in various conditions for useful purposes
CLO 6	Select the eco-friendly relevant simple lifting machine(s) for given purposes

r. Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes	
CLO 1	Identify the force systems for given conditions by applying the basics of mechanics.
CLO 2	Find the centroid and centre of gravity of various components in engineering systems.
CLO 3	Determine unknown force(s) of different engineering systems.
CLO 4	Determine unknown force(s) of different engineering systems.
CLO 5	Apply the principles of friction in various conditions for useful purposes
CLO 6	Select the eco-friendly relevant simple lifting machine(s) for given purposes

s. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
0	-	2	1	-	-	50	-	-	50

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

t. Text Book and Reference Book:

1. "Applied Mechanics" by H. J. Shah and S. B. Junarkar.
2. "A Text Book of Engineering Mechanics" by Bansal R K.
3. "Engineering Mechanics" by J.L. Meriam, and L.G.Kraige.
4. "Engineering Mechanics" by S.S. Bhavikatti and K. G. Rajashekarappa

u. Mapping of Experiment List with Course Learning Outcomes:

Exp. No.	Name of the Experiment
1	Law of Parallelogram: Verify and calculate resultant force through Law of Parallelogram.
2	Triangle Law of Forces: Verify and calculate resultant force through triangle Law of Forces.
3	Lami's Theorem: Verify and calculate resultant force through Lami's Theorem.
4	Polygon Law of Forces: Verify and calculate resultant force through Polygon Law of Forces.
5	Reactions in beam through Graphical & analytical method: Verify reactions in beam through Graphical & analytical method
6	Co efficient of Sliding Friction and angle of repose: Calculate Co efficient of Sliding Friction and angle of repose for different surfaces – Wood, Glass
7	Simple machines: To find out efficiency, velocity ratio and M.A for differential wheel and axle
8	Simple screw jack: To find out efficiency, velocity ratio and M.A for simple lifting machine using simple screw jack.
9	Centroid and Centre of Gravity: Solve numerical problems on Centroid and Centre of Gravity.

(3)

a. Course Name: Fundamentals of Electrical and Electronics Engineering

b. Course Code: 03607151

c. Prerequisite: Knowledge of Physics and Mathematics up to 10th Standard Level

d. Rationale: Electrical and electronics engineering equipment is widely used in mechanical/metallurgy/mining/Automobile/ Aeronautical engineering applications and a diploma engineer from any of these disciplines have to identify the related equipment being used in the industry with respect to their working and major faults that could occur. Electronics is an integral part of computers; hence students of computer engineering and information technology need to know the fundamental of electronics. This course has been designed to provide the needful inputs to handle simple electronic components and circuits. Students after studying this course will be able to understand the basics of analog electronics, various electronics components and develop skills to use simple electronic instruments needed for computer-based working environment.

e. Course Learning Objective:

CLOBJ 1	Understand the fundamental principles of basic circuit elements, including resistors, capacitors, and inductors, and analyze their behavior in electrical circuits.
CLOBJ 2	Apply knowledge of logic gates to design and implement various electronic circuits, demonstrating proficiency in Boolean algebra and logic gate operations.
CLOBJ 3	Demonstrate comprehension of the basic concepts of operational amplifiers (op-amps), including their characteristics, configurations, and common applications in electronic circuits.
CLOBJ 4	Solve basic problems related to electrical circuits and machines, utilizing appropriate mathematical techniques and analytical methods to analyze circuit behaviour, troubleshoot issues, and optimize performance.

f. Course Learning Outcomes:

CLO 1	Understand the basic circuit elements.
CLO 2	Understand logic gates and apply them in various electronic circuits.
CLO 3	Understand the basic concepts of op-amps, and their applications.
CLO 4	Solve basic problems related to electrical circuits and machines.

g. Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes	
CLO 1	Understand the basic circuit elements.
CLO 2	Understand logic gates and apply them in various electronic circuits.
CLO 3	Understand the basic concepts of op-amps, and their applications.
CLO 4	Solve basic problems related to electrical circuits and machines.

h. Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Learning Outcomes:

CLOs	PLOs												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CLO 1	1.00	1.00	3.00	1.00	1.00	3.00	3.00	3.00	3.00	3.00	1.00	3.00	3.00	1.00
CLO 2	2.00	2.00	3.00	1.00	1.00	1.00	2.00	2.00	2.00	3.00	1.00	1.00	3.00	2.00
CLO 3	1.00	1.00	3.00	1.00	2.00	3.00	2.00	1.00	1.00	2.00	1.00	2.00	3.00	2.00
CLO 4	3.00	2.00	1.00	3.00	1.00	1.00	1.00	3.00	2.00	3.00	1.00	3.00	1.00	3.00
Weighted Average	1.67	1.67	2.33	1.67	1.33	2.17	2.17	2.17	2.17	2.83	1.33	2.33	2.33	2.00

i. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	1	-	3	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

j. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**Overview of Electronic Components & Signals** Passive Active Components: Resistances, Capacitors, Inductors, Diodes, Transistors, FET, MOS and CMOS and their Applications. Signals: DC/AC, voltage/current, periodic/non-periodic signals, average, rms, peak values, different types of signal waveforms, Ideal/non-ideal voltage/current source, independent/dependent voltage current sources.	15%	6
2	**Introduction of Semiconductor Components** P-N junction diode, V-I Characteristics of P-N junction Diode, Zener Diode, Classification of Transistor, Transistor construction, Types of transistors (NPN & PNP)	10%	5
3	**Overview of Digital Electronics** Number systems, Base Conversion -BINARY -DECIMAL -	25%	10

	HEX -OCTAL, Complements - 2' and 10's Complement -1's and 9's Complement, Binary addition, subtraction, multiplication and division Logic Gates -Basic Gates (AND, OR, Not), Universal Gates (NAND and NOR Gate), Complementary Gates-(EX-OR, EX-NOR), De-Morgan's Theorems, Adder and Subtractor, Multiplexer and De-multiplexer.		
4	**Electric Circuit** Generation of electricity, Different terms related to electric circuit, Concept of AC and DC, Concept of 1-phase and 3-phase supply, Electrical circuit elements – Resistor Inductor and Capacitor, Resistor in series and parallel, Ohm's law and its limitations, Factors affecting the value of resistance	**20%**	**8**
5	**Magnetic Circuit** Terms Related to magnetic circuit, Terms Related to AC circuit, Faraday's Law, Fleming's law, Lenz's Law, Hysteresis loop (B/H Curve), Types of Induced EMF, Comparison between Electric and Magnetic Circuit	**20%**	**8**
6	**Transformer and Machines** General construction and principle of different type of transformers; Emf equation and transformation ratio of transformers; Auto transformers; Construction and Working principle of motors; Basic equations of motors.	**10%**	**5**

k. Text Book and Reference Book:

1. **Basic Electrical Engineering** by Ritu Sahdev | Khanna Publishing House
2. **Fundamentals of Electrical Engineering** by Saxena, S. B. Lal | Cambridge University Press
3. **Electrical Technology Vol-1** By Theraja, B. L. | S. Chand, New Delhi

(4)

a. Course Name: Fundamentals of Electrical and Electronics Engineering Lab

b. Course Code: 03607152

c. Prerequisite: Knowledge of Physics and Mathematics up to 10th Standard Level.

d. Rationale: Electrical and electronics engineering equipment is widely used in mechanical/metallurgy/mining/Automobile/Aeronautical engineering applications and a diploma engineer from any of these disciplines have to identify the related equipment being used in the industry with respect to their working and major faults that could occur. Electronics is an integral part of computers; hence students of computer engineering and information technology need to know the fundamental of electronics. This course has been designed to provide the needful inputs to handle simple electronic components and circuits. Students after studying this course will be

able to understand the basics of analog electronics, various electronics components and develop skills to use simple electronic instruments needed for computer-based working environment.

e. Course Learning Objective:

CLOBJ 1	Understand the fundamental principles of basic circuit elements, including resistors, capacitors, and inductors, and analyze their behavior in electrical circuits.
CLOBJ 2	Apply knowledge of logic gates to design and implement various electronic circuits, demonstrating proficiency in Boolean algebra and logic gate operations.
CLOBJ 3	Demonstrate comprehension of the basic concepts of operational amplifiers (op-amps), including their characteristics, configurations, and common applications in electronic circuits.
CLOBJ 4	Solve basic problems related to electrical circuits and machines, utilizing appropriate mathematical techniques and analytical methods to analyze circuit behaviour, troubleshoot issues, and optimize performance.

f. Course Learning Outcomes:

CLO 1	Understand the basic circuit elements.
CLO 2	Understand logic gates and apply them in various electronic circuits.
CLO 3	Understand the basic concepts of op-amps, and their applications.
CLO 4	Solve basic problems related to electrical circuits and machines.

g. Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes	
CLO 1	Understand the basic circuit elements.
CLO 2	Understand logic gates and apply them in various electronic circuits.
CLO 3	Understand the basic concepts of op-amps, and their applications.
CLO 4	Solve basic problems related to electrical circuits and machines.

h. Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Learning Outcomes:

CLOs	PLOs												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CLO 1	1.00	1.00	3.00	1.00	1.00	3.00	3.00	3.00	3.00	3.00	1.00	3.00	3.00	1.00
CLO 2	2.00	2.00	3.00	1.00	1.00	1.00	2.00	2.00	2.00	3.00	1.00	1.00	3.00	2.00
CLO 3	1.00	1.00	3.00	1.00	2.00	3.00	2.00	1.00	1.00	2.00	1.00	2.00	3.00	2.00
CLO 4	3.00	2.00	1.00	3.00	1.00	1.00	1.00	3.00	2.00	3.00	1.00	3.00	1.00	3.00
Weighted Average	1.67	1.67	2.33	1.67	1.33	2.17	2.17	2.17	2.17	2.83	1.33	2.33	2.33	2.00

i. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
-	-	2	1	-	-	50	-	0	50

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

j. Mapping of Experiment List with Course Learning Outcomes:

Sr. NO.	Experiment List
1	Determine the permeability of magnetic material by plotting its B-H curve
2	Measure voltage, current and power in 1-phase circuit with resistive load.
3	Measure voltage, current and power in R-L series circuit.
4	Determine the transformation ratio (K) of 1-phase transformer.
5	Connect single phase transformer and measure input and output quantities.
6	Identify various active and passive electronic components.
7	Connect resistors in series and parallel combination on bread board and measure its value using digital Multimeter.
8	Use Multimeter to measure the value of given resistor. Determine the value of given resistor using digital multimeter to confirm with colour code.
9	Test the performance of PN-junction diode.
10	Test the half wave rectifier using CRO.
11.	Test the Bridge rectifier and capacitor filter using CRO.
12	Test the performance of Zener diode.
13	Identify the pins of IC 741.
14	Test the performance of CE NPN transistor.
15	Test the performance of transistor amplifier circuit.

(5)

a. **Course Name:** Introduction to Mechanical Engineering
b. **Course Code:** 03609155
c. **Prerequisite:** Learn about fundamental of mechanical.
d. **Rationale:** This course mainly encompasses the major and general areas of mechanical engineering which are being used by common man to large industrial sectors. A technician has to know many times the implications and knowledge of other disciplines so as to conclude the solution of his/her own branch tasks.

e. **Course Learning Objective:**

CLOBJ 1	Develop analytical skills necessary for solving engineering problems, including mathematical modeling, problem-solving techniques, and critical thinking.
CLOBJ 2	Introduce students to the engineering design process, including problem identification, conceptualization, analysis, optimization, and implementation.
CLOBJ 3	Students should grasp the foundational principles of mechanical engineering, including mechanics, thermodynamics, materials science, and fluid dynamics.
CLOBJ 4	Introduce students to contemporary issues and challenges in mechanical engineering, such as sustainable design, renewable energy, and advanced materials.

f. **Course Learning Outcomes:**

CLO 1	Students will be able to explain fundamental concepts of Boiler, Mountings, Accessories and operation of boiler.
CLO 2	Students will be able to understand basic fundamentals of Internal Combustion engine and its components.
CLO 3	Students will be able to understand basic Fundamental of Pump and Turbine.
CLO 4	Students will be able to learn basics of material handling, various material handling equipment.

g. **Mapping of Course Learning Outcomes and Bloom's Taxonomy:**

Course Learning Outcomes	
CLO 1	Students will be able to explain fundamental concepts of Boiler, Mountings, Accessories and operation of boiler.
CLO 2	Students will be able to understand basic fundamentals of Internal Combustion engine and its components.
CLO 3	Students will be able to understand basic Fundamental of Pump and Turbine.

CLO 4	Students will be able to learn basics of material handling, various material handling equipment.

h. Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Outcomes:

CLOs	**PLOs**												**PSO**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CLO 1	2.00	2.00	1.00	2.00	1.00	1.00	2.00	2.00	3.00	2.00	1.00	3.00	2.00	2.00
CLO 2	3.00	2.00	1.00	1.00	1.00	2.00	1.00	3.00	2.00	2.00	1.00	3.00	1.00	2.00
CLO 3	2.00	3.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00	2.00	1.00	3.00	2.00	3.00
CLO 4	2.00	2.00	2.00	1.00	3.00	1.00	2.00	1.00	1.00	1.00	1.00	3.00	1.00	1.00
Weighted Average	2.25	2.25	1.25	1.25	1.50	1.25	1.50	1.75	2.00	1.75	1.00	3.00	1.50	2.00

i. Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
1	**-**	**-**	**1**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

j. Course Content:

Sr. No.	**Content**	**Weightage**	**Teaching Hours**
1	**Steam Generation and Prime Movers** Steam: Generation process, Properties. Boilers: Classification, Working, Accessories and mountings-types and Applications, Regulations and safety requirements, Common troubles and remedies. Thermal Conductivity and Insulating material. Prime movers: Meaning, Classification, Working, Steam turbine-working, Gas turbine-types and applications, Common troubles and remedies.	**35%**	**5**

2	**Internal Combustion Engines** Internal Combustion Engines: Meaning, Classification, Main parts and functions, Working, Applications.	**15%**	**2**
3	**Hydraulic And Pneumatic Devices** Pump: Working principle, Types, Working of centrifugal and reciprocating pumps, Performance parameters, Main parts of pumps and their functions, Common troubles and remedies. Water turbines: working principle, types and Applications, Common troubles and remedies of water turbine. Air compressor: Working principle, Types, Applications.	**30%**	**4**
4	**Material Handling** Need of material handling. Types, principle of working and applications of material handling: Equipment, hoisting equipment, conveying equipment, Surface & overhead equipment, Earth moving machineries, Construction machineries. Criteria for selection of material handling equipment. Factors affecting selection of material handling Equipment. Selection of suitable material handling equipment for the given Situation. Common troubles and remedies.	**20%**	**3**

k. Text Book and Reference Book:

1. Heat engines By N C Pandya, C S Shah, S S Khandare | Charotar Publishing House | 10th edition, Pub. Year 2005
2. Hydraulic Machines by Jagdish Lal | S.K. Kataria & Sons
3. "Signals and Systems: Analysis Using Transform Methods & MATLAB" by M.J. Roberts.
4. Thermal Engineering by R. K. Rajput | Laxmi Publication “Fundamentals of Signals and Systems”, by Govind Sharma, Michael J. Roberts

(6)

a. **Course Name:** Introduction to Mechanical Engineering Lab
b. **Course Code:** 03609156
c. **Prerequisite:** Learn about fundamental of mechanical.
d. **Rationale:** This course mainly encompasses the major and general areas of mechanical engineering which are being used by common man to large industrial sectors. A technician has to know many times the implications and knowledge of other disciplines so as to conclude the solution of his/her own branch tasks.

e. Course Learning Objective:

CLOBJ 1	Students should understand and follow safety protocols and practices in a laboratory setting, including proper handling of equipment, materials, and chemicals.

CLOBJ 2	Provide hands-on experience in applying theoretical concepts learned in lectures to practical engineering problems encountered in the lab.
CLOBJ 3	Enable students to design experiments, develop procedures, and conduct tests to investigate engineering phenomena and validate theoretical models.
CLOBJ 4	Develop proficiency in using laboratory equipment and instruments commonly used in mechanical engineering experiments, such as sensors, data acquisition systems, and measurement tools.
CLOBJ 5	Teach students how to collect, record, and analyze experimental data accurately, using appropriate statistical methods and software tools.
CLOBJ 6	Enhance students' ability to troubleshoot experimental setups, identify sources of error, and implement corrective measures to ensure reliable data collection.

f. Course Learning Outcomes:

CLO 1	Students will be able to identify potential hazards in the laboratory environment and implement appropriate safety measures to ensure personal and environmental safety.
CLO 2	Students will be able to apply fundamental mechanical engineering principles learned in lectures to design, conduct, and analyze experiments in the laboratory.
CLO 3	Students will demonstrate proficiency in using various laboratory equipment, instruments, and measurement tools commonly used in mechanical engineering experiments.
CLO 4	Students will be able to collect, record, and analyze experimental data accurately using appropriate techniques and software tools, and interpret results within the context of theoretical models.

g. Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes	
CLO 1	Students will be able to identify potential hazards in the laboratory environment and implement appropriate safety measures to ensure personal and environmental safety.
CLO 2	Students will be able to apply fundamental mechanical engineering principles learned in lectures to design, conduct, and analyze experiments in the laboratory.
CLO 3	Students will demonstrate proficiency in using various laboratory equipment, instruments, and measurement tools commonly used in mechanical engineering experiments.

CLO 4	Students will be able to collect, record, and analyze experimental data accurately using appropriate techniques and software tools, and interpret results within the context of theoretical models.

h. Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Outcomes:

CLOs	**PLOs**												**PSO**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CLO 1	3.00	3.00	2.00	1.00	1.00	1.00	2.00	1.00	1.00	3.00	1.00	3.00	1.00	1.00
CLO 2	3.00	2.00	2.00	1.00	2.00	2.00	2.00	1.00	3.00	3.00	1.00	3.00	1.00	2.00
CLO 3	3.00	3.00	2.00	1.00	1.00	3.00	2.00	2.00	2.00	2.00	2.00	3.00	2.00	3.00
CLO 4	3.00	2.00	2.00	2.00	1.00	2.00	1.00	2.00	2.00	3.00	3.00	3.00	2.00	3.00
Weighted Average	3.00	2.50	2.00	1.25	1.25	2.00	1.75	1.50	2.00	2.75	1.75	3.00	1.50	2.25

i. Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
0	**-**	**2**	**1**	**-**	**-**	**20**	**-**	**30**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

j. Mapping of Experiment List with Course Learning Outcomes:

Exp. No.	**Name of the Experiment**
1	Introduction of boiler and study about low pressure boiler.
2	Study about High-pressure boiler.
3	Study about boiler mountings and boiler accessories.
4	Perform and study the effect of variation of load on fuel- consumption of an I.C. engines (On petrol engine).
5	Perform and study the effect of variation of load on fuel - consumption of an I.C. engines (On diesel engine).
6	Demonstrate a water-turbine.
7	Perform test on Air compressor.
8	Perform test on centrifugal pump. Also find fault and remedies for centrifugal pump.
9	Study various types of materials handling equipment.

Exp. No.	Name of the Experiment
10	Study various types of materials handling equipment.
11	Mini Project (Student making Chart, model, presentation).

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a. **Course Name:** Mathematics II
b. **Course Code:** 03691151
c. **Prerequisite:** Knowledge of Basic concept of mathematics studied till first semester
d. **Rationale:** This course is designed to give a comprehensive coverage at an introductory level to the subject of matrices, Integral Calculus coordinate geometry, Basic elements of vector algebra and First Order Differential Equations**..**
e. **Course Learning Objective:**

CLOBJ 1	Understand concept of determinant and matrix in engineering
CLOBJ 2	Understand concept of vector algebra in engineering
CLOBJ 3	Learn geometry of lines and circle
CLOBJ 4	Understand the integral calculus in engineering
CLOBJ 5	Apply integral calculus in differential equation
CLOBJ 6	Use of MATLAB software to solve engineering problems

f. **Course Learning Outcomes:**

CLO 1	To Understand concept of determinant and matrix in engineering
CLO 2	To Understand concept of vector algebra in engineering
CLO 3	To Learn geometry of lines and circle
CLO 4	To Understand the integral calculus in engineering
CLO 5	To Apply integral calculus in differential equation
CLO 6	To Use of MATLAB software to solve engineering problems

g. **Mapping of Course Learning Outcomes and Bloom's Taxonomy:**

Course Learning Outcomes	
CLO 1	To Understand concept of determinant and matrix in engineering
CLO 2	To Understand concept of vector algebra in engineering
CLO 3	To Learn geometry of lines and circle
CLO 4	To Understand the integral calculus in engineering
CLO 5	To Apply integral calculus in differential equation
CLO 6	To Use of MATLAB software to solve engineering problems

h. Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Outcomes:

CLOs	PLOs												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CLO 1	3.00	3.00	2.00	2.00	2.00	2.00	2.00	1.00	1.00	-	-	-	2.00	2.00
CLO 2	3.00	3.00	2.00	2.00	2.00	1.00	2.00	1.00	1.00	-	-	-	2.00	2.00
CLO 3	3.00	3.00	2.00	2.00	2.00	2.00	2.00	1.00	1.00	-	-	-	2.00	2.00
CLO 4	3.00	2.00	2.00	2.00	2.00	2.00	2.00	1.00	1.00	-	-	-	2.00	2.00
CLO 5	3.00	2.00	2.00	2.00	2.00	2.00	2.00	1.00	1.00	-	-	-	2.00	2.00
CLO 6	3.00	3.00	2.00	2.00	2.00	2.00	2.00	1.00	1.00	-	-	-	2.00	2.00
Weighted Average	3.00	2.60	2.00	2.00	2.00	1.80	2.00	1.00	1.00				2.00	2.00

i. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	1	0	4	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

j. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**Determinants and Matrices:** Elementary properties of determinants up to 3rd order, consistency of equations, Crammer s rule. Algebra of matrices, Inverse of a matrix, matrix inverse method to solve a system of linear equations in 3 variables.	22%	8
2	**Vector Algebra:** Definition notation and rectangular resolution of a vector. Addition and subtraction of vectors. Scalar and vector products of two vectors. Simple problems related to work, moment and angular velocity.	13%	5

3	**Co-Ordinate Geometry:** Straight line Inclination and slope of a line, different forms of equations to a straight line, Slope-intercept form, Point slope form ,Two-point form , Intercept form. General equation of a Straight line, Family of lines. Conditions for concurrency of lines. Circle Definition, Equation of a circle with given center and radius, General form of equation of circle, Equation of a circle when intercepts are given, circle passing through three points, Equation of chord, Equations of tangents and normal at a point on a circle.	**15%**	**7**
4	**Integral Calculus:** Integration as inverse operation of differentiation, Integration of simple functions, Integration by substitution, by parts and by partial fractions (for linear factors only). Definite integral: Definition, Properties of Definite integral, Odd and Even functions, Use of formulas, and for solving problems Where m and n are positive integers. Applications of integration for i. Simple problem on evaluation of area bounded by a curve and axes. ii. Calculation of Volume of a solid formed by revolution of an area about axes. (Simple problems)	**37%**	**14**
5	**Differential Equations:** Solution of first order and first degree differential equation by variable separation method (simple problems), Exact differential equations(simple problems), Linear differential equations(simple problems), MATLAB Simple Introduction.	**13%**	**5**

k. Text Book and Reference Book:

1. Higher Engineering Mathematics B. S. Grewal; Khanna Publications
2. Polytechnic Mathematics S P Deshpande; Pune Vidyarthi Gruh Prakashan

(8)

a. Course Name: Basic Physics Lab

b. Course Code:03692154

c. Prerequisite: The ability to think critically, identify potential sources of error, and troubleshoot experimental setups is crucial in a physics lab.

d. Rationale: Physics involves quantitative analysis and mathematical modeling to describe physical phenomena. Basic physics education helps students develop quantitative and analytical skills that are valuable in a wide range of academic and professional settings.

e. Course Learning Objective:

CLOBJ 1	Students will demonstrate an understanding of basic electrical circuits, including Ohm's law, resistances in series and parallel combinations, and Kirchhoff's laws.
CLOBJ 2	Students will develop practical laboratory skills through hands-on experimentation, including the use of equipment such as galvanometers, voltmeters, ammeters, and Vernier calipers.
CLOBJ 3	Students will gain an understanding of semiconductor devices and their characteristics, including the V-I characteristics of semiconductor diodes made of different materials (e.g., Ge, Si).
CLOBJ 4	Students will apply physics principles to real-world situations, such as measuring AC frequency with a sonometer, determining energy and power in electrical circuits, and understanding nanotechnology concepts through SA/V ratio calculations.
CLOBJ 5	Students will learn to make accurate measurements using precision instruments such as Vernier calipers and screw gauges, and apply mathematical concepts to calculate physical quantities such as volume and diameter.

f. Course Learning Outcomes:

CLO 1	Students will demonstrate an understanding of basic electrical circuits, including Ohm's law, resistances in series and parallel combinations, and Kirchhoff's laws.
CLO 2	Students will develop practical laboratory skills through hands-on experimentation, including the use of equipment such as galvanometers, voltmeters, ammeters, and Vernier calipers.
CLO 3	Students will gain an understanding of semiconductor devices and their characteristics, including the V-I characteristics of semiconductor diodes made of different materials (e.g., Ge, Si).
CLO 4	Students will apply physics principles to real-world situations, such as measuring AC frequency with a sonometer, determining energy and power in electrical circuits, and understanding nanotechnology concepts through SA/V ratio calculations.
CLO 5	Students will learn to make accurate measurements using precision instruments such as Vernier calipers and screw gauges, and apply mathematical concepts to calculate physical quantities such as volume and diameter.

g. Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes	
CLO 1	Students will demonstrate an understanding of basic electrical circuits, including Ohm's law, resistances in series and parallel combinations, and Kirchhoff's laws.
CLO 2	Students will develop practical laboratory skills through hands-on experimentation, including the use of equipment such as galvanometers, voltmeters, ammeters, and Vernier calipers.
CLO 3	Students will gain an understanding of semiconductor devices and their characteristics, including the V-I characteristics of semiconductor diodes made of different materials (e.g., Ge, Si).
CLO 4	Students will apply physics principles to real-world situations, such as measuring AC frequency with a sonometer, determining energy and power in electrical circuits, and understanding nanotechnology concepts through SA/V ratio calculations.
CLO 5	Students will learn to make accurate measurements using precision instruments such as Vernier calipers and screw gauges, and apply mathematical concepts to calculate physical quantities such as volume and diameter.

h. Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Outcomes:

i. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
0	-	2	1	-	-	50	-	-	50

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination.

Experiment List with Course

List of Practical/Activities: (To perform minimum 10 Practical)

1. To verify Ohm’s law by plotting graph between current and potential difference.
2. To verify laws of resistances in series and parallel combination
3. To draw V-I characteristics of a semiconductor diode (Ge, Si) and determine its knee voltage
4. To convert a galvanometer into an ammeter.
5. To convert a galvanometer into a voltmeter.
6. To verify Kirchhoff’s law using electric circuits.
7. To determine A.C. frequency with the help of sonometer
8. Measurement of Energy

9. To Measure A.C. Power using resistive load
10. To calculate SA/V ratio of simple objects to understand nanotechnology
11. To determine focal length and magnifying power of a convex lens.
12. To verify inverse square law of radiations using a photo-electric cell.
13. To measure length, radius of a given cylinder, a test tube and a beaker using a Vernier caliper and find volume of each object
14. To determine diameter of a wire, a solid ball and thickness of cardboard using a screw gauge.

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a. **Course Name: Basic Physics**
b. **Course Code:03692155**
c. **Prerequisite:** Basic understanding of scientific notation and units of measurement.
d. **Rationale:** It provides the fundamental principles necessary for further scientific exploration, interdisciplinary connections, and practical applications in various fields, ultimately empowering individuals to navigate and contribute to an increasingly complex world.

e. **Course Learning Objective:**

CLOBJ 1	Understand fundamental and derived physical quantities and their units in various systems (FPS, CGS, SI). Understand concepts related to errors in measurements, including systematic and random errors, absolute and relative errors, error propagation, and error estimation.
CLOBJ 2	Understand Coulomb's law and electric field, and their application in Gauss's law. Explore concepts related to electric current, resistance, Ohm's law, Kirchhoff's laws, and Wheatstone bridge.
CLOBJ 3	Understand different types of magnetic materials and their properties.
CLOBJ 4	Understand energy bands in solids and different types of materials (insulator, semiconductor, conductor). Explore the principles and working of diodes, rectifiers, and transistors.
CLOBJ 5	Understand the principles of lasers, including energy levels, ionization, and excitation potentials. Explore different types of lasers and their characteristics, as well as their engineering and medical applications.

f. **Course Learning Outcomes:**

CLO 1	Understand fundamental and derived physical quantities and their units in various systems (FPS, CGS, SI). Understand concepts related to errors in

	measurements, including systematic and random errors, absolute and relative errors, error propagation, and error estimation.
CLO 2	Understand Coulomb's law and electric field, and their application in Gauss's law. Explore concepts related to electric current, resistance, Ohm's law, Kirchhoff's laws, and Wheatstone bridge.
CLO 3	Understand different types of magnetic materials and their properties.
CLO 4	Understand energy bands in solids and different types of materials (insulator, semiconductor, conductor). Explore the principles and working of diodes, rectifiers, and transistors.
CLO 5	Understand the principles of lasers, including energy levels, ionization, and excitation potentials. Explore different types of lasers and their characteristics, as well as their engineering and medical applications.

g. Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes		**Bloom's Level**
CLO 1	Understand fundamental and derived physical quantities and their units in various systems (FPS, CGS, SI). Understand concepts related to errors in measurements, including systematic and random errors, absolute and relative errors, error propagation, and error estimation.	2
CLO 2	Apply Coulomb's law and electric field, and their application in Gauss's law. Explore concepts related to electric current, resistance, Ohm's law, Kirchhoff's laws, and Wheatstone bridge.	3
CLO 3	To identify different types of magnetic materials and their properties.	4
CLO 4	Understand energy bands in solids and different types of materials (insulator, semiconductor, conductor). Explore the principles and working of diodes, rectifiers, and transistors.	3
CLO 5	Understand and apply the principles of lasers, including energy levels, ionization, and excitation potentials. Explore different types of lasers and their characteristics, as well as their engineering and medical applications.	3

h) Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Outcomes:

i) Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**		
L	**T**	**P**	**C**	**Internal Evaluation**	**ESE**	**Total**

				MSE	CE	P	Theory	P	
3	**-**		**3**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Topic	Weightage	Teaching Hrs.
1.	**Unit 1: Physical world, Units and Measurements** Physical quantities; fundamental and derived, Units and systems of units (FPS, CGS and SI units),Dimensions and dimensional formulae of physical quantities, Principle of homogeneity of dimensions, Dimensional equations and their applications (conversion from one system of units to other, checking of dimensional equations and derivation of simple equations), Limitations of dimensional analysis. Measurements: Need, measuring instruments, least count, types of measurement (direct, indirect), Errors in measurements (systematic and random), absolute error, relative error, error propagation, error estimation and significant figures.		
2	**UNIT - 3: Electrostatics Current Electricity** Coulombs law, unit of charge, Electric field, Electric lines of force and their properties, Electric flux, Electric potential and potential difference, Gauss law. Capacitor and its working, Types of capacitors, Capacitance and its units. Capacitance of a parallel plate capacitor, Series and parallel combination of capacitors (related numerical), dielectric and its effect on capacitance, dielectric break down. Electric Current and its units, Direct and alternating current, Resistance and its units, Specific resistance, Conductance, Specific conductance, Series and parallel combination of resistances. Factors affecting resistance of a wire, carbon resistances and color coding. Ohm's law and its verification, Kirchhoff's laws, Wheatstone bridge and its applications (slide wire bridge only), Concept of terminal potential difference and Electro motive force (EMF) Heating effect of current, Electric power, Electric energy and its units (related numerical problems), Advantages of Electric Energy over other forms of energy.		

3.	**UNIT - 5: Electromagnetism and Magnetic materials** Types of magnetic materials; dia, para and ferromagnetic with their properties, Magnetic field and its units, magnetic intensity, magnetic lines of force, magnetic flux and units, magnetization. Concept of electromagnetic induction, Faraday's Laws, Lorentz force (force on moving charge in magnetic field). Force on current carrying conductor, force on rectangular coil placed in magnetic field. Moving coil galvanometer; principle, construction and working, Conversion of a galvanometer into ammeter and voltmeter.	20%	8
4.	**UNIT - 6: Semiconductor Physics** Energy bands in solids, Types of materials (insulator, semi-conductor, conductor), intrinsic and extrinsic semiconductors, p-n junction, junction diode and V-I characteristics, types of junction diodes. Diode as rectifier – half wave and full wave rectifier (center taped). Transistor; description and three terminals, Types- pnp and npn, some electronic applications (list only). Photocells, Solar cells; working principle and engineering applications.	20%	10
5.	**UNIT - 7: Modern Physics** Lasers: Energy levels, ionization and excitation potentials; spontaneous and stimulated emission; population inversion, pumping methods, optical feedback, Types of lasers; Ruby, He-Ne and semiconductor, laser characteristics, engineering and medical applications of lasers. Fiber Optics: Introduction to optical fibers, light propagation, acceptance angle and numerical aperture, fiber types, applications in; telecommunication, medical and sensors. Nanoscience and Nanotechnology: Introduction, nanoparticles and nanomaterials, properties at nanoscale, nanotechnology, and nano technology-based devices and applications.	20%	8

References:

1. Text Book of Physics for Class XI& XII (Part-I, Part-II); N.C.E.R.T., Delhi
2. Applied Physics, Vol. I and Vol. II, TTTI Publications, Tata McGraw Hill, Delhi
3. Concepts in Physics by HC Verma, Vol. I & II, Bharti Bhawan Ltd. New Delhi
4. Engineering Physics by PV Naik, Pearson Education Pvt. Ltd, New Delhi.
5. Modern approach to Applied Physics-I and II, AS Vasudeva, Modern Publishers.
6. A Textbook of Optics, N Subramanyam, Brij Lal, MN Avahanulu, S Chand and Company Ltd.
7. Introduction to Fiber Optics, Ajoy Ghatak and K Thyagarajan, Cambridge University Press India Pvt. Ltd, New Delhi.
8. Nanoscience and Nanotechnology, KK Choudhary, Narosa Publishing House, Pvt. Ltd. New Delhi.
9. Nanotechnology: Importance and Applications, M.H. Fulekar, IK International Publishing House Pvt. Ltd, New Delhi.

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l. **Course Name:** COMMUNICATION SKILLS-II

m. **Course Code:** 03693153

n. **Prerequisite:** Inclination to improve speaking & listening skills. Basic speaking & writing skills

o. **Rationale:** Communication skills are essential for all Diploma Engineers

p. **Course Learning Objective:**

CLOBJ 1	Develop learning & establish a platform for the students that they can easily learn through various life skills required in the organization for becoming an asset for the organization.
CLOBJ 2	Make them understand how new words are formed, role of syllable, vowel , consonant in pronunciation of word.
CLOBJ 3	Enables students to engage in formal communication as well as to participate in events like debate, extempore etc, and to introduce them to various international Language testing systems
CLOBJ 4	Co-relating of sentence through para jumble concepts.
CLOBJ 5	Encourage students to overcome stage fear through classroom activities.
CLOBJ 6	Make learning fun through the usage of comprehension units.

q. **Course Learning Outcomes:**

CLO 1	Develop basic speaking and writing skills including proper usage of language and vocabulary so that they can become highly confident and skilled speakers and writers.
CLO 2	Apply and analyses the right kind of pronunciation with regards to speech sounds and able to get different types of pronunciations.
CLO 3	Able to read, understand, and interpret a text intrinsically as well as extrinsically. The learner can browse a text quickly to come-up with a gist and personal interpretation. One is able to create a healthy work-environment and prove to be an asset or one of the most reliable resources to the Organization. As a professional, one is mature to bridge the gulf between the existing behavior/ lifestyle and the expected corporate behaviour cum lifestyle with the help of learning life skills.
CLO 4	Apply the concepts of grammar, various strategies and the usage of formal language in written expression. By using synonyms rewrite the same text in the same format and meaning. Write the gist of the given text.

r. Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes	
CLO 1	Understand the concepts of listening its importance & its implication in proper way.
CLO 2	Understanding basic formation & concept of antonym, synonyms, and One word substitutes.
CLO 3	Understand speaking skills & bringing out the best from through various activities which make them confident
CLO 4	Understand how life skills are important & utilize the knowledge for becoming competent & asset for the organization

s. Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Outcomes:

CLOs	**PLOs**												**PSO**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CLO 1	2.00	2.00	1.00	2.00	1.00	1.00	2.00	2.00	3.00	2.00	1.00	3.00	2.00	2.00
CLO 2	3.00	2.00	1.00	1.00	1.00	2.00	1.00	3.00	2.00	2.00	1.00	3.00	1.00	2.00
CLO 3	2.00	3.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00	2.00	1.00	3.00	2.00	3.00
CLO 4	2.00	2.00	2.00	1.00	3.00	1.00	2.00	1.00	1.00	1.00	1.00	3.00	1.00	1.00
Weighted Average	2.25	2.25	1.25	1.25	1.50	1.25	1.50	1.75	2.00	1.75	1.00	3.00	1.50	2.00

t. Teaching & Examination Scheme:

Teaching Scheme			**Credit**	**Examination Scheme**					**Total**
				External		**Internal**			
Lect Hrs/ Week	**Tut Hrs / Week**	**Lab Hrs/ Week**		**T**	**P**	**T**	**CE**	**P**	
1	0	-	1	-	-	-	100	-	100

Lect. - Lecture, **Tut.** - Tutorial, **Lab** - Lab, **T** - Theory, **P** - Practical, **CE** – Continuous Evaluation

Note: 15 Hours of additional sessions will be taken (within the semester) to match up 30 hours content.

u. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**Listening skills:** **Listening Process and Practice** : Introduction, importance of good Listening skills, difference between listening and hearing, types of listening, Barriers to effective listening, traits of a good listener.	10%	6
2	**Listening Skills – Questions**: With audio aids, students will be able to listen to dialogues, improve in gathering information and to summarize the content. To listen and understand day-to-day conversations and to solvequestions based on audio files.	2%	1
3	**Building Vocabulary** Synonyms, Antonyms, Homophones, Homonyms, Homographs,Phrasal verbs, idioms & phrases, One word substitution	2%	1
4	**Introduction to Phonetics** **Sounds:** Consonant, Vowel, Diphthongs, transcription of words (IPA)weak forms, syllable division, word stress, intonation and voice	10%	6
5	**Speaking Skill Building Introduction**: To enable students to eliminate stage fright and engage in conversationwith others.	3%	2
6	**Speaking Skill Building Activity:** Enables students to engage in formal communication as well as to participate in events like debate, extempore etc, and to introduce themto various international Language testing systems	2%	1
7	**Tourism Pitch:** Classroom activity which helps students to express their feelings and experiences in English. Encouraging students to overcome stage fear.	2%	1
8	**Lifeboat:** Classroom Activity to encourage Communication and Convincing Skills	5%	1
9	**Reporter:** Classroom Activity to encourage Communication and ConvincingSkills**.**		1

		5%	
10	**Paragraph jumble:** Enhance the skill of writing by completing the paragraph in appropriateand sensible form	5%	4
11	**Life skills:** Self-Awareness, Empathy, Sympathy, Emotional Intelligence	5%	4
12	**Reading Comprehension:** A Day's Wait – Ernest Hemingway, My Lost Dollar- Stephen Leacock	10%	2

****Continuous Evaluation:**

It consists of

1. Phase I Exam-35 Marks(Hybrid or Offline Mode)
2. Phase II Exam -35 Marks (Hybrid or Offline Mode)
3. Activities – (Listening and Speaking) -10+10=20 Marks
4. Attendance -10 Marks
    a. The passing marks for Continous Evaluation will be 40 out of 100.There will not be any re-test.

v. Text Book and Reference Book:

1. Technical Communication –Principles & Practice-IInd Edition by Meenakshi Raman & SangeetaSharma.
2. Effective Technical Communication by Dr. Bharti Kukreja & Dr. Anupama Jain
3. Daniel Johns : The Pronunciation of English. Cambridge: Cambridge University Press, 1956
4. James Hartman & et al. Ed. English Pronouncing Dictionary .Cambridge University Press,2006.
5. Kulbhushan Kumar, Effective Communication Skills, Khanna Publishing House, New Delhi00(Revised Ed.2018)
6. Active English –Almas Juneja and Vaseem Qureshi-Macmillan Publishers India Ltd
7. English- Prof. Pradyuman Raj, Prof. Rakhi Moghe, Ms. Anisha Modi

i. 8.J.D.O's Connor. Better English Pronunciation0 Cambridge University Press,1980

8. Lindley Murry .An English Grammar: Comprehending Principles and Rules. London: Wison andsons,1908.
9. Margaret M. Maison. Examine your English Orient Longman:New Delhi,1964
10. J.Sethi & et al.A Practice Course in English Pronunciation, New Delhi: Prentice Hall, 2004
11. Pfeiffer, William Sanborn and T.V.S. Padmaja. Technical Communication: A Practical

Approach 6th ed Delhi: Pearson, 2007.

Semester 3

(1)

a. **Course Name:** Entrepreneurship and Start-ups
b. **Course Code:** 03600201
c. **Prerequisite:** Zeal to Learn the Subject.
d. **Rationale:** The main objective of this course is to understanding the concept and process of entrepreneurship - its contribution and role in the growth and development of individual and the nation and learning the process and skills of creation. This subject provides detail information about Acquiring Entrepreneurial spirit and resourcefulness, Familiarization with various uses of human resource for earning dignified means of living, Acquiring entrepreneurial quality, competency, and motivation and management of entrepreneurial venture.
e. **Course Learning Objective:**

CLOBJ 1	Define entrepreneurship and startups, understand the traits of an entrepreneur, and explore the motivation behind starting a business. Identify different types of business structures and analyze the similarities and differences between entrepreneurs and managers.
CLOBJ 2	Discover business ideas, visualize business concepts, and create activity maps. Develop a comprehensive business plan that outlines the vision, goals, and strategies for the startup venture.
CLOBJ 3	Conduct market analysis to identify the target market and evaluate competition. Develop strategies for marketing, accounting, and risk management to ensure the success of the startup.
CLOBJ 4	Understand the importance of company organization structure in startup management. Learn techniques for recruitment and management of talent, as well as financial organization and management.
CLOBJ 5	Explore financing methods available for startups in India and learn to effectively communicate ideas to potential investors through investor pitches. Understand the process of patenting and obtaining licenses to protect intellectual property.
CLOBJ 6	Understand exit strategies for entrepreneurs, including bankruptcy, succession planning, and harvesting strategies. Explore the implications and considerations of each exit strategy.

a. **Course Learning Outcomes:**

CLO	Understanding the dynamic role of entrepreneurship and small businesses

1	
CLO 2	Organizing and Managing a Small Business
CLO 3	Financial Planning and Control
CLO 4	Forms of Ownership for Small Business
CLO 5	Strategic Marketing Planning
CLO 6	New Product or Service Development
CLO 7	Business Plan Creation

a. Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes	
CLO 1	Understanding the dynamic role of entrepreneurship and small businesses
CLO 2	Organizing and Managing a Small Business
CLO 3	Financial Planning and Control
CLO 4	Forms of Ownership for Small Business
CLO 5	Strategic Marketing Planning
CLO 6	New Product or Service Development
CLO 7	Business Plan Creation

b. Mapping of Course Learning Outcomes and Program Learning Outcomes and ProgramSpecific Outcomes:

CLOs	**PLOs**												**PSO**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CLO 1	2.00	3.00	3.00	3.00	2.00	1.00	3.00	3.00	3.00	3.00	3.00	2.00	3.00	3.00-
CLO 2	3.00	2.00	3.00	3.00	3.00	1.00	3.00	3.00	3.00	3.00	3.00	2.00	3.00	2.00
CLO 3	3.00	3.00	3.00	3.00	3.00	1.00	3.00	3.00	3.00	3.00	3.00	2.00	3.00	3.00
CLO 4	3.00	3.00	3.00	3.00	3.00	1.00	3.00	3.00	3.00	3.00	3.00	2.00	3.00	3.00
CLO 5	3.00	3.00	3.00	3.00	3.00	1.00	3.00	3.00	3.00	3.00	3.00	2.00	3.00	3.00
Weighted Average	**2.80**	**2.80**	**3.00**	**3.00**	**2.80**	**1.00**	**3.00**	**3.00**	**3.00**	**3.00**	**3.00**	**2.00**	**3.00**	**2.75**

c. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
				Internal Evaluation			ESE		
L	T	P	C	MSE	CE	P	Theory	P	Total
1	0	0	1	20	20	0	60	0	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**-Continuous Evaluation, **ESE-** End Semester Examination.

d. Course Content:

Unit No.	Topic	Weightage	Teaching Hrs.
1.	**Introduction to Entrepreneurship and Start Ups** Definitions, Traits of an entrepreneur, Entrepreneurship, Motivation, Types of Business Structures, Similarities/differences between entrepreneurs and managers.	20%	06
2.	**Business Ideas and their implementation** Discovering ideas and visualizing the business, Activity map , Business Plan.	15%	04
3.	**Idea to Start-up** Market Analysis – Identifying the target market, Competition evaluation and Strategy Development, Marketing and accounting, Risk analysis	15%	04
4.	**Management** Company's Organization Structure,Recruitment and management of talent, Financial organization and management	20%	04
5.	**Financing and Protection of Ideas** Financing methods available for start-ups in India, Communication of Ideas to potential investors – Investor Pitch, Patenting and Licenses	15%	04
6.	**Exit strategies for entrepreneurs** Bankruptcy, and succession and harvesting strategy	15%	04

e. Text Book and Reference Book:

Reference Books:

1. The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company by Steve Blank and Bob Dorf, K & S Ranch
2. The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Business by Eric Ries, Penguin UK
3. 3 Demand: Creating What People Love Before They Know They Want It by Adrian J. Sloutsky with Karl Weber, Headline Book Publishing
4. The Innovator's Dilemma: The Revolutionary Book That Will Change the Way You Do Business by Clayton M. Christensen, Harvard business

(2)

a. Course Name: Non-Renewable and Renewable Electric Energy Generation System

b. Course Code: 03607201

c. Prerequisite: Knowledge of power generation

d. Rationale: The course will provide understanding of power generation technology using conventional and non-conventional energy sources which will be useful for understanding the operation and working of power plants. Students will learn basics of Economics of Power Generation.

e. Course Learning Objective:

CLOBJ 1	Students will be able to describe the operational principles of Thermal Power Plants, including Coal, Gas/Diesel, and Nuclear-based facilities, utilizing single-line diagrams while articulating the functions of primary equipment and auxiliary systems.
CLOBJ 2	Comprehend the operational mechanisms of nuclear power stations, diesel power stations, and gas turbine power plants, elucidating their distinct working principles.
CLOBJ 3	Conduct economic analyses and discern the diverse components integral to Wind Energy Conversion Systems, facilitating the evaluation of their economic viability.
CLOBJ 4	Conduct comparative analyses among different types of power plants to determine their respective economic advantages and disadvantages, fostering an understanding of economically beneficial power generation methods.
CLOBJ 5	Explain the economics underlying power generation processes and interconnected power systems, encompassing factors such as cost analysis, efficiency considerations, and the dynamics of interconnected grids.

f. Course Learning Outcomes:

CLO 1	Describe the working of Thermal Power Plants: Coal, Gas/ Diesel and Nuclear-based using single line diagrams and state the functions of the major equipment and auxiliaries.
CLO 2	Explain the working of nuclear power station, Diesel power station and Gas turbine power plant.
CLO 3	Prepare economic analysis and identify various components of the Wind Energy Conversion system.
CLO 4	Comparison between various Power Plants which is economically beneficial.
CLO 5	Describe the Economics of Power Generation and Interconnected Power Systems.

g. Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes	
CLO 1	Describe the working of Thermal Power Plants: Coal, Gas/ Diesel and Nuclear-based using single line diagrams and state the functions of the major equipment and auxiliaries.
CLO 2	Explain the working of nuclear power station, Diesel power station and Gas turbine power plant.
CLO 3	Prepare economic analysis and identify various components of the Wind Energy Conversion system.
CLO 4	Comparison between various Power Plants which is economically beneficial.
CLO 5	Describe the Economics of Power Generation and Interconnected Power Systems.

h. Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Outcomes:

CLOs	**PLOs**												**PSO**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CLO 1	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
CLO 2	2.00	3.00	3.00	3.00	3.00	2.00	2.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
CLO 3	2.00	3.00	3.00	3.00	3.00	2.00	2.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
CLO 4	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	3.00	2.00
CLO 5	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
CLO 6	3.00	3.00	3.00	3.00	3.00	2.00	2.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Weighted Average	2.50	2.83	2.83	2.83	2.83	2.33	2.33	2.83	2.83	2.83	2.83	2.83	3.00	2.83

i. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	0	3	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

j. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**Thermal Power Plants**: Coal, Gas/ Diesel and Nuclear-based Layout and working of a typical thermal power plant with steam turbines and electric generators. Properties of conventional fuels used in the energy conversion equipment used in thermal power plants: Coal, Gas/ diesel, nuclear fuels –fusion and fission action. Safe Practices and working of various thermal power plants: coal-based, gas-based, diesel-based, and nuclear-based. Functions of the following types of thermal power plants and their major auxiliaries: Coal fired boilers: fire tube and water tube. Gas/diesel-based combustion engines. Types of nuclear reactors: Disposal of nuclear waste and nuclear shielding. Thermal power plants in Gujarat.	20%	9
2	**Large and Micro-Hydro Power Plants:** Energy Conversion process of hydro power plant. Classification of hydro power plant: High, medium and low head. Construction and working of hydro turbines used in different types of hydro power plant: a. High head-Pelton turbine b. medium head-Francis turbine c. Low head-Kaplan turbine. Safe Practices for hydro power plants. Different types of micro- hydro turbines for different heads: Pelton, Francis and Kaplan turbines. Locations of these different types of large and micro-hydro power plants in Gujarat. Potential locations of micro-hydro power plants in Gujarat.	15%	16
3	**Solar and Biomass based Power Plants: -**Solar Map of India: Global solar power radiation. Solar Power Technology:	25%	12

	a. Concentrated Solar Power (CSP) plants, construction and working of: Power Tower, Parabolic Trough, Parabolic Dish, Fresnel Reflectors, b. Solar Photovoltaic (PV) power plant: layout, construction, working. Biomass-based Power Plants. a. Layout of a Bio-chemical based (e.g. biogas) power plant: b. Layout of a Thermo-chemical based (e.g. Municipal waste) power plant c. Layout of an Agro-chemical based (e.g. bio-diesel) power plant Features of the solid, liquid and gas biomasses as fuel for biomass power plant.		
4	**Wind Power Plants: -**Wind Map of India: Wind power density in watts per square meter, Layout of Horizontal axis large wind power plant. Geared wind power plant. Direct-drive wind power plant. Salient Features of electric generators used in large wind power plants: a. Constant Speed Electric Generators: Squirrel Cage Induction Generators (SCIG), b. Wound Rotor Induction Generator (WRIG), c. Variable Speed Electric Generators: Doubly-fed induction generator (DFIG), d. Wound rotor synchronous generator (WRSG), permanent magnet synchronous generator (PMSG).	**15%**	**16**
5	**Economics of Power Generation and Interconnected Power System: -**Related terms: connected load, firm power, cold reserve, hot reserve, spinning reserve. Base load and peak load plants; Load curve, load duration curve, integrated duration curve, Cost of generation: Average demand, maximum demand, demand factor, plant capacity factor, plant use factor, diversity factor, load factor and plant load factor. Choice of size and number of generator units, combined operation of power station. Causes and Impact and reasons of Grid system fault: State grid, national grid, brownout and black out; sample blackouts at national and international level.	**25%**	**12**

k. Text Book and Reference Book:

1. Power Plant Engineering By P.K. Nag | McGraw-Hill, New Delhi
2. Wind Power Principles By N G Calvert.
3. Electrical Power Generation By Tanmoy Deb | Khanna Publishing House
4. Generation of Electrical Energy By B. R. Gupta,, S. Chand | S. Chand& Co
5. A course in Electrical Power By Soni, Gupta and Bhatnagar | Dhanpat Rai & Sons

6. A Course in Electrical Power By J.B.Gupta | S. K Kataria and Sons
7. Solar Photovoltaics: Fundamentals, Technologies and Applications By Solanki, Chetan Singh

(2)

l. **Course Name:** Non-Renewable and Renewable Electric Energy Generation System Lab
m. **Course Code:** 03607202
n. **Prerequisite:** Knowledge of basic of power plant
o. **Rationale:** Generation of Electric Power is most important activity in power system. With growing demand for electric power at one hand and depleting fossil fuel resources it has become more necessary to generate electric power more efficiently and with the help of renewal energy resources. With advancement in technology, it has become possible to generate electric power commercially using wind and solar energy. This course therefore deals in detail about generation of electric power using Thermal (Coal), Hydro, Nuclear, Solar, Wind, Diesel and Other renewal energy sources.
p. **Course Learning Objective:**

CLOBJ 1	Understand the different types of power plants including thermal, hydroelectric, nuclear, and renewable energy sources. Differentiate between the operation, components, and efficiencies of various power generation technologies. Analyse the advantages, disadvantages, and environmental impacts of different power plant configurations.
CLOBJ 2	Evaluate the performance metrics of power plant accessories such as turbines, generators, transformers, and control systems. Analyse the operational characteristics of power plants including load management, efficiency optimization, and safety protocols. Assess the impact of maintenance practices and operational strategies on the overall performance of power plants.
CLOBJ 3	Understand the principles of wind energy conversion and its potential as a renewable energy source. Identify the key components of wind energy systems including wind turbines, towers, and control mechanisms. Analyse factors affecting the efficiency and reliability of wind energy systems such as wind speed, turbine design, and site selection.
CLOBJ 4	Understand the principles of solar energy conversion including photovoltaic and solar thermal technologies.

	Explore the applications of solar energy in various fields such as residential, commercial, industrial, and agricultural sectors. Analyse the economic, environmental, and technical considerations associated with the deployment of solar energy systems.
CLOBJ 5	Understand the biochemical processes involved in biogas generation from organic waste materials. Evaluate the environmental benefits and challenges associated with biogas production including waste management, greenhouse gas emissions, and Odor control. Analyse the potential for integrating biogas production into sustainable waste management and energy generation systems.

q. Course Learning Outcomes:

CLO 1	Discriminate knowledge of different power plant.
CLO 2	Assess the performance of different power plant accessories and operation.
CLO 3	Identify Winds energy as alternate form of energy and to know how it can be tapped
CLO 4	Explain the field applications of solar energy.
CLO 5	Explain bio gas generation and its impact on environment

r. Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes	
CLO 1	Discriminate knowledge of different power plant.
CLO 2	Assess the performance of different power plant accessories and operation.
CLO 3	Identify Winds energy as alternate form of energy and to know how it can be tapped
CLO 4	Explain the field applications of solar energy.
CLO 5	Explain bio gas generation and its impact on environment

s. Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Outcomes:

CLOs	PLOs												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CLO 1	3.00	3.00	2.00	1.00	1.00	1.00	2.00	3.00	2.00	3.00	2.00	2.00	3.00	2.00
CLO 2	3.00	3.00	3.00	2.00	2.00	2.00	3.00	3.00	3.00	3.00	3.00	3.00	2.00	3.00
CLO 3	3.00	2.00	3.00	2.00	2.00	2.00	3.00	3.00	2.00	3.00	2.00	3.00	2.00	3.00
CLO 4	3.00	2.00	3.00	3.00	2.00	2.00	3.00	3.00	3.00	3.00	3.00	3.00	2.00	3.00
CLO 5	3.00	1.00	2.00	1.00	3.00	3.00	2.00	3.00	2.00	3.00	2.00	3.00	1.00	2.00
Weighted Average	3.00	2.50	2.00	1.25	1.25	2.00	1.75	1.50	2.00	2.75	1.75	3.00	1.50	2.25

t. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
0	-	2	1	-	-	50	-	-	50

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

u. Text Book and Reference Book:

1. Power Plant Engineering By P.K. Nag | McGraw-Hill, New Delhi
2. Wind Power Principles By N G Calvert.
3. Electrical Power Generation By Tanmoy Deb | Khanna Publishing House
4. Generation of Electrical Energy By B. R. Gupta,, S. Chand | S. Chand& Co
5. A course in Electrical Power By Soni, Gupta and Bhatnagar | Dhanpat Rai & Sons
6. A Course in Electrical Power By J.B.Gupta | S. K Kataria and Sons
7. Solar Photovoltaics: Fundamentals, Technologies and Applications By Solanki, Chetan Singh

v. Mapping of Experiment List with Course Learning Outcomes:

Exp. No.	Name of the Experiment
1	Interpret the line diagram of Thermal Power Station (T.P.S.) and main cycles & explain working of T. P. S.
2	Prepare technical report of visit to a nearby T.P.S./Prepare a report on thermal power stations in Gujarat by collecting data from Internet.

Exp. No.	Name of the Experiment
3	Interpret the schematic diagram of nuclear power station & explain the function of each component.
4	Prepare technical report of visit to a nearby Solar PV station.
5	Draw and interpret schematic diagram of a Diesel Power Station.
6	Identify the routine maintenance parts of the micro hydro power plant after watching a video program.
7	Identify the routine maintenance parts of the large wind power plant after watching a video program.
8	Identify the routine maintenance parts of the Solar PV station after watching a video program or nearby site.
9	Visit a nearby Biogas plant and prepare a report.
10	Draw and interpret schematic diagram of gas-based power plant.
11	Solve simple numerical related to different type of power generation plants

(3)

a) **Course Name:** Electrical Circuits
b) **Course Code:** 03607203
c) **Prerequisite:** Knowledge of Physics and mathematics up to 12th Science level, also need basic knowledge of electric and magnetic circuits.
d) **Rationale**: An electrical circuit is a path in which electrons from a voltage or current source flow. The point where those electrons enter an electrical circuit is called the "source" of electrons. The point where the electrons leave an electrical circuit is called the "return" or "earth ground". The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences: Maintain electrical systems applying AC and DC circuit fundamentals.
e) **Course Learning Objective:**

CLOBJ 1	Develop the ability to troubleshoot issues in single-phase A.C series circuits. Understand the functions and behaviours of resistors, capacitors, and inductors within these circuits.
CLOBJ 2	Acquire skills in identifying and resolving problems in single-phase A.C parallel circuits.
CLOBJ 3	Develop expertise in identifying and resolving issues in three-phase circuits.

CLOBJ 4	Apply fundamental principles of circuit analysis to diagnose and troubleshoot problems in electric circuits.
CLOBJ 5	Comprehend various circuit theorems and apply them to determine circuit parameters during troubleshooting and analysis.

a) Course Learning Outcomes:

CLO 1	Troubleshoot problems related to single phase A.C series circuits and understand the role of resistor, capacitor and inductor and their behaviour's.
CLO 2	Troubleshoot problems related to single phase A.C parallel circuits.
CLO 3	Troubleshoot problems related to three phase circuits.
CLO 4	Use principles of circuit analysis to troubleshoot electric circuits.
CLO 5	Understand different theorem and able to find circuit parameters.

b) Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes	
CLO 1	Troubleshoot problems related to single phase A.C series circuits and understand the role of resistor, capacitor and inductor and their behaviour's.
CLO 2	Troubleshoot problems related to single phase A.C parallel circuits.
CLO 3	Troubleshoot problems related to three phase circuits.
CLO 4	Use principles of circuit analysis to troubleshoot electric circuits.
CLO 5	Understand different theorem and able to find circuit parameters.

c) Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Outcomes:

CLOs	PLOs												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CLO 1	3.000	3.000	3.000	4.000	3.000	2.000	2.000	3.000	3.000	3.000	4.000	3.000	3.000	2.000
CLO 2	3.000	3.000	3.000	4.000	3.000	2.000	2.000	3.000	3.000	3.000	4.000	3.000	3.000	2.000
CLO 3	3.000	3.000	3.000	4.000	3.000	2.000	2.000	3.000	3.000	3.000	4.000	3.000	3.000	2.000
CLO 4	3.000	3.000	3.000	4.000	3.000	2.000	2.000	3.000	3.000	3.000	4.000	3.000	3.000	2.000
CLO 5	3.000	3.000	3.000	4.000	3.000	2.000	2.000	3.000	3.000	3.000	4.000	3.000	3.000	2.000
Weighted Average	3.000	3.000	3.000	4.000	3.000	2.000	2.000	3.000	3.000	3.000	4.000	3.000	3.000	2.000

d) Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	1	0	3	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

e) Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**Single Phase A.C Series Circuits** Generation of alternating voltage, Phasor representation of sinusoidal quantities. R, L, C circuit elements its voltage and current response. R-L, R-C, R-L-C combination of A.C series circuit, impedance, reactance, impedance. Triangle, Power factor, active power, reactive power, apparent power, power triangle and vector diagram. Resonance, Bandwidth, Quality factor and voltage magnification in series R-L, R-C, RLC circuit.	25%	10
2	**Single Phase A.C Parallel Circuits**	25%	10

	R-L, R-C and R-L-C parallel combination of A.C. circuits. Impedance, reactance, phasor diagram, impedance triangle. R-L, R-C, R-L-C parallel A.C. circuits power factor, active power, apparent power, reactive power, power triangle. Resonance in parallel R-L, R-C, R-L-C circuit, Bandwidth, Quality factor and voltage magnification.		
3	**Three Phase Circuits** Phasor and complex representation of three phase supply. Phase sequence and polarity. Types of three-phase connections, Phase and line quantities in three phase star and delta system. Balanced and unbalanced load, neutral shift in unbalanced load. Three phase power, active, reactive and apparent power in star and delta system.	**15%**	**06**
4	**Network Reduction and Principles of Circuit Analysis** Source transformation. Star/delta and delta/star transformation. KCL, KVL, Mesh Analysis. Node Analysis	**15%**	**06**
5	**Network Theorems** Superposition theorem. Thevenin's theorem. Norton's theorem. Maximum power transfer theorem. Reciprocity theorem. Duality in electric circuits**.**	**20%**	**08**

f) Text Book and Reference Book:

1. Fundamentals of Electrical Engineerin By Saxena, S. B. Lal | Cambridge University Press Electrical Technology Vol-1 By Theraja, B. L. | S. Chand, New Delhi
2. Fundamentals of Electrical Network By Gupta, B. R; Singhal, Vandana | S. Chand and Co. Circuit & Networks By U.A.PATEL | MAHAJAN PUBLISHING HOUSE
3. Circuit and network By Sudhakar, A.; Shyammohan, S. Palli | McGraw Hill Education Circuit theory By Salivahanan S.; Pravinkumar S. | Vikas Publishing House Pvt. Ltd
4. Electric Circuit Analysis By Sivanandam, S.N | Vikas Publishing House Pvt. Ltd

(4)

a) Course Name: Electrical Circuits Lab

b) Course Code: 03607204

c) Prerequisite: Knowledge of Physics and mathematics up to 12th Science level also need basic knowledge of electric and magnetic circuits.

d) Rationale: An electrical circuit is a path in which electrons from a voltage or current source flow. The point where those electrons enter an electrical circuit is called the "source" of electrons. The point where the electrons leave an electrical circuit is called

the "return" or "earth ground". The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences.

e) Course Learning Objective:

CLOBJ 1	Develop the ability to identify and resolve issues in single-phase A.C series circuits. Understand the behaviour of components like resistors, capacitors, and inductors in series circuits.
CLOBJ 2	Acquire skills in diagnosing and rectifying issues in single-phase A.C parallel circuits. Understand the characteristics and behaviours of components in parallel circuits.
CLOBJ 3	Develop expertise in troubleshooting and resolving issues in three-phase circuits. Understand the differences and complexities associated with three-phase circuits compared to single-phase circuits.
CLOBJ 4	Apply fundamental principles of circuit analysis to identify and troubleshoot problems in electric circuits. Utilize techniques such as Ohm's Law, Kirchhoff's Laws, and nodal analysis for circuit troubleshooting.
CLOBJ 5	Apply various network theorems such as Thevenin's Theorem, Norton's Theorem, and Superposition Theorem to analyse and troubleshoot electric circuits. Understand how these theorems can simplify complex circuit analysis and aid in troubleshooting.

f) Course Learning Outcomes:

CLO 1	Troubleshoot problems related to single phase A.C series circuits.
CLO 2	Troubleshoot problems related to single phase A.C parallel circuits.
CLO 3	Troubleshoot problems related to three phase circuits.
CLO 4	Use principles of circuit analysis to troubleshoot electric circuits.
CLO 5	Apply network theorems to troubleshoot electric circuits.

g) Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes	
CLO 1	Discriminate knowledge of different power plant.
CLO 2	Assess the performance of different power plant accessories and operation.

CLO 3	Identify Winds energy as alternate form of energy and to know how it can be tapped
CLO 4	Explain the field applications of solar energy.
CLO 5	Explain bio gas generation and its impact on environment

h) Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Outcomes:

CLOs	**PLOs**												**PSO**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CLO 1	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	2.000
CLO 2	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	2.000
CLO 3	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	3.000	2.000
CLO 4	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	3.000	2.000
CLO 5	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	3.000	2.000
Weighted Average	2.400	2.400	2.400	2.400	2.400	2.400	2.400	2.400	2.400	2.400	2.400	2.400	3.000	2.000

i) Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
0	**-**	**2**	**1**	**-**	**-**	**50**	**-**	**-**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

j) Text Book and Reference Book:

1. Fundamentals of Electrical Engineerin By Saxena, S. B. Lal | Cambridge University Press Electrical Technology Vol-1 By Theraja, B. L. | S. Chand, New Delhi
2. Fundamentals of Electrical Network By Gupta, B. R; Singhal, Vandana | S. Chand and Co. Circuit & Networks By U.A.PATEL | MAHAJAN PUBLISHING HOUSE
3. Circuit and network By Sudhakar, A.; Shyammohan, S. Palli | McGraw Hill Education Circuit theory By Salivahanan S.; Pravinkumar S. | Vikas Publishing House Pvt. Ltd

4. Electric Circuit Analysis By Sivanandam, S.N | Vikas Publishing House Pvt. Ltd

k) Mapping of Experiment List with Course Learning Outcomes:

Exp. No.	Name of the Experiment
1	Use dual trace oscilloscope to determine A.C voltage and current response in given R, L, C circuit.
2	Use voltmeter, ammeter, wattmeter to determine active, reactive and apparent power consumed in given R-L series circuit and R-C series circuit. Draw phasor diagram.
3	Use voltmeter, ammeter, wattmeter to determine active, reactive and apparent power consumed in given R-L-C series circuit. Draw phasor diagram.
4	Use variable frequency supply to create resonance in given series R-L-C circuit and parallel R-L-C circuit or by using variable inductor or variable capacitor.
5	Use voltmeter, ammeter, wattmeter to determine current, p.f., active, reactive and apparent power in R-C parallel A.C. circuit.
6	Use voltmeter, ammeter, wattmeter, power factor meter to determine current, power factor, active, reactive and apparent power for given R-L-C parallel circuit with series connection of resistor and inductor in parallel with capacitor.
7	Use voltmeter, ammeter, wattmeter, power factor meter to determine line and phase quantities of voltage and current for balanced three phase star and delta connected load and calculate active, reactive, and apparent power. Draw phasor diagram.
8	Use voltmeter, ammeter, wattmeter, p.f meter to determine line and phase quantities of voltage and current for unbalanced three phase star and delta connected load and calculate active reactive, and apparent power. Draw phasor diagram.
9	Use voltmeter, ammeter to determine current through the given branch of an electric network by applying mesh analysis and node analysis.
10	Use voltmeter, ammeter to determine current through the given branch and voltage across the given element of circuit by applying superposition theorem.
11	Use voltmeter, ammeter to determine equivalent circuit parameter in a given circuit by applying Thevenin ’s theorem.
12	Use voltmeter, ammeter to determine equivalent circuit parameter in a given circuit by applying Norton ’s theorem.
13	Use voltmeter, ammeter to determine load resistance for maximum power transfer for a given circuit by applying maximum power transfer theorem.

(5)

a) Course Name: Electric Motors and Transformers

b) Course Code: 03607205

c) Prerequisite: Knowledge of Physics up to 12th Science level.

d) Rationale: This course deals with single phase transformer and DC Machines which are widely used in power systems, industries and commercial applications. This course will enable the students to develop skills to select, install, operate, and maintain various types of DC machines and transformers. Practical aspects of the course will make the students capable of performing various tests on these machines. It is therefore very important for every electrical engineer to learn this course if he/she wants to excel in his/her professional life.

e) Course Learning Objective:

CLOBJ 1	Understand the constructional features of a DC generator. Explain the working principles of a DC generator. Describe the phenomena of armature reaction in DC generators. Explain the concept of commutation in DC machines.
CLOBJ 2	Understand the working principles of various types of DC motors. Perform routine maintenance tasks on DC motors. Identify and troubleshoot common issues in DC motors.
CLOBJ 3	Understand the construction and working principles of a single-phase transformer. Perform routine maintenance and inspection of single-phase transformers. Identify and rectify common issues in single-phase transformers.
CLOBJ 4	Understand the construction and working principles of three-phase transformers. Perform routine maintenance and inspection of three-phase transformers. Identify and rectify common issues in three-phase transformers.
CLOBJ 5	Identify various types of special purpose transformers used in specific applications. Understand the unique features and working principles of special purpose transformers. Perform maintenance and inspection tasks specific to special purpose transformers.

f) Course Learning Outcomes:

CLO 1	Describe the construction and working of DC Generator and Explain armature reaction and commutation.
CLO 2	Maintain different types of DC motors.
CLO 3	Maintain a single-phase transformer.
CLO 4	Maintain three phase transformers.
CLO 5	Maintain different types of special purpose transformers used in different applications

g) Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes	
CLO 1	Describe the construction and working of DC Generator and Explain armature reaction and commutation.
CLO 2	Maintain different types of DC motors.
CLO 3	Maintain a single-phase transformer.
CLO 4	Maintain three phase transformers.
CLO 5	Maintain different types of special purpose transformers used in different applications

h) Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Outcomes:

CLOs	**PLOs**												**PSO**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CLO 1	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	2.00
CLO 2	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	2.00
CLO 3	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	2.00
CLO 4	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	2.00
CLO 5	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	2.00
Weighted Average	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	2.00

i) Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
2	**1**	**-**	**3**	**-**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

j) Course Content:

Sr. No.	**Content**	**Weightage**	**Teaching Hours**

1	**DC Generators** DC generator: construction, parts, materials and their functions Principle of operation of DC generator: Fleming 's right hand rule, schematic diagrams, e.m.f. equation of generator, armature reaction, commutation and. Applications of DC generators.	**20%**	**08**
2	**D.C. Motors** DC motor: Types of DC motors. Fleming's left-hand rule, Principle of operation of, Back e.m.f. and its significance, Voltage equation of DC motor. Torque and Speed; Armature torque, Shaft torque, BHP, Brake test, losses, efficiency. DC motor starters: Necessity, two point and three-point starters. Speed control of DC shunt and series motor: Flux and Armature control.	**20%**	**08**
3	**Single Phase Transformers** Types of transformers: Shell type and core type; Construction: Parts and functions, materials used for different parts: CRGO, CRNGO, HRGO, amorphous cores, Transformer: Principle of operation, EMF equation of transformer: Derivation, Voltage transformation ratio, Significance of transformer ratings Transformer No-load and on-load phasor diagram, Leakage reactance, Equivalent circuit of transformer: Equivalent resistance and reactance. Voltage regulation and Efficiency: Direct loading, OC/SC method, All day efficiency.	**20%**	**08**
4	**Three Phase Transformers** Bank of three single phase transformers, Single unit of three phase transformer Distribution and Power transformers. Construction, cooling, Three phase transformers connections as per IS: 2026 (part IV)-1977, Three phase to two phase conversion (Scott Connection), Selection of transformer as per IS: 10028 (Part I)-1985, Criteria for selection of distribution transformer, and power transformer, Amorphous Core type Distribution Transformer, Specifications of three-phase distribution transformers as per IS:1180 (part I)-1989 Need of parallel operation of three phase transformer, Conditions for parallel operation. Polarity tests on mutually inductive coils and single-phase transformers; Polarity test, Phasing out test on Three-phase transformer.	**25%**	**10**
5	**Special Purpose Transformers** Single phase and three phase auto transformers: Construction, working and applications. Instrument Transformers: Construction, working and applications of Current transformer and Potential transformer. Isolation	**15%**	**06**

	transformer: Constructional Features and applications. Single phase welding transformer: constructional features and applications. Pulse transformer: constructional features and applications. 'K' factor of transformers: overheating due to non-linear loads and harmonics.		

k) Text Book and Reference Book:

1. Generalized Theory of Electrical Machines By P. S. Bhimbra | Khanna Publications.
2. Electrical Technology (Vol-II) By B L Theraja & A K Theraja | S Chand
3. Electrical Machine By D P Kothari & I J Nagrath | TATA McgrawHill
4. Electrical Machine By Bhattacharya S.K. and John Dearden | Tata McGraw Hill
5. Electrical Machine-I By Gupta, J. B. | S. K. Kataria & Sons, New Delhi

(6)

a) Course Name: Electric Motors and Transformers Lab
b) Course Code: 03607206
c) Prerequisite: Any application of a motor must meet some specific output requirement for a given input. Furthermore, the motor must fit in the allotted space and mount securely to the device
d) Rationale: This course deals with single phase transformer and DC Machines which are widely used in power systems, industries and commercial applications. This course will enable the students to develop skills to select, install, operate, and maintain various types of DC machines and transformers. Practical aspects of the course will make the students capable of performing various tests on these machines. It is therefore very important for every electrical engineer to learn this course if he/she wants to excel in his/her professional life.

e) Course Learning Objective:

CLOBJ 1	Describe the constructional features of DC generators and motors. Explain the working principles of DC generators and motors, including the generation of electromotive force and mechanical energy conversion. Analyze the power flow in DC machines, including power input, output, and losses.
CLOBJ 2	Classify different types of machines, including DC motors and transformers, based on their construction and operation principles. Understand the characteristics of DC motors and transformers, such as efficiency, speed regulation, and voltage regulation.

	Identify and explain the performance parameters associated with DC motors and transformers, such as efficiency, power factor, and regulation.
CLOBJ 3	Evaluate the performance of DC machines and transformers based on various parameters, including efficiency, voltage regulation, and losses. Analyze the impact of design and operational factors on the performance characteristics of DC machines and transformers. Interpret performance data and make informed decisions regarding the operation and maintenance of DC machines and transformers.
CLOBJ 4	Describe the working principles and applications of special purpose transformers, such as instrument transformers, autotransformers, and isolation transformers. Explain the unique features and functionalities of special purpose transformers in specific applications, such as voltage regulation, isolation, and impedance matching.

f) Course Learning Outcomes:

CLO 1	Explain construction, working principle and power flow in DC Machines - Generator and Motor.
CLO 2	Classify various machines and understand - characteristics, performance parameters of DC motors, transformer.
CLO 3	Analyse various performance parameters of DC Machines and Transformers. .
CLO 4	Illustrate the working of Special Purpose Transformers.

g) Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes	
CLO 1	Explain construction, working principle and power flow in DC Machines - Generator and Motor.
CLO 2	Classify various machines and understand - characteristics, performance parameters of DC motors, transformer.
CLO 3	Analyse various performance parameters of DC Machines and Transformers. .
CLO 4	Illustrate the working of Special Purpose Transformers.

h) Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Outcomes:

CLOs	PLOs												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CLO 1	3.00	3.00	3.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	3.00	3.00
CLO 2	3.00	3.00	3.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	3.00	3.00
CLO 3	3.00	3.00	3.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	3.00	3.00
CLO 4	2.00	2.00	2.00	3.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	3.00	3.00
Weighted Average	2.75	2.75	2.75	2.25	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	3.00	3.00

i) Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
0	-	2	1	-	-	50	-	-	50

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

j) Text Book and Reference Book:

1. Generalized Theory of Electrical Machines By P. S. Bhimbra | Khanna Publications.
2. Electrical Technology (Vol-II) By B L Theraja & A K Theraja | S Chand
3. Electrical Machine By D P Kothari & I J Nagrath | TATA McgrawHill
4. Electrical Machine By Bhattacharya S.K. and John Dearden | Tata McGraw Hill
5. Electrical Machine-I By Gupta, J. B. | S. K. Kataria & Sons, New Delhi

k) Mapping of Experiment List with Course Learning Outcomes:

Exp. No.	Name of the Experiment
1	identify various parts of DC machine and transformer.
2	Test the performance of a separately excited DC shunt generator.
3	Reverse the direction of rotation of the DC shunt motor.
4	Perform brake test on DC shunt motor/DC series motor.
5	Control the speed of DC shunt motor by different methods.
6	Control the speed of DC series motor by different methods
7	Test DC compound generator for external and internal load characteristic.
8	Determine regulation and efficiency of single phase transformer by direct loading.

Exp. No.	Name of the Experiment
9	Perform open circuit and short circuit test on single phase transformer to determine equivalent circuit constants, voltage regulation and efficiency
10	Perform parallel operation of two single phase transformers to determine the load current sharing and determine the apparent and real power load sharing
11	Connect the auto-transformer in step-up and step-down modes noting the input/output readings.
12	Check the functioning of the CT, PT and isolation transformer.

(7)

a) **Course Name:** Electrical and Electronic Measurements
b) **Course Code:** 03607207
c) **Prerequisite:** Basics of Fundamentals of electrical engineering.
d) **Rationale:** The course provides the details knowledge different measuring apparatus. The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences: Use relevant measuring instrument in different electrical applications.
e) **Course Learning Objective:**

CLOBJ 1	Gain knowledge about the classification systems used for instruments in electrical engineering. Understand the categorization of instruments based on their principles of operation, applications, and other relevant factors.
CLOBJ 2	Acquire proficiency in selecting and utilizing various measuring instruments such as voltmeters and ammeters for measuring voltage and current accurately. Understand the operating principles and techniques involved in using these instruments effectively.
CLOBJ 3	Develop the ability to employ power measuring instruments like wattmeters and power analyzers to determine electric power accurately. Understand the functionality and limitations of different types of power measuring instruments.
CLOBJ 4	Learn to utilize energy measuring instruments such as energy meters and energy analyzers for measuring electric energy consumption.

	Understand the methods and procedures involved in measuring electric energy accurately.
CLOBJ 5	Gain proficiency in employing a variety of electrical instruments across different ranges to measure parameters such as resistance, capacitance, and inductance. Understand the appropriate selection and calibration of instruments for measuring specific electrical parameters.

f) Course Learning Outcomes:

CLO 1	Understand Classification of Instrument Systems.
CLO 2	Use different types of measuring instruments for measuring voltage and current.
CLO 3	Use different types of measuring instruments for measuring electric power.
CLO 4	Use different types of measuring instruments for measuring electric energy.
CLO 5	Use different types of electrical instruments for measuring various ranges of electrical parameters.

g) Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes	
CLO 1	Understand Classification of Instrument Systems.
CLO 2	Use different types of measuring instruments for measuring voltage and current.
CLO 3	Use different types of measuring instruments for measuring electric power.
CLO 4	Use different types of measuring instruments for measuring electric energy.
CLO 5	Use different types of electrical instruments for measuring various ranges of electrical parameters.

h) Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Outcomes:

CLOs	PLOs												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CLO 1	2.00	2.00	3.00	2.00	2.00	2.00	3.00	3.00	2.00	3.00	3.00	2.00	2.00	3.00
CLO 2	2.00	3.00	3.00	2.00	3.00	2.00	3.00	3.00	3.00	3.00	3.00	2.00	3.00	3.00
CLO 3	2.00	3.00	3.00	2.00	3.00	2.00	3.00	3.00	3.00	3.00	3.00	2.00	3.00	3.00
CLO 4	2.00	3.00	3.00	2.00	3.00	2.00	3.00	3.00	3.00	3.00	3.00	2.00	3.00	3.00
CLO 5	2.00	3.00	3.00	2.00	3.00	2.00	3.00	3.00	3.00	3.00	3.00	2.00	3.00	3.00
Weighted Average	2.00	2.80	3.00	2.00	2.80	2.00	3.00	3.00	2.80	3.00	3.00	2.00	2.80	3.00

i) Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	1	-	3	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

j) Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**Fundamentals of Measurements** Significance, units, fundamental quantities and standards Classification of Instrument Systems: Null and deflection type instruments, Absolute and secondary instruments, Analog and digital instruments. Static and dynamic characteristics, types of errors Calibration: need and procedure. Classification of measuring instruments: indicating, recording and integrating instruments. Essential requirements of an indicating instruments	20%	08
2	**Measurement of voltage and current** DC Ammeter: Basic, Multi range, Universal shunt. DC Voltmeter: Basic, multi-range, concept of loading effect and sensitivity. AC voltmeter: Rectifier type (half wave and full wave). CT and PT: construction, working and applications. Clamp-on meter	20%	08
3	**Measurement of Electric Power** Analog meters: Permanent magnet moving coil (PMMC)	20%	08

	and Permanent magnet moving iron (PMMI) meter, them construction, working, salient features, merits and demerits. Dynamometer type wattmeter: Construction and working Range: Multiplying factor and extension of range using CT and PT Errors and compensations. Active and reactive power measurement: One, two and three wattmeter method. Effect of Power factor on wattmeter reading in two wattmeter method. Maximum Demand indicator		
4	**Measurement of Electric Energy** Single and three phase electronic energy meter: Constructional features and working principle. Errors and their compensations. Calibration of single-phase electronic energy meter using direct loading.	**10%**	**05**
5	**Circuit Parameter Measurement, CRO and Other Meters** Measurement of resistance: Low resistance: Kelvin's double bridge, Medium Resistance: Voltmeter and ammeter method, High resistance: Megger and Ohm meter: Series and shunt. Measurement of inductance using Anderson bridge (no derivation and phasor diagram). Measurement of capacitance using Schering bridge (no derivation and phasor diagram). Single beam/single trace CRO, Digital storage Oscilloscope: Basic block diagram, working, Cathode ray tube, electrostatic deflection, vertical amplifier, time base generator, horizontal amplifier, measurement of voltage/ amplitude/ time period/ frequency/ phase angle delay line, specifications. Other meters: Earth tester, Digital Multimeter; L-C-R meter, Frequency meter (ferromagnetic and Weston type), Phase sequence indicator, power factor meter (single phase and three phase dynamometer type), Synchro scope, Tri-vector meter Signal generator: need, working and basic block diagram. Function generator: need, working and basic block diagram, function of symmetry.	**30%**	**15**

k) Text Book and Reference Book:

1. A Course in Electrical And Electronics Measurements And Instrumentation By Shawhney A. K. Dhanpat Rai & Sons.
2. Electrical Technology Vol-1 By Theraja, B. L. | S. Chand, New Delhi
3. Electrical and Electronics Technology By E. Hughes | Pearson | 10, Pub. Year 2010
4. Electrical Measurement and Measuring Instruments By R.K.Rajput | S. Chand Publication

(8)

a) **Course Name:** Electrical and Electronic Measurements Lab
b) **Course Code:** 03607208
c) **Prerequisite:** Basics of Fundamentals of electrical engineering
d) **Rationale:** The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences: Use relevant measuring instrument in different electrical applications.
e) **Course Learning Objective:**

CLOBJ 1	Understand how to verify the functionality and accuracy of electrical measuring instruments. Learn the procedures for checking and calibrating measuring instruments to ensure proper operation.
CLOBJ 2	Acquire proficiency in selecting and operating various measuring instruments to accurately measure voltage and current. Understand the principles behind voltage and current measurement techniques and apply them effectively.
CLOBJ 3	Develop the skills to select and utilize appropriate measuring instruments for determining electric power parameters. Understand the methods and calculations involved in measuring electric power accurately.
CLOBJ 4	Gain competence in choosing and employing suitable measuring instruments for quantifying electric energy consumption. Learn the principles and methodologies for measuring electric energy efficiently and accurately.
CLOBJ 5	Familiarize oneself with a variety of electrical instruments available for measuring diverse electrical parameters. Develop the ability to select the appropriate instrument for specific measurement requirements across different ranges of electrical parameters.

f) **Course Learning Outcomes:**

CLO 1	Check the working of the electrical measuring instrument.
CLO 2	Use different types of measuring instruments for measuring voltage and current.
CLO 3	Use different types of measuring instruments for measuring electric power.
CLO 4	Use different types of measuring instruments for measuring electric energy.
CLO 5	Use different types of electrical instruments for measuring various ranges of electrical parameters.

g) **Mapping of Course Learning Outcomes and Bloom's Taxonomy:**

Course Learning Outcomes	
CLO 1	Check the working of the electrical measuring instrument.
CLO 2	Use different types of measuring instruments for measuring voltage and current.
CLO 3	Use different types of measuring instruments for measuring electric power.
CLO 4	Use different types of measuring instruments for measuring electric energy.
CLO 5	Use different types of electrical instruments for measuring various ranges of electrical parameters.

h) Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Outcomes:

CLOs	**PLOs**												**PSO**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CLO 1	3.00	3.00	3.00	3.00	3.00	2.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
CLO 2	3.00	3.00	3.00	2.00	3.00	2.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
CLO 3	3.00	3.00	3.00	2.00	3.00	2.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
CLO 4	2.00	2.00	2.00	3.00	2.00	1.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Weighted Average	2.75	2.75	2.75	2.50	2.75	1.75	2.75	2.75	2.75	2.75	2.75	2.75	2.75	2.75

i) Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
0	**-**	**2**	**1**	**-**	**-**	**50**	**-**	**-**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

j) Text Book and Reference Book:

1. A Course In Electrical And Electronics Measurements And Instrumentation By Shawhney A. K. Dhanpat Rai & Sons.
2. Electrical Technology Vol-1 By Theraja, B. L. | S. Chand, New Delhi
3. Electrical and Electronics Technology By E. Hughes | Pearson | 10, Pub. Year 2010
4. Electrical Measurement and Measuring Instruments By R.K.Rajput | S. Chand Publication

k) Mapping of Experiment List with Course Learning Outcomes:

Exp. No.	Name of the Experiment
1	Identify measuring instruments on the basis of symbols on dial, type, accuracy, class position and scale.
2	Identify the components of PMMC and MI instruments.
3	Measure AC and DC quantities in a working circuit.
4	Extend range of ammeter and voltmeter by using (i) shunt and multiplier (ii) CT and PT.
5	Use Clamp-on meter for measurement of AC/DC current, AC/DC voltage.
6	Use electro-dynamic watt-meter for measurement of power in a single phase circuit.
7	Use single wattmeter for measurement of active and reactive power of three phase balanced load.
8	Calibrate single phase electronic energy meter by direct loading.
9	Troubleshoot single phase electronic energy meter.
10	Use digital multi-meter for measurement of AC/DC current, AC/DC voltage.
11	Use Kelvin's double bridge for measurement of low resistance.
12	Use voltmeter and ammeter method for measurement of medium resistance.
13	Use Megger for insulation resistance measurements.
14	Use earth tester for measurement of earth resistance.
15	Use CRO for the Measurement of supply frequency in single-phase circuit

(9)

a) Course Name: Fundamental of Digital Electronics

b) Course Code: 03608211

c) Prerequisite: Knowledge of Basic maths.

d) Rationale: The students need to learn basic concepts of digital circuits and system which leads to design of complex digital system such as microprocessors. The students need to know combinational and sequential circuits using digital logic fundamentals. This is the first course by which students get exposure to digital electronics world.

e) Course Learning Objective:

CLOBJ 1	Understand different number systems including binary, decimal, octal, and hexadecimal. Learn the representation of numbers in binary form and its significance in digital systems. Explore various binary codes such as BCD, Gray code, and ASCII.
CLOBJ 2	Understand the process of converting numbers between different number systems.

	Learn about the complements of binary numbers including 1's complement and 2's complement. Practice converting numbers and their complements in various systems.
CLOBJ 3	Learn about basic logic gates such as AND, OR, NOT, NAND, NOR, and XOR. Understand the truth tables and logic operations of each gate. Explore the concept of universal gates and how they can be used to implement any logic function.
CLOBJ 4	Understand Boolean algebra and its application in digital circuit design. Learn about Boolean functions, expressions, and truth tables. Practice simplifying Boolean expressions using Karnaugh maps and Boolean algebra theorems.
CLOBJ 5	Design combinational logic circuits using basic logic gates and Boolean functions. Understand the concept of code conversion between different binary codes. Gain knowledge about logic families such as TTL, CMOS, and their characteristics. Learn about parameters of digital integrated circuits including power consumption, speed, and noise immunity.

j. Course Learning Outcomes:

CLO 1	Learn about Number systems and binary codes.
CLO 2	Learn to Convert Number systems and its complements.
CLO 3	Understand Logic gates and implementation of Universal gates.
CLO 4	Learn Boolean function Implementation and simplification.
CLO 5	Students able to design Combinational Logic Circuit and code conversion and get a basic idea about Logic Families and Parameter of Digital IC.

g) Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes	
CLO 1	Learn about Number systems and binary codes.
CLO 2	Learn to Convert Number systems and its complements.
CLO 3	Understand Logic gates and implementation of Universal gates.
CLO 4	Learn Boolean function Implementation and simplification.
CLO 5	Students able to design Combinational Logic Circuit and code conversion and get a basic idea about Logic Families and Parameter of Digital IC.

h) Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Outcomes:

CLOs	PLOs												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CLO 1	3.00	2.00	1.00	1.00	2.00	2.00	2.00	2.00	2.00	3.00	2.00	1.00	1.00	2.00
CLO 2	2.00	3.00	2.00	1.00	2.00	2.00	2.00	2.00	2.00	2.00	3.00	2.00	1.00	2.00
CLO 3	1.00	2.00	3.00	2.00	3.00	3.00	2.00	2.00	2.00	1.00	2.00	3.00	2.00	3.00
CLO 4	1.00	1.00	2.00	3.00	3.00	3.00	2.00	2.00	2.00	1.00	1.00	2.00	3.00	3.00
CLO 5	2.00	2.00	3.00	3.00	3.00	3.00	2.00	2.00	2.00	2.00	2.00	3.00	3.00	3.00
Weighted Average	1.80	2.00	2.20	2.00	2.60	2.60	2.00	2.00	2.00	1.80	2.00	2.20	2.00	2.60

i) Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	1	-	3	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

j) Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**Number Systems and Logic gates** Introduction to different number systems: Binary, Octal, Decimal, Hexadecimal, Conversion from one number system to another. Logic Gates: AND, OR, NOT, NAND, NOR, XOR, XNOR, Symbolic representation and truth table	15%	06
2	**Boolean Algebra** Implementation of Boolean expressions and Logic Functions using gates, Simplification of expressions, Boolean variables: Rules and laws of Boolean Algebra, De-Morgan's Theorem, Karnaugh Maps and their use for simplification of Boolean expressions.	15%	06
3	**Combinational Logic Circuits** Arithmetic Circuits – Addition, Subtraction, 1's 2's Complement, Half Adder, Full Adder, Half Subtractor, Full Subtractor, Parallel and Series Adders Encoder, Decoder, Multiplexer: 2 to 1 MUX, 4 to 1 MUX, 8 to 1 MUX,	30%	15

	Applications, Demultiplexer – 1 to 2 DEMUX, 1- 4 DEMUX, 1- 8 DEMUX		
4	**Sequential Logic Circuits** Introduction of Sequential Logic Circuits, Comparison Between Combinational Logic Circuit & Sequential Logic Circuits, Introduction of Flip Flops, Shift Register & Counters	**15%**	**06**
5	**Memory Devices** Classification of Memories: RAM Organization, Address Lines and Memory Size, Static RAM, Bipolar RAM, cell Dynamic RAM, D RAM, DDR RAM, Read Only memory: ROM organization, Expanding memory, PROM, EPROM, EEPROM, Flash memory, Data Converters: Digital to Analog converters, Analog to Digital Converters.	**25%**	**10**

k) Text Book and Reference Book:

1. Modern Digital Electronics By R. P. Jain | Tata McGraw-Hill Education.
2. Fundamentals of Digital Electronics By A. Anandkumar | PHI Publication
3. Digital Electronics By Mandal, Soumitra Kumar | McGraw Hill | 1st
4. Principle of digital Electronics By Malvino & Leach | McGraw-Hill Inc.

(10)

a. **Course Name:** Fundamental of Digital Electronics Lab
b. **Course Code:** 03608212
c. **Prerequisite:** Knowledge of Basic maths.
d. **Rationale:** The students need to learn basic concepts of digital circuits and system which leads to design of complex digital system such as microprocessors. The students need to know combinational and sequential circuits using digital logic fundamentals. This is the first course by which students get exposure to digital electronics world.
e. **Course Learning Objective:**

CLOBJ 1	Understand different number systems including binary, decimal, octal, and hexadecimal. Learn the principles behind binary codes such as binary addition, subtraction, and multiplication. Understand the significance and applications of binary codes in digital systems and computer architecture.
CLOBJ 2	Understand the process of converting numbers between different number systems including binary, decimal, octal, and hexadecimal.

	Learn about the methods for obtaining complements of binary numbers including the 1's complement and 2's complement. Practice converting numbers and finding complements to reinforce understanding and proficiency.
CLOBJ 3	Learn the basic logic gates such as AND, OR, NOT, NAND, NOR, and XOR. Understand the truth tables and logical operations performed by each logic gate. Explore the concept of universal gates such as NAND and NOR gates and their implementation to realize any logical function.
CLOBJ 4	Understand Boolean algebra and its relationship to logic gates and digital circuits. Learn techniques for implementing Boolean functions using logic gates and truth tables. Practice simplifying Boolean expressions using laws and theorems such as De Morgan's theorem and Karnaugh maps.
CLOBJ 5	Design combinational logic circuits using logic gates to perform specific functions. Understand the process of code conversion between binary, decimal, octal, and hexadecimal representations. Gain knowledge about different logic families and parameters of digital integrated circuits including speed, power consumption, and noise immunity.

f. Course Learning Outcomes:

CLO 1	Learn about Number systems and binary codes.
CLO 2	Learn to Convert Number systems and its complements.
CLO 3	Understand Logic gates and implementation of Universal gates.
CLO 4	Learn Boolean function Implementation and simplification.
CLO 5	Students able to design Combinational Logic Circuit and code conversion and get a basic idea about Logic Families and Parameter of Digital IC.

g. Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes	
CLO 1	Learn about Number systems and binary codes.
CLO 2	Learn to Convert Number systems and its complements.
CLO 3	Understand Logic gates and implementation of Universal gates.
CLO 4	Learn Boolean function Implementation and simplification.
CLO 5	Students able to design Combinational Logic Circuit and code conversion and get a basic idea about Logic Families and Parameter of Digital IC.

h. Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Outcomes:

CLOs	PLOs												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CLO 1	3.00	2.00	2.00	2.00	3.00	2.00	3.00	3.00	2.00	2.00	2.00	3.00	3.00	2.00
CLO 2	3.00	3.00	2.00	2.00	3.00	2.00	3.00	3.00	2.00	2.00	2.00	3.00	3.00	3.00
CLO 3	3.00	3.00	3.00	2.00	3.00	2.00	3.00	3.00	2.00	2.00	2.00	3.00	3.00	3.00
CLO 4	3.00	3.00	3.00	3.00	3.00	2.00	3.00	3.00	2.00	2.00	2.00	3.00	3.00	2.00
CLO 5	2.00	2.00	2.00	2.00	3.00	2.00	3.00	3.00	2.00	2.00	2.00	3.00	2.00	2.00
Weighted Average	2.80	2.60	2.40	2.20	3.00	2.00	3.00	3.00	2.00	2.00	2.00	3.00	2.80	2.40

i. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
0	-	2	1	-	-	50	-	-	50

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

j. Text Book and Reference Book:

1. Modern Digital Electronics by R. P. Jain | Tata McGraw-Hill Education.
2. Fundamentals of Digital Electronics by A. Anandkumar | PHI Publication
3. Digital Electronics by Mandal, Soumitra Kumar | McGraw Hill | 1st
4. Principle of digital Electronics by Malvino & Leach | McGraw-Hill Inc.

k. Mapping of Experiment List with Course Learning Outcomes:

Exp. No.	Name of the Experiment
1	To verify the truth tables for all logic fates: NOT, OR, AND, NAND, NOR, XOR, XNOR using CMOS Logic gates and TTL Logic Gates.
2	Implement and realize Boolean Expressions with Logic Gates.
3	Implement Half Adder, Full Adder, Half Subtractor, Full subtractor using ICs.
4	Implement parallel and serial full-adder using ICs.
5	Design and development of Multiplexer and De-multiplexer using multiplexer ICs.

Exp. No.	Name of the Experiment
6	Verification of the function of SR, D, JK and T Flip Flops.
7	Design controlled shift registers.
8	Construct a Single digit Decade Counter (0-9) with 7 segment display.
9	To design a programmable Up-Down Counter with a 7-segment display.
10	Study of different memory ICs.
11	Study Digital to Analog and Analog to Digital Converters.
12	Simulate in Software (such as PSpice) an Analog to Digital Converter.
13	Simulate in Software (such as PSpice) an Digital to Analog Converter

(11)

a. **Course Name:** PROFESSIONAL COMUNICATION & CRITICAL THINKING
b. **Course Code:** 03693203
c. **Prerequisite:** Inclination to improve personality traits for development & basic communication
d. **Rationale:** Advance level of communication and personality development is crucial for and afterplacement
e. **Course Learning Objective:**

CLOBJ 1	Develop basic speaking and writing skills including proper use of language & vocabulary so that they become highly confident & skilled speakers & writers
CLOBJ 2	Be informed of the latest trends in basic verbal activities such as presentations, facing interviews & other forms of oral communication.
CLOBJ 3	Also develop skills of group presentation & communication in team.
CLOBJ 4	Develop non-verbal communication such as proper use of body language & gestures.
CLOBJ 5	Understand basic reading skills
CLOBJ 6	Understand format & basic to write professionally through emails & reports

f. Course Learning Outcomes:

CLO 1	Develop their Personality
CLO 2	Analyze various concepts included in competitive exams.
CLO 3	Imply their knowledge for appearing in Interview
CLO 4	Writing & Communication is improved by their efforts.

g. Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes	
CLO 1	Understand the concepts of Body language, verbal & nonverbal communication for understanding the basic psychology behind a person's behavior.
CLO 2	Use their knowledge & learn more about different competitive exams, patterns, content asked in it.
CLO 3	Develop personality & learn presentation skills
CLO 4	Understand types of formal communication & speaking skills through different activities.

h. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
1	0	-	1	-	100	-	-	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

Sr. no.	Content	Weightage	Teaching Hours
1	**Story Mason:** Classroom activity to encourage students to speak on topics they aregood at, hence boosting confidence of students.	09%	5
2	**Determiners, Articles, and Interrogatives** This session will enable students to understand proper usage ofDeterminers and Articles. It will also enhance their daily speaking conversational/ communicationskills. Preparation of verbal section in company's aptitude exam	14%	8
3	**Subject-Verb Agreement:** This will enable students to understand the formation of sentencewith the usage of subject-verb agreement	05%	3
4	**Reading-Skill Building:** **Types of Reading – reading for different purposes** **An Astrologer's Day-Malgudi Days** Enhance reading skills by collecting information, know the importanceof reading	07%	4
5	**Reading Comprehension:** Learn to solve the reading comprehension questions in an easymanner and also in less amount of time	10%	6

	Introduction, Factual & Inferential comprehension, Reasons forPoor Comprehension Able to solve reading comprehension in less amount of Time bypracticing		
6	**Mafia The art of observation and convincing**: The interesting activity is targeted toward improving observation and convincing skills. A team activity in which every single Individual is very important person of his team to win	10%	6
7	**Direct and Indirect Speech** This session will enable students to understand proper usage ofnarration	09%	5
8	**Industry Expectation**: In this class the students will be made to understand what will be theworld after their college life will be, how they should prepare themselves from that competitive world with full of challenges for them	03%	2
9	**Mirror & Water Images** Reflection of an object into a mirror and water It is obtained by inverting an object laterally (mirror) & vertically(water).	05%	3
10	**Sentence Correction** It will also enhance their daily speaking conversational/communication skills. Preparation of verbal section in company's aptitude exam	03%	2
11	**Play Teacher:** Classroom activity to encourage students to speak on topics they aregood at, hence boosting confidence of students.	10%	6
12	**Professional Writing** Email and report	05%	3
13	**Group Discussion** It is a systematic exchange of information, views and opinions about a topic, problem, issue or situation among the members ofa *group* who share some common objectives.	10%	6
	Total	100	30

Continuous Evaluation:

It consists of

1. Phase I Exam-35 Marks(Hybrid or Offline Mode)
2. Phase II Exam -35 Marks (Hybrid or Offline Mode)
3. Activities – (Listening and Speaking) -10+10=20 Marks
4. Attendance -10 Marks

5. The passing marks for Continous Evaluation will be 40 out of 100.There will not be any re-test.

k. Text Book and Reference Book:

1. " Active English –Almas Juneja and Vaseem Qureshi-Macmillan Publishers India Ltd
2. English- Prof. Pradyuman Raj, Prof. Rakhi Moghe, Ms. Anisha Modi
3. Verbal and Non-Verbal Reasoning-B.S. Sijwali and Indu Sijwali
4. Competitive English- Azahar Siddiqui,Shaily Kavaiya,Amisha Pathak,Mayank Barot,Gautam Nayak,AnkitPandya
5. The Functional Aspects of Communication Skills-Dr. P. Prasad-S.K. Kataria and Sons.
6. Malgudi Days by R.K.Narayan

Semester 4

(1)

a. Course Name: Essence of Indian Knowledge and Tradition

b. Course Code: 03600251

c. Prerequisite: Zeal to learn Subject

d. Rationale: The course aims at imparting basic principles of thought process, reasoning and inference. Sustainability is at the core of Indian Traditional Knowledge Systems connecting society and nature. Holistic life style of Yogic-science and wisdom capsules in Sanskrit literature is also important in modern society with rapid technological advancements and societal disruptions. The course focuses on introduction to Indian Knowledge System, Indian perspective of modern scientific world-view and basic principles of Yoga and holistic health care system.

e. Course Learning Objective:

CLOBJ 1	Gain knowledge about the Vedas and Unvedas, including Ayurveda, Dhanurveda, Gandharvaveda, and Sthanya, and their significance in the Indian knowledge system.
CLOBJ 2	Learn about Vedangas such as Education, Kalpa, Nirukta, Grammar, and Jyotisha, and their importance in supporting and enriching the understanding of Vedic texts.
CLOBJ 3	Understand the purpose and relevance of Upangas such as Dharma Shastras, Itihasas, Puranas, and Tantras in providing supplementary knowledge and guidance in various aspects of life.
CLOBJ 4	Examine how modern scientific approaches are applied to ancient Indian practices like Yoga and Holistic Healthcare, exploring their effectiveness and potential benefits.

CLOBJ 5	Analyze real-world case studies demonstrating the practical implementation and outcomes of Yoga and Holistic Healthcare practices, including their effects on physical, mental, and emotional well-being.

f. Course Learning Outcomes:

CLO 1	Understanding the role of Modern Science
CLO 2	Ability to understand, connect up and explain basics of Indian Traditional knowledge modern scientific perspective

g. Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes	
CLO 1	Understanding the role of Modern Science
CLO 2	Ability to understand, connect up and explain basics of Indian Traditional knowledge modern scientific perspective

h. Mapping of Course Learning Outcomes and Program Learning Outcomes and ProgramSpecific Learning Outcomes:

CLOs	**PLOs**												**PSO**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CLO 1	2	2	2	2	3	3	3	3	3	3	3	3	3	2
CLO 2	2	2	2	2	1	2	2	2	2	3	2	3	1	3
Weighted Average	2	2	2	2	2	2.5	2.5	2.5	2.5	3	2.5	3	2	2.5

i. Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	
2	**-**	**-**	**0**	**20**	**20**	**-**	**-**	**-**	**40**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- ContinuousEvaluation, **ESE-** End Semester Examination

j. Course Content:

Sr.	Topics	W	T
1	**Basic Structure of Indian Knowledge System:** i) Vedas, (ii) Unveda (Ayurveda, Dhanuveda, Gandhveda, Sthanya etc.) (iii) Vedanga (Education, Kalna, Nanrut, Grammar, Jyotish verses), (iv) Upaayaga (Dharma level, Vivamsa, Purana, Takma level)	60	12
2	**Modern Science and Indian Knowledge System:**	15	5
3	**Yoga and Holistic Health care:**	15	5
4	**Case Studies:**	10	4

(2)

a. **Course Name:** Fundamentals of Power Electronics
b. **Course Code:** 03607251
c. **Prerequisite:** Basic Knowledge of Power Electronics Equipment
d. **Rationale:** The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences: Maintain the proper functioning of power electronic devices. The broad objective of the course is to teach students energy conversion, processing using power electronic converters, application of power electronics for drives. At the end of this course, students will be able to explain working of various power devices and power converters, derive converters mathematical relations, Laboratory exercises are guided design problems
e. **Course Learning Objective:**

CLOBJ 1	Define and explain the construction and operation of various thyristor family devices, including SCR (Silicon Controlled Rectifier), TRIAC (Triode for Alternating Current), and GTO (Gate Turn-Off Thyristor).
CLOBJ 2	interpret the construction and operation of power electronics devices, encompassing diodes, transistors, and thyristors, and understand their roles in power electronic circuits.
CLOBJ 3	Understand and describe the various techniques of commutation used in Silicon Controlled Rectifiers (SCRs), such as forced commutation, natural commutation, and complementary commutation.
CLOBJ 4	Comprehend the circuit diagrams and operational principles of single-phase half-wave and full-wave-controlled rectifiers for resistive I and resistive-inductive (RL) loads.
CLOBJ 5	Explain the working principle of cyclo-converters, detailing the process of frequency conversion in power systems.

f. **Course Learning Outcomes:**

CLO 1	Understand Construction and operation of various thyristor family devices.
CLO 2	Interpret Construction and operation of power electronics devices.

CLO 3	Understand different techniques of commutation of SCR.
CLO 4	Understand Circuit diagram and operation of single-phase half wave and full wave-controlled rectifier for R and RL load.
CLO 5	Explain Working Principle and application of cyclo-converter.

g. Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes	
CLO 1	Understand Construction and operation of various thyristor family devices.
CLO 2	Interpret Construction and operation of power electronics devices.
CLO 3	Understand different techniques of commutation of SCR.
CLO 4	Understand Circuit diagram and operation of single-phase half wave and full wave-controlled rectifier for R and RL load.
CLO 5	Explain Working Principle and application of cyclo-converter.

h. Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Outcomes:

CLOs	**PLOs**												**PSO**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CLO 1	3.00	1.00	1.00	2.00	1.00	1.00	1.00	1.00	1.00	2.00	1.00	2.00	3.00	2.00
CLO 2	3.00	1.00	1.00	2.00	1.00	1.00	1.00	1.00	1.00	2.00	1.00	2.00	3.00	2.00
CLO 3	1.00	2.00	1.00	2.00	1.00	1.00	1.00	1.00	1.00	2.00	1.00	2.00	1.00	1.00
CLO 4	2.00	2.00	3.00	1.00	3.00	2.00	1.00	2.00	2.00	2.00	1.00	2.00	3.00	2.00
Weighted Average	3.00	1.00	1.00	2.00	2.00	1.00	2.00	1.00	1.00	2.00	1.00	2.00	3.00	2.00

i. Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	**-**	**0**	**3**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

j. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**Thyristor Devices Types of Thyristors:** SCR, LASCR, SCS, GTO, UJT, PUT, DIAC and TRIAC, Thyristor family devices: symbol, construction, operating principle and V-I characteristics, SCR, construction, two transistor analogy, types, working and characteristics, Protection circuits: over-voltage, over-current, Snubber, Crowbar	**20%**	**8**
2	**Power semi-conductor Devices Power electronic devices, Power transistor:** construction, working principle, V-I characteristics and uses, IGBT and MOSFET: Construction, working principle, V-I characteristics and uses	**25%**	**10**
3	**Commutation of SCR** SCR Turn-On methods, SCR Turn-Off methods, Class A-Series resonant commutation circuit, Class B-Shunt Resonant commutation circuit, Class C-Complimentary Symmetry commutation circuit, Class D –Auxiliary commutation, Class E- External pulse commutation, Class F- Line or natural commutation.	**25%**	**10**
4	**Phase Controlled Rectifiers** Phase control: firing angle, conduction angle, Single phase half controlled, full controlled and midpoint-controlled rectifier with R, RL load: Circuit diagram, working, input-output waveforms, equations for DC output and effect of freewheeling diode, Different configurations of bridge-controlled rectifiers: Full bridge, half bridge with common anode, common cathode, SCRs in one arm and diodes in another arm.	**15%**	**7**
5	**Industrial Control Circuits** Explain the working principle of Chopper and its applications, explain basic working principle of inverter and its applications, Explain the working principle of cyclo-converter and its applications	**15%**	**7**

k. Text Book and Reference Book:

1.Thyristors: Theory and Applications by Sugandhi, Rajendra Kumar and Sugandhi, Krishna Kumar | New Age International (P) ltd

2. An Introduction to Thyristors and their applications By Ramamoorty M

3. Fundamentals of Power Electronics by Bhattacharya, S.K | Vikas Publishing House Pvt. Ltd

4. Power Electronics and its Applications By Jain &Alok | Power Electronics and its Applications

(2)

a. **Course Name:** Fundamentals of Power Electronics Lab
b. **Course Code:** 03607252
c. **Prerequisite**: Basic Knowledge of Power Electronics Equipment
d. **Rationale:** The course introduces basics of power electronic devices and converters. Working principles, operating modes and analysis of DC-DC, DC-AC, AC-DC, and AC-AC converters would be covered for a variety of loads. Control of power electronic converters would be explained. Certain specialized concepts in power electronics like matrix converter, active rectifiers and facts devices would be included, along with some of the popular applications of power electronics such as renewable energy conversion and power quality enhancement**.**

e. **Course Learning Objective:**

CLOBJ 1	Describe the construction and fundamental characteristics of power semiconductor devices, including diodes, thyristors (SCRs), power MOSFETs, IGBTs, and GTOs.
CLOBJ 2	Identify the suitable power electronic devices for specific applications based on their voltage and current ratings, switching speeds, and other performance parameters.
CLOBJ 3	Explain the turn-on and turn-off methods of thyristors, including forward voltage triggering, gate triggering, and commutation techniques such as forced commutation and natural commutation.
CLOBJ 4	Understand the operation principles of different types of phase-controlled rectifiers, such as half-wave, full-wave, and bridge rectifiers, and analyze their output voltage and current waveforms under various load conditions.

f. **Course Learning Outcomes:**

CLO 1	Explain the construction and characteristics of Power semiconductor devices family.
CLO 2	Select power electronics devices for specific application.
CLO 3	Understand the turn on and off methods of thyristors
CLO 4	Understand the working of different types of phase-controlled rectifiers

g. **Mapping of Course Learning Outcomes and Bloom's Taxonomy:**

Course Learning Outcomes	
CLO 1	Explain the construction and characteristics of Power semiconductor devices family.
CLO 2	Select power electronics devices for specific application.
CLO 3	Understand the turn on and off methods of thyristors

CLO 4	Understand the working of different types of phase-controlled rectifiers

h. Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Outcomes:

CLOs	**PLOs**												**PSO**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CLO 1	3	3	3	3	3	2	2	3	2	3	2	3	3	2
CLO 2	3	3	3	3	3	2	2	3	2	3	2	3	3	2
CLO 3	3	3	3	3	3	2	2	3	2	3	2	3	3	2
CLO 4	3	3	3	3	3	2	2	3	2	3	2	3	3	2
Weighted Average	3	3	3	3	3	2	2	3	2	3	2	3	3	2

i. Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
0	**-**	**2**	**1**	**-**	**-**	**50**	**-**	**-**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

j. Mapping of Experiment List with Course Learning Outcomes:

Sr. NO.	Experiment List
1	Test the proper functioning of power transistor and IGBT
2	Test the proper functioning of DIAC to determine the break over voltage
3	Determine the latching current and holding current using V-I characteristics of SCR.
4	Test the variation of R, C in R and RC triggering circuits on firing angle of SCR
5	Test the effect of variation of R, C in UJT triggering technique.
6	Perform the operation of Class – A, B, C, and turn off circuits.
7	Perform the operation of Class –D, E, F turn off circuits.
8	Use CRO to observe the output waveform of half wave-controlled rectifier with resistive load and determine the load voltage.
9	Draw the output waveform of Full wave-controlled rectifier with R load, RL load, and freewheeling diode and determine the load voltage.
10	Test the performance of DAIC/TRIAC for AC load control

(3)

a. **Course Name:** - Induction, Synchronous and Electrical Machines
b. **Course Code:** 03607253
c. **Prerequisite:** Basic knowledge of electrical machines
d. **Rationale:** Every generating station uses alternators for electricity generation. Induction motors and Synchronous motors are widely used in industries, farms and domestic applications. It is therefore must for electrical engineers to possess knowledge and skills required to operate and maintain 3 phase transformers, induction motors, synchronous motors and alternators. This course attempts to develop these skills into the students.

e. **Course Learning Objective:**

CLOBJ 1	Explain the working principle of a three-phase induction motor, highlighting the generation of a rotating magnetic field and torque production.
CLOBJ 2	Analyze the working principle of single-phase induction motors, focusing on the role of a single-phase power supply and starting methods.
CLOBJ 3	Grasp the working principles of three-phase alternators, emphasizing the generation of alternating current and synchronization.
CLOBJ 4	Analyze the working principles of synchronous motors, focusing on synchronous speed, rotor locking, and excitation methods.
CLOBJ 5	Comprehend the working principles of fractional horsepower motors, emphasizing efficiency and performance in low-power applications.

f. **Course Learning Outcomes:**

CLO 1	Understand the construction, working principle and application of Three phase induction motor.
CLO 2	Interpret the construction, working principle, and application of single-phase induction motor.
CLO 3	Understand the construction, working principle, and application of three phase alternators
CLO 4	Interpret the construction, working principle, and application of Synchronous motors
CLO 5	Understand the construction, working principle and application of Fractional horsepower (FHP) Motors.

g. **Mapping of Course Learning Outcomes and Bloom's Taxonomy:**

Course Learning Outcomes

CLO 1	Understand the construction, working principle and application of Three phase induction motor.
CLO 2	Interpret the construction, working principle, and application of single-phase induction motor.
CLO 3	Understand the construction, working principle, and application of three phase alternators
CLO 4	Interpret the construction, working principle, and application of Synchronous motors
CLO 5	Understand the construction, working principle and application of Fractional horsepower (FHP) Motors.

h. Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Outcomes:

CLOs	**PLOs**												**PSO**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CLO 1	3.00	3.00	2.00	1.00	1.00	1.00	2.00	1.00	1.00	3.00	1.00	3.00	1.00	1.00
CLO 2	3.00	2.00	2.00	1.00	2.00	2.00	2.00	1.00	3.00	3.00	1.00	3.00	1.00	2.00
CLO 3	3.00	3.00	2.00	1.00	1.00	3.00	2.00	2.00	2.00	2.00	2.00	3.00	2.00	3.00
CLO 4	3.00	2.00	2.00	2.00	1.00	2.00	1.00	2.00	2.00	3.00	3.00	3.00	2.00	3.00
Weighted Average	3.00	2.50	2.00	1.25	1.25	2.00	1.75	1.50	2.00	2.75	1.75	3.00	1.50	2.25

i. Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
2	**1**	**-**	**3**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

j. Course Content:

Sr. No.	**Content**	**Weightage**	**Teaching Hours**
1	**Three Phase Induction Motor** Working principle: production of rotating magnetic field, Synchronous speed, rotor speed and slip, Constructional details of 3 phase induction motors: Squirrel cage	**30%**	**12**

	induction motor and Slipping induction motor, Rotor quantities: frequency, induced emf, power factor at starting and running condition, Characteristics of torque versus slip (speed), Torques: starting, full load and maximum with relations among them, Induction motor as a generalized transformer with phasor diagram, Four quadrant operation, Power flow diagram, Starters: need and types; stator resistance, auto transformer, star delta, rotor resistance and soft starters, Speed control methods: stator voltage, pole changing, rotor resistance and VVVF, Motor selection for different applications as per the load torque-speed requirements. Maintenance of three phase induction motors		
2	**Single phase induction motors** Double field revolving theory, principle of making these motors self-start, Construction and working: Resistance start induction run, capacitor start induction run, capacitor start capacitor run, shaded pole, repulsion type, series motor, universal motor, hysteresis motor, Torque-speed characteristics for all of the above motors, Motor selection for different applications as per the load torque-speed requirements, Maintenance of single-phase induction motors	**15%**	**6**
3	**Three phase Alternators** Principle of working, moving and stationary armatures, Constructional details: parts and their functions, rotor constructions. Windings: Single and Double layer, E.M.F. equation of an Alternator with numerical by considering short pitch factor and distribution factor, Alternator loading: Factors affecting the terminal voltage of alternator; Armature resistance and leakage reactance drops. Armature reaction at various power factors and synchronous impedance, Voltage regulation: direct loading and synchronous impedance methods	**25%**	**10**
4	**Synchronous motors** Principle of working /operation, significance of load angle, torques: starting torque, running torque, pull in torque, pull out torque, Synchronous motor on load with constant excitation (numerical), effect of excitation at constant load (numerical), V-Curves and Inverted V-Curves, Hunting and Phase swinging. Methods of Starting of Synchronous Motor, Losses in synchronous motors and efficiency (no numerical), Applications areas	**20%**	**8**
5	**Fractional horse power (FHP) Motors**	**10%**	**4**

	Construction and working: Synchronous Reluctance Motor, Switched Reluctance Motor, BLDC, Permanent Magnet Synchronous Motors, stepper motors, AC and DC servomotors. Torque speed characteristics of above motors, Applications of above motors.		

k. Text Book and Reference Book:

1. Basic Electrical Engineering by Mittle V N and Mittle Arvind | McGraw Hill Education New Delhi
2. Electrical Machines by Kothari D P and Nagrath I J | McGraw Hill Education
3. Electrical Machines by Bhattacharya S. K | McGraw Hill Education
4. Electrical Technology Vol-II By Theraja, B.L. | S. Chand, New Delhi

(4)

a. Course Name: Induction, Synchronous and Electrical Machines Lab

b. Course Code: 03607254

c. Prerequisite: Basic knowledge of electrical machines lab terms

d. Rationale: The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences. Maintain Induction, Synchronous and FHP Machines used in different applications.

e. Course Learning Objective:

CLOBJ 1	Stator: The stationary part of the motor, typically made of laminated steel, which contains the windings. Rotor: The rotating part of the motor, either squirrel cage or wound type, inducing currents to produce torque. Bearings: To support the rotor shaft.
CLOBJ 2	Tachometer Method: Measure the rotor speed and synchronous speed, then calculate slip. Stroboscopic Method: Use a stroboscope to visually observe the rotor speed relative to the stator frequency.
CLOBJ 3	Direct Online (DOL) Starter: Directly connects the motor to the power supply. Star-Delta Starter: Initially starts the motor in a low-voltage star configuration and then switches to a higher voltage delta configuration. Autotransformer Starter: Uses an autotransformer to reduce the voltage during starting.
CLOBJ 4	Efficiency vs. Output: Plot the efficiency of the motor against the output power. Power Factor vs. Output: Plot the power factor against the output power. Power Factor vs. Motor Current: Plot the power factor against the motor current. Torque-Slip/Speed Characteristics: Plot the torque developed by the motor against slip or speed.

CLOBJ 5	Autotransformer: Vary the voltage supplied to the motor using an autotransformer. Variable Voltage Variable Frequency (VVVF): Control both voltage and frequency supplied to the motor.

f. Course Learning Outcomes:

CLO 1	To Know the Performance of three phase induction motor used in different applications
CLO 2	Working of Single-phase induction motor used in different applications
CLO 3	Study about three phase alternators used in different applications
CLO 4	Working and Performance of synchronous motors used in different applications
CLO 5	Study the Performance and Working of FHP motors used in different applications

g. Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes	
CLO 1	To Know the Performance of three phase induction motor used in different applications
CLO 2	Working of Single-phase induction motor used in different applications
CLO 3	Study about three phase alternators used in different applications
CLO 4	Working and Performance of synchronous motors used in different applications
CLO 5	Study the Performance and Working of FHP motors used in different applications

h. Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Outcomes:

CLOs	**PLOs**												**PSO**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CLO 1	3.00	3.00	2.00	1.00	1.00	1.00	2.00	3.00	2.00	3.00	2.00	2.00	3.00	2.00
CLO 2	3.00	3.00	3.00	2.00	2.00	2.00	3.00	3.00	3.00	3.00	3.00	3.00	2.00	3.00
CLO 3	3.00	2.00	3.00	2.00	2.00	2.00	3.00	3.00	2.00	3.00	2.00	3.00	2.00	3.00
CLO 4	3.00	2.00	3.00	3.00	2.00	2.00	3.00	3.00	3.00	3.00	3.00	3.00	2.00	3.00
CLO 5	3.00	1.00	2.00	1.00	3.00	3.00	2.00	3.00	2.00	3.00	2.00	3.00	1.00	2.00
Weighted Average	3.00	2.50	2.00	1.25	1.25	2.00	1.75	1.50	2.00	2.75	1.75	3.00	1.50	2.25

i. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
0	-	2	1	-	-	50	-	-	50

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

l. Mapping of Experiment List with Course Learning Outcomes:

Sr. NO.	Experiment List
1	Identify the different parts (along with function and materials) for the given single phase and three phase induction motor.
2	Measure the slip of 3-phase Induction motor by using Tachometer and by Stroboscopic method
3	Connect and run the three-phase squirrel cage induction motors (in both directions) using the DOL, star-delta, autotransformer starters (any two)
4	Measure the open circuit voltage ratio of the three-phase slip ring induction motor
5	Perform the direct load test on the three-phase squirrel cage induction motor and plot the i) efficiency versus output, ii) power factor versus output, iii) power factor versus motor current and iv) torque – slip/speed characteristics.
6	Perform the direct loading test on the given three phase alternator and determine the regulation and efficiency
7	Determine the regulation and efficiency of the given three phase alternators from OC and SC tests (Synchronous impedance method)
8	Conduct the test on load or no load to plot the 'V' curves and inverted 'V' curves (at no-load) of 3-f synchronous motor
9	Dismantling and reassembling of single-phase motors used for ceiling fans, universal motor for mixer
10	Conduct the direct load test to determine the efficiency and speed regulation for different loads on the given single phase induction motor; plot the efficiency and speed regulation curves with respect to the output power

(5)

a. Course Name: Electric Power Transmission and Distribution

b. Course Code: 03607255

c. Prerequisite: Basic knowledge of about transmission and distribution system.

d. Rationale: The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences: Maintain the proper functioning of the electrical transmission and distribution systems.

e. Course Learning Objective:

CLOBJ 1	Demonstrate a comprehensive understanding of the various types of Transmission and Distribution Systems, distinguishing between their functionalities and applications.
CLOBJ 2	Apply maintenance practices to ensure the efficient functioning of medium and high voltage transmission systems, including troubleshooting and addressing operational challenges.
CLOBJ 3	Analyze and interpret the specific requirements of High Voltage Direct Current (HVDC) transmission systems for effective power transmission, while also interpreting parameters associated with Extra High Voltage (EHV) transmission systems.
CLOBJ 4	Explain the diverse types and components of AC Distribution systems and substations, including their roles and significance in the overall power distribution network.
CLOBJ 5	Identify and describe the different components of Transmission and Distribution Lines, elucidating their roles, characteristics, and interconnections within the broader energy infrastructure.

f. Course Learning Outcomes:

CLO 1	Describe the different types of Transmission and Distribution System.
CLO 2	Maintain the functioning of the medium and high voltage transmission system.
CLO 3	Understand the requirements of HVDC transmission system for power transmission and interpret the parameters of the extra high voltage transmission system
CLO 4	Describe the types and components of the AC Distribution system and substations.
CLO 5	Describe the different components Transmission and Distribution Line.

g. Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes

CLO 1	Describe the different types of Transmission and Distribution System.
CLO 2	Maintain the functioning of the medium and high voltage transmission system.
CLO 3	Understand the requirements of HVDC transmission system for power transmission and interpret the parameters of the extra high voltage transmission system
CLO 4	Describe the types and components of the AC Distribution system and substations.
CLO 5	Describe the different components Transmission and Distribution Line.

h. Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Outcomes:

CLOs	**PLOs**												**PSO**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CLO 1	2.00	1.00	2.00	3.00	1.00	1.00	1.00	2.00	1.00	2.00	2.00	1.00	1.00	2.00
CLO 2	2.00	1.00	2.00	2.00	1.00	2.00	1.00	2.00	2.00	2.00	2.00	2.00	1.00	3.00
CLO 3	3.00	2.00	3.00	2.00	2.00	1.00	1.00	2.00	1.00	2.00	2.00	1.00	2.00	2.00
CLO 4	2.00	3.00	2.00	2.00	1.00	3.00	2.00	1.00	2.00	1.00	2.00	1.00	3.00	1.00
CLO 5	1.00	2.00	1.00	2.00	2.00	1.00	2.00	3.00	1.00	1.00	2.00	2.00	2.00	1.00
Weighted Average	2.00	1.80	2.00	2.20	1.40	1.60	1.40	2.00	1.40	1.60	2.00	1.40	1.80	1.80

i. Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	**-**	**-**	**3**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination.

j. Course Content:

Sr.	**Topics**	**Weightage (%)**	**Teaching hours**
1	**Basics of Transmission and Distribution:** Single line diagrams with components of the electric supply transmission and distribution systems. Classification of transmission lines: Primary and secondary transmission; standard voltage level used in India. Classification of transmission lines:	**20**	**8**

	based on type of voltage, voltage level, length and others Characteristics of high voltage for power transmission. Method of construction of electric supply transmission system – 110 kV, 220 kV, 400 kV. Method of construction of electric supply distribution systems – 220 V, 400V, 11 kV, 33 kV		
2	**Transmission Line Parameters and Performance** Line Parameters: Concepts of R, L and C of line parameters and types of lines. Performance of short line: Efficiency, regulation and its derivation, effect of power factor, vector diagram for different power factor. Performance of medium line: representation, nominal 'T', nominal 'π' and end condenser methods. Transposition of conductors and its necessity. Skin effect and proximity effect.	**25**	**10**
3	**Extra High Voltage Transmission** Extra High Voltage AC (EHVAC) transmission line: Necessity, high voltage substation components such as transformers and other switchgears, advantages, limitations and applications and lines in India. Ferranti and Corona effect. High Voltage DC (HVDC) Transmission Line: Necessity, components, advantages, limitations and applications. Layout of mono polar, bi-Polar and homo-polar transmission lines. Lines in India. Features of EHVAC and HVDC transmission line. Flexible AC Transmission line: Features, d types of FACTS controller	**15**	**7**
4	**A.C Distribution System AC distribution** Components classification, requirements of an ideal distribution system, primary and secondary distribution system. Feeder and distributor, factors to be considered in design of feeder and distributor. Types of different distribution schemes: radial, ring, and grid, layout, advantages, disadvantages and applications. Voltage drop, sending end and receiving end voltage. Distribution Sub-Station: Classification, site selection, advantages, disadvantages and applications. Single Line diagram (layout) of 33/11KV Sub-Station, 11KV/400V sub-station, Symbols and functions of their components.	**20**	**8**
5	**Components of Transmission and Distribution Line** Overhead Conductors: Properties of material, types of conductors with trade names, significance of sag. Line supports Requirements, types of line structures and their specifications, methods of erection. Line Insulators: Properties of insulating material, selection of material, types of insulators and their applications, causes of insulator failure, derivation of equation of string efficiency for string of three suspension insulator, methods of improving string efficiency. Underground Cables: Requirements, classification, construction, comparison with overhead lines, cable laying and cable jointing	**20**	**8**

k. Text Book and Reference Book:

1. Utilization of Electric Power & Electric Traction by G C Garg | Khanna Book Publishing Co New Delhi
2. Principles of Power System by Mehta V K | S Chand and Co New Delhi
3. A Course in Electrical Power by Soni Gupta Bhatnagar | Dhanpat Rai and Sons New Delhi "Linear Systems and Signals" by B.P. Lathi.
4. A Course in Power Systems by J.B. Gupta | Katson Publication

(6)

a) Course Name: Electric Power Transmission and Distribution Lab

b) Course Code: 03607255

c) Prerequisite: Basic Knowledge about transmission and distribution system.

d) Rationale: The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences: Maintain the proper functioning of the electrical transmission and distribution systems.

e) Course Learning Objective:

CLOBJ 1	Develop a foundational understanding of the history and components of power systems, encompassing the evolution of the field and the key elements that constitute a power system.
CLOBJ 2	Gain insight into the properties of materials utilized in power systems, exploring how different materials contribute to the efficiency, safety, and reliability of power transmission and distribution infrastructure.
CLOBJ 3	Comprehend the electrical parameter properties and classifications relevant to power systems, including key concepts such as voltage, current, resistance, and their significance in the operation and design of electrical systems.
CLOBJ 4	Acquire a comprehensive understanding of the fundamental concepts underlying power transmission and distribution lines, exploring their design principles, functions, and the technologies employed in ensuring efficient energy transfer.
CLOBJ 5	Demonstrate the ability to interpret the normal operation of electric transmission and distribution systems, identifying standard procedures, safety measures, and key performance indicators to ensure the reliable and effective delivery of electricity to end-users.

f) Course Learning Outcomes:

CLO 1	Understand the basics of power system history and components
CLO 2	Understand the properties of different material used in power system.

CLO 3	Understand the electrical parameter properties and classifications.
CLO 4	Understand the concepts of power transmission and distribution line.
CLO 5	Interpret the normal operation of the electric transmission and distribution systems

g) Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes	
CLO 1	Understand the basics of power system history and components
CLO 2	Understand the properties of different material used in power system.
CLO 3	Understand the electrical parameter properties and classifications.
CLO 4	Understand the concepts of power transmission and distribution line.
CLO 5	Interpret the normal operation of the electric transmission and distribution systems

h) Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Outcomes:

CLOs	**PLOs**												**PSO**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CLO 1	2.00	3.00	2.00	1.00	2.00	1.00	1.00	1.00	2.00	1.00	2.00	2.00	2.00	2.00
CLO 2	2.00	2.00	2.00	1.00	2.00	1.00	1.00	1.00	2.00	1.00	2.00	1.00	2.00	2.00
CLO 3	3.00	3.00	2.00	3.00	2.00	2.00	1.00	2.00	2.00	2.00	1.00	1.00	2.00	2.00
CLO 4	3.00	2.00	2.00	3.00	2.00	1.00	1.00	2.00	1.00	1.00	2.00	2.00	3.00	2.00
CLO 5	3.00	1.00	1.00	2.00	3.00	2.00	2.00	2.00	1.00	2.00	1.00	2.00	2.00	1.00
Weighted Average	2.60	2.20	1.80	2.00	2.20	1.40	1.20	1.60	1.60	1.40	1.60	1.60	2.20	1.80

i) Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
0	**-**	**2**	**1**	**-**	**-**	**50**	**-**	**-**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

j) Text Book and Reference Book:

1. Utilization of Electric Power & Electric Traction By G C Garg | Khanna Book Publishing Co New Delhi
2. Principles of Power System By Mehta V K | S Chand and Co New Delhi
3. A Course in Electrical Power By Soni Gupta Bhatnagar | Dhanpat Rai and Sons New Delhi "Linear Systems and Signals" by B.P. Lathi.
4. A Course in Power Systems By J.B. Gupta | Katson Publication

k) Mapping of Experiment List with Course Learning Outcomes:

Exp. No.	Name of the Experiment
1	Prepare a report based on transmission line network in Gujarat.
2	Prepare a report on different type of insulators and bushings used in transmission system with their specifications.
3	Prepare a report about types of cables used in distribution system by visiting nearby cable suppliers/industries or otherwise with the help of internet
4	Prepare a report on different type of Transmission Towers used in the industry
5	Prepare a report on different types of connectors used in the transmission lines.
6	Prepare a report on substation with its layout after visiting a nearby substation
7	Prepare a report based on Library/ Internet survey of electrical high voltage line and HVDC lines.
8	Draw a layout diagram of 11KV/400 V substation in your campus/ adjacent substation.
9	Collect different samples of Overhead Conductors, Underground Cables, Line supports and Line Insulators.
10	Prepare a power point presentation: i. Extra High Voltage AC Transmission line. Ii. High Voltage DC Transmission line. iii. Flexible AC Transmission line. Iv. New trends in wireless transmission of electrical power.

(7)

a. **Course Name:** Minor Project
b. **Course Code:** 03607260
c. **Prerequisite:** Zeal to learn the Subject.
d. **Rationale:** The main aim of this subject is to transform theoretical knowledge into practical.

e. **Course Learning Objective:**

CLOBJ 1	Develop the ability to apply theoretical knowledge effectively in practical settings, demonstrating proficiency in transforming theoretical concepts into real-world applications.
CLOBJ 2	Foster and enhance innovative thinking and problem-solving skills, encouraging students to explore creative solutions and novel approaches to challenges encountered in their field of study.
CLOBJ 3	Cultivate a sense of curiosity and enthusiasm for learning, promoting active engagement in academic pursuits and fostering a passion for continuous self-improvement and exploration of new ideas.
CLOBJ 4	Enhance leadership and teamwork abilities, equipping students with the skills necessary to lead and collaborate effectively in group settings, while also developing strategies for solving complex problems through collective effort and cooperation.

f. Course Learning Outcomes:

CLO 1	Makes Transformation of Theoretical Knowledge and its Applications.
CLO 2	Improves Innovative Spirit.
CLO 3	Boosts Curiosity and Liking for Studies.
CLO 4	Improves Team Leading and Problem-Solving Skills.

g. Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes	
CLO 1	Makes Transformation of Theoretical Knowledge and its Applications.
CLO 2	Improves Innovative Spirit.
CLO 3	Boosts Curiosity and Liking for Studies.
CLO 4	Improves Team Leading and Problem-Solving Skills.

h. Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Learning Outcomes:

CLOs	PLOs												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CLO 1	3.00	2.00	3.00	2.00	3.00	2.00	1.00	2.00	2.00	2.00	1.00	2.00	3.00	2.00
CLO 2	2.00	3.00	2.00	3.00	2.00	3.00	2.00	2.00	3.00	2.00	3.00	3.00	1.00	3.00
CLO 3	1.00	1.00	3.00	1.00	2.00	2.00	1.00	1.00	2.00	2.00	1.00	3.00	1.00	2.00
CLO 4	2.00	3.00	2.00	3.00	2.00	2.00	2.00	2.00	3.00	2.00	3.00	2.00	2.00	3.00
Weighted Average	2.00	2.25	2.50	2.25	2.25	2.25	1.50	1.75	2.50	2.00	2.00	2.50	1.75	2.50

i. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
-	-	2	1	-	-	50	-	0	50

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

(8)

a. **Course Name:** Employability Skills
b. **Course Code:** 03693251
c. **Prerequisite:** Inclination to learn the importance of critical thinking & Interview Skills.
d. **Rationale:** Cracking aptitude is the first step towards cracking placements and competitive exams
e. **Course Learning Objective:**

CLOBJ 1	Improve their critical thinking
CLOBJ 2	Prepares them for Campus Placement & Competitive Exams.
CLOBJ 3	Builds up their confidence level

CLOBJ 4	Understanding ways to present the points in Group Discussions & how it plays an important role in cracking interviews.(selection process)
CLOBJ 5	Learning Entrepreneur skills which promotes them to learn selling techniques.
CLOBJ 6	Grasping the knowledge for preparing resume.

f. Course Learning Outcomes:

CLO 1	Application of the knowledge learnt in resume building
CLO 2	Building confidence & cracking interviews.
CLO 3	Improve competency in Competitive exams through various topics learnt
CLO 4	Selling skills are focused helping them to become an entrepreneur in future.

g. Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes	
CLO 1	Understand the concepts of various competitive topics
CLO 2	Analyze various skills required in resume building & updating it & adding it in **linked in.**
CLO 3	Understand & implication of entrepreneur skills
CLO 4	Understand interview skills, questions asked in it & their formations.

h. Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Outcomes:

CLOs	**PLOs**												**PSO**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CLO 1	2.00	2.00	1.00	2.00	1.00	1.00	2.00	2.00	3.00	2.00	1.00	3.00	2.00	2.00
CLO 2	3.00	2.00	1.00	1.00	1.00	2.00	1.00	3.00	2.00	2.00	1.00	3.00	1.00	2.00
CLO 3	2.00	3.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00	2.00	1.00	3.00	2.00	3.00
CLO 4	2.00	2.00	2.00	1.00	3.00	1.00	2.00	1.00	1.00	1.00	1.00	3.00	1.00	1.00
Weighted Average	2.25	2.25	1.25	1.25	1.50	1.25	1.50	1.75	2.00	1.75	1.00	3.00	1.50	2.00

i. Teaching & Examination Scheme:

Teaching Scheme	**Credit**	**Examination Scheme**	**Total**

Lect. Hrs/ Week	Tut Hrs/ Week	Lab Hrs/		External		Internal			
				T	P	T	CE	P	
2	0	-	0	-	-	-	100	-	100

Lect- Lecture, **Tut** – Tutorial, **Lab** – Lab, **T** – Theory, **P** – Practical, **CE** – Continuous Evaluation

Note: 15 Hours of additional sessions will be taken (within the semester) to match up 30 hours content.

j. Course Content:

Sr.	Topic	Weightage	TeachingHrs.
1	**Critical Thinking -Case Studies:** Critical thinking is based on pure logical thinking. Solving a criticalreasoning question requires nothing but reasoning ability of the candidate. This session deals with the basic logic involved in critical reasoning questions and covers all the type of questions inCT. Worksheets would be provided to students for further practice.	10%	6
2	**Coding & decoding, Alphabetical Series** • Understand various types of questions which they can comeacross in the given topic. • Tips and tricks to solve questions on the above mentionedtopics.	8%	4
3	**Analogy and odd man out** • Understand various types of questions which they can comeacross in the given topic. • Tips and tricks to solve questions on the above mentionedtopics.	8%	4
4	**Direction sense** : • Able to solve all the direction sense question in competitiveexams and aptitude exams of different companies	8%	4
5	**Blood relations**: • Able to solve all the Blood Relation questions in competitiveexams and aptitude exams of different companies	8%	4
6	**Paper Folding** • In this section of non verbal reasoning a figure is obtained by folding a piece of paper containing same	4%	2

	design along the dottedline.		
7	**Seating Arrangement** Candidates are required to arrange the objects either in a row or circle on the basis of information given • Questions are presented in distorted form to create confusion and to taste the candidate's ability to analyze the information step by step in order to answer the question	3%	2
8	**Completion of Figure** • In each of the following figure, a part of figure is missing. Find out from the given options, the right figure to fit in the missing figure	3%	2
9	**Completion of Series** • In these questions a series of figures is given as problem figure & the candidate are asked to select one of the figurefrom the set of answer figure which will continue the given sequence.	8%	4
10	**Entrepreneurship skills (SELLING THE CONCEPT):** This topic will help students develop the skills necessary to develop into Self- Sufficient business leaders through Entrepreneurshipstudies.	4%	2
11	**Resume Building** The students will have a proper understanding of the content and how it is to be presented in resume	8%	4
12	**Group Discussion** It is a systematic exchange of information, views and opinions about a topic, problem, issue or situation among the members of a group who share some common objectives.	14%	8
13	**Interview Skills** Students are prepared for their interviews, question and answers, how to react on some unique questions, body language & grooming is taken into account.	14%	8
	Total	100	60

Continuous Evaluation:

It consists of

1. Phase I Exam-35 Marks(Hybrid or Offline Mode)
2. Phase II Exam -35 Marks (Hybrid or Offline Mode)
3. Activities – (Listening and Speaking) -10+10=20 Marks
4. Attendance -10 Marks

The passing marks for Continous Evaluation will be 40 out of 100.There will not be any re-test.

Text Book and Reference Book:

1. Verbal & Non-Verbal Reasoning, Indu Sijwali & B.S. Sijwali
2. Contributor Personality Development by i-become Critical Thinking Skills for Engineers

(9)

a. **Course Name:** Illumination Practices
b. **Course Code:** 03607281
c. **Prerequisite:** Basic knowledge of illumination of light and various kinds of lamps
d. **Rationale:** The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences: Design illumination schemes and associated electrification of buildings.

e. **Course Learning Objective:**

CLOBJ 1	Develop a comprehensive understanding of the law of illumination, including the principles and factors influencing the distribution of light in different settings.
CLOBJ 2	Explore the various lamps and fittings used in illumination systems, delving into their characteristics, applications, and considerations for optimal lighting solutions.
CLOBJ 3	Grasp the concepts of Illumination Control and Control Circuits, gaining proficiency in the implementation of control mechanisms to regulate and enhance lighting conditions efficiently.
CLOBJ 4	Acquire knowledge about Illumination for Interior Applications in residential and commercial units, focusing on the specific requirements, design considerations, and practical applications for creating well-lit and aesthetically pleasing environments.
CLOBJ 5	Analyze and comprehend illumination schemes tailored for various applications, including but not limited to residential, commercial, and specialized settings, ensuring a nuanced understanding of lighting design principles to meet diverse needs and objectives.

f. **Course Learning Outcomes:**

CLO 1	Understand the law of illumination.
CLO 2	Understand the various lamps and fittings in use..

CLO 3	Understand the Illumination Control and Control Circuits.
CLO 4	Understand Illumination for Interior Applications for Residential, Commercial units.
CLO 5	Understand illumination schemes for various applications.

g. Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes	
CLO 1	Understand the law of illumination.
CLO 2	Understand the various lamps and fittings in use.
CLO 3	Understand the Illumination Control and Control Circuits.
CLO 4	Understand Illumination for Interior Applications for Residential, Commercial units.
CLO 5	Understand illumination schemes for various applications.

h. Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Outcomes:

CLOs	**PLOs**												**PSO**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CLO 1	3.00	2.00	2.00	2.00	1.00	1.00	1.00	1.00	2.00	1.00	2.00	2.00	2.00	2.00
CLO 2	2.00	3.00	2.00	2.00	2.00	1.00	1.00	1.00	2.00	1.00	2.00	1.00	2.00	2.00
CLO 3	2.00	2.00	3.00	2.00	2.00	2.00	1.00	1.00	2.00	2.00	1.00	1.00	2.00	2.00
CLO 4	2.00	2.00	2.00	3.00	2.00	2.00	2.00	1.00	2.00	2.00	1.00	1.00	2.00	2.00
CLO 5	1.00	2.00	2.00	2.00	3.00	2.00	2.00	2.00	1.00	2.00	1.00	2.00	2.00	1.00
Weighted Average	2.00	2.20	2.20	2.20	2.00	1.60	1.40	1.20	1.80	1.60	1.40	1.40	2.00	1.80

i. Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	**-**	**-**	**3**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination.

j. Course Content:

Sr.	Topics	Weightage (%)	Teaching hours
1	**Fundamentals of illumination** Basic illumination, Terminology, Laws of illumination, Polar curves, polar curve: its meaning and applications for designing the lamp, Concept of Photometry, Measurement of illumination Lighting calculation methods, Watt /m 2 method, Lumens or light flux method, Point to point method, Standards for illumination	18	8
2	**Types of lamps** Incandescent lamp, ARC lamps – AC and DC arc lamps, Fluorescent lamp Types of other lamps: Mercury vapors lamp, HPMV lamp, Mercury iodide lamp, Sodium vapor lamp, Halogen Lamps, Ultraviolet Lamps, and Neon Lamps. Neon Sign Tubes. Metal halides, HID and Arc lamps LED lamps, CFL, Lasers Selection Criteria for lamps	24	10
3	**Illumination Control and Control Circuits:** Purpose of lighting control, and Dimmer, Resistance type Salt water Dimmer, Working principle and operation of Dimmer, Transformer and their types, Dimmer Transformer, Auto transformer dimmer, Two winding transformer dimmer, Electronic Dimmer: working principle and operation a Thyristor operated dimmer, Triac operated dimmer, Control of Enhance Lighting, Methods used for light control, Control circuits for lamps (refer): ON/OFF control, Control circuits for lamps: single lamp controlled by single switch, two switches, Single Lamp control by two point method, three point method and four point method,	24	10
4	**Illumination for Interior Applications for Residential, Commercial units** Standard for various locations of Interior Illumination, Design considerations for Interior location of residences (1/2/3/4 BHK), Commercial, Industrial premises, Illumination scheme for different Interior locations of Residential, Commercial units	24	10
5	**Illumination for Interior Applications** Factory Lighting, Street Lighting (Latest Technology), Flood Lighting, Railway Lighting, Lighting for advertisement /Hoardings/sports lighting, Agriculture and Horticulture lighting, Health Care Centers / Hospitals, Decorating Purposes, Stage Lighting, Aquariums and Shipyards, Special purpose lamps used in photography video films.	10	4

k. Text Book and Reference Book:

1. Lighting Engineering Applied Calculations By Simons R H Bean, Robert | Architectural Press
2. Utilization of Electric Power & Electric Traction By J.B. Gupta | KATSON BOOKS
3. Handbook of Industrial Lighting By Butterworth Lyons Stanley | Butterworth's
4. Lighting Control Technology and Applications By Simpson Robert S | Focal Press 6.

Kao Chen, Energy Management in Illuminating Systems, CRC Press

(9)

a. **Course Name:** Illumination Practices Lab
b. **Course Code:** 03607282
c. **Prerequisite:** Basic knowledge of illumination of light and various kinds of lamps
d. **Rationale:** The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences: Design illumination schemes and associated electrification of buildings.
e. **Course Learning Objective:**

CLOBJ 1	Develop the capability to select appropriate illumination levels for a variety of applications, considering factors such as space function, user requirements, and industry standards.
CLOBJ 2	Gain proficiency in selecting suitable lamps for diverse applications, taking into account factors such as energy efficiency, color rendering, and compatibility with specific lighting requirements.
CLOBJ 3	Demonstrate the ability to select lighting accessories essential for a chosen wiring scheme, ensuring compatibility, safety, and optimal performance within the selected illumination setup.
CLOBJ 4	Acquire skills in designing relevant illumination schemes for interior applications, incorporating considerations such as aesthetics, functionality, and energy efficiency to meet the specific needs of residential, commercial, or institutional spaces.
CLOBJ 5	Develop expertise in designing illumination schemes tailored to various applications, ensuring an understanding of lighting design principles that address diverse requirements and objectives.
CLOBJ 6	Extend design capabilities to include illumination schemes for various outdoor applications, considering factors such as landscape, architectural features, and safety standards to create well-lit and aesthetically pleasing outdoor environments.

f. **Course Learning Outcomes:**

CLO 1	Select the relevant Illumination levels for various applications
CLO 2	Select relevant lamps for various applications
CLO 3	Select the lighting accessories required for selected wiring scheme.
CLO 4	Design relevant illumination schemes for interior applications.
CLO 5	Design Illumination schemes for various applications.
CLO 6	Design Illumination schemes for various outdoor applications.

g. Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes	
CLO 1	Select the relevant Illumination levels for various applications
CLO 2	Select relevant lamps for various applications
CLO 3	Select the lighting accessories required for selected wiring scheme.
CLO 4	Design relevant illumination schemes for interior applications.
CLO 5	Design Illumination schemes for various applications.
CLO 6	Design Illumination schemes for various outdoor applications.

h. Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Outcomes:

CLOs	**PLOs**												**PSO**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CLO 1	3.00	2.00	2.00	2.00	2.00	1.00	1.00	1.00	2.00	1.00	2.00	2.00	2.00	2.00
CLO 2	3.00	2.00	2.00	2.00	2.00	1.00	1.00	1.00	2.00	1.00	2.00	1.00	2.00	2.00
CLO 3	3.00	2.00	2.00	2.00	2.00	1.00	1.00	1.00	2.00	1.00	2.00	1.00	2.00	2.00
CLO 4	2.00	2.00	2.00	3.00	2.00	2.00	2.00	1.00	2.00	2.00	1.00	1.00	2.00	2.00
CLO 5	2.00	2.00	2.00	2.00	3.00	2.00	2.00	2.00	1.00	2.00	1.00	2.00	2.00	1.00
CLO 6	2.60	2.00	2.00	2.20	2.20	1.40	1.40	1.20	1.80	1.40	1.60	1.40	2.00	1.80
Weighted Average	3.00	2.00	2.00	2.00	2.00	1.00	1.00	1.00	2.00	1.00	2.00	2.00	2.00	2.00

i. Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
0	**-**	**2**	**1**	**-**	**-**	**50**	**-**	**-**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

j. Text Book and Reference Book:

1. Lighting Engineering Applied Calculations by Simons R H Bean, Robert | Architectural Press
2. Utilization of Electric Power & Electric Traction by J.B. Gupta | KATSON BOOKS
3. Handbook of Industrial Lighting by Butterworth Lyons Stanley | Butterworth's

4. Lighting Control Technology and Applications By Simpson Robert S | Focal Press 6. Kao Chen, Energy Management in Illuminating Systems, CRC Press

k. Mapping of Experiment List with Course Learning Outcomes:

Exp. No.	Name of the Experiment
1	Conduct illumination level assessment in workplace using lux meter.
2	Study different lamps with their mounting
3	Interpret the polar curves of the given type of lamp and verify it using the lux meter
4	Measure the illumination output of different lamps (Incandescent, Fluorescent, CFL, LED, HPSV, and HPMV) and compare it with their wattage.
5	Estimate and compare luminous efficiency of incandescent and compact fluorescent lamp.
6	Prepare light dimmer arrangement using the relevant dimmer type of transformer
7	Identify the given types of dimmer transformer and their parts
8	Build an electronic dimmer – Part I and part-II
9	Build a single lamp control by different methods (single switch, two switches, two-point method, three-point method, four-point method).
10	Prepare a visit report nearby industry (ERDA).

(10)

a. Course Name: Electrical Estimation and Contracting

b. Course Code: 03607283

c. Prerequisite: Basic knowledge of electrical wiring and related terms

d. Rationale: This course aims to teach students advanced knowledge of Estimation and Contracting skills for wiring.

e. Course Learning Objective:

CLOBJ 1	Demonstrate a thorough understanding of electrical installations and safety practices by adhering to the guidelines set forth in the National Electrical Code 2011, ensuring compliance and promoting a safe working environment.
CLOBJ 2	Provide a comprehensive description of the various types of installation tenders and contracts, emphasizing the legal and contractual aspects associated with electrical installations.
CLOBJ 3	Develop the skills necessary to estimate the scope of work for non-industrial electrical installations, including the ability to assess materials, labour, and associated costs for accurate project planning and budgeting.

CLOBJ 4	Apply estimation techniques specific to industrial electrical installations, considering the unique requirements, complexities, and scale of industrial projects to ensure precise cost assessments.
CLOBJ 5	Explain the process of estimating the work involved in Distribution Line and Substation Components, covering the various elements such as equipment, materials, and labour required for the successful implementation of electrical distribution infrastructure projects.

f. Course Learning Outcomes:

CLO 1	Follow National Electrical Code 2011 in electrical installations and Safety.
CLO 2	Describe the Types of Installation Tenders and Contracts
CLO 3	Estimate the work of non-industrial electrical installations
CLO 4	Estimate the work of industrial electrical installations.
CLO 5	Describe the Estimation of Distribution line and Substation Components.

g. Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes	
CLO 1	Follow National Electrical Code 2011 in electrical installations and Safety.
CLO 2	Describe the Types of Installation Tenders and Contracts
CLO 3	Estimate the work of non-industrial electrical installations
CLO 4	Estimate the work of industrial electrical installations.
CLO 5	Describe the Estimation of Distribution line and Substation Components.

h. Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Outcomes:

CLOs	**PLOs**												**PSO**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CLO 1	3.00	2.00	2.00	2.00	2.00	1.00	1.00	1.00	2.00	1.00	2.00	2.00	2.00	2.00
CLO 2	2.00	3.00	2.00	2.00	2.00	1.00	1.00	1.00	2.00	1.00	2.00	1.00	2.00	2.00
CLO 3	2.00	2.00	3.00	2.00	2.00	2.00	1.00	1.00	2.00	2.00	1.00	1.00	2.00	2.00
CLO 4	2.00	2.00	2.00	3.00	2.00	2.00	2.00	1.00	2.00	2.00	1.00	1.00	2.00	2.00
CLO 5	2.00	2.00	2.00	2.00	3.00	2.00	2.00	2.00	1.00	2.00	1.00	2.00	2.00	1.00
Weighted Average	2.20	2.20	2.20	2.20	2.20	1.60	1.40	1.20	1.80	1.60	1.40	1.40	2.00	1.80

i. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	-	3	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination.

j. Course Content:

Sr.	Topics	Weightage (%)	Teaching hours
1	**Electric Installation and Safety** Scope and features of National electric code 2011, Types of electrical installation, Fundamental principles for electrical installation, permit to work, safety instructions and safety practices, Purpose of estimating and costing.	10	6
2	**Estimation and Costing** Meaning and purpose of- Rough estimate, Detailed estimate, Supplementary estimate, Annual maintenance estimate and revised estimate Factors to be considered while preparation of detailed estimate and economical execution of work Contracts- Concepts of contracts, Types of contracts, Contractor, Role of contractor Tenders and Quotations- Type of tender, Tender notice, Preparation of tender document, and method of opening of tender Quotation, Quotation format, Comparison between tender and quotation Comparative statement, Format comparative statement. Order format, Placing of purchasing order. Principle of execution of works, Planning, Organizing and completion of work, Billing of work	30	12
3	**Non-Industrial Installations** Types of Non-industrial installations- Office buildings, Shopping and commercial Centre, Residential installation, Electric service and supply Design consideration of electrical installation in commercial buildings. Design procedure of installation- steps involved in detail, Estimating and costing of unit Earthing of commercial installation. Design electrical installation scheme of commercial complex. Erection, Inspection and testing of installation as per NEC	20	8
4	**Industrial Installation** Classification of industrial buildings Classification based on power consumption, Drawing of wiring diagram and single line diagram for single phase and three phase Motors. Design consideration in industrial installations, Design procedure of installation-detailed steps, Design electrical installation scheme of factory/ small industrial	20	8

	unit, Preparation of material schedule and detailed estimation Installation and estimation of agricultural pump and flourmill		
5	**Distribution Lines and LT Substation** Introduction to overhead and underground distribution line. Materials used for distribution line HT and LV Cables used for distribution line, Factors determining selection of LT/ HT power Cables, Cable laying and cable termination method according to IS Design, Estimation and costing of HT LT overhead line and underground cabling. Types of 11 KV Distribution substations their line diagram, Estimation of load, Load factor, Diversity factor and determination of rating of distribution transformer, Design, estimation and costing of outdoor and indoor 11 KV substation	**20**	**8**

k. Text Book and Reference Book:

1. Electrical Design Estimating and Costing by Raina K B Dr. S. K. Bhattacharya | New Age International Publisher First, Reprint 2010
2. Electrical Estimating and Costing by Allagappan, N. S. Ekambarram | Tata Mc-Graw Hill Publishing Co. Ltd
3. A Course in Electrical Installation Estimating and Costing by Gupta, J.B. S.K. | Kataria and Sons Reprint Edition
4. Dhanpat Rai and Sons Electrical Estimating and Costing By 3. Singh, Surjit Ravi Deep Singh | Dhanpat Rai and Sons

(11)

a. Course Name: Electrical Estimation and Contracting Lab

b. Course Code: 03607284

c. Prerequisite: Basic knowledge of electrical wiring and related lab experience.

d. Rationale: This course aims to teach students practical knowledge of Estimation and Contracting skills for wiring.

e. Course Learning Objective:

CLOBJ 1	Demonstrate a thorough understanding of electrical installations and safety practices by adhering to the guidelines set forth in the National Electrical Code 2011, ensuring compliance and promoting a safe working environment.
CLOBJ 2	Provide a comprehensive description of the various types of installation tenders and contracts, emphasizing the legal and contractual aspects associated with electrical installations.
CLOBJ 3	Develop the skills necessary to estimate the scope of work for non-industrial electrical installations, including the ability to assess materials, labour, and associated costs for accurate project planning and budgeting.

CLOBJ 4	Apply estimation techniques specific to industrial electrical installations, considering the unique requirements, complexities, and scale of industrial projects to ensure precise cost assessments.
CLOBJ 5	Explain the process of estimating the work involved in Distribution Line and Substation Components, covering the various elements such as equipment, materials, and labour required for the successful implementation of electrical distribution infrastructure projects.

f. Course Learning Outcomes:

CLO 1	Follow National Electrical Code 2011 in electrical installations and Safety.
CLO 2	Describe the Types of Installation Tenders and Contracts
CLO 3	Estimate the work of non-industrial electrical installations
CLO 4	Estimate the work of industrial electrical installations.
CLO 5	Describe the Estimation of Distribution line and Substation Components.

g. Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes	
CLO 1	Follow National Electrical Code 2011 in electrical installations and Safety.
CLO 2	Describe the Types of Installation Tenders and Contracts
CLO 3	Estimate the work of non-industrial electrical installations
CLO 4	Estimate the work of industrial electrical installations.
CLO 5	Describe the Estimation of Distribution line and Substation Components.

h. Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Outcomes:

CLOs	**PLOs**												**PSO**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CLO 1	3.00	2.00	2.00	2.00	2.00	1.00	1.00	1.00	2.00	1.00	2.00	2.00	2.00	2.00
CLO 2	2.00	3.00	2.00	2.00	2.00	1.00	1.00	1.00	2.00	1.00	2.00	1.00	2.00	2.00
CLO 3	2.00	2.00	3.00	2.00	2.00	2.00	1.00	1.00	2.00	2.00	1.00	1.00	2.00	2.00
CLO 4	2.00	2.00	2.00	3.00	2.00	2.00	2.00	1.00	2.00	2.00	1.00	1.00	2.00	2.00
CLO 5	2.00	2.00	2.00	2.00	3.00	2.00	2.00	2.00	1.00	2.00	1.00	2.00	2.00	1.00
CLO 6	2.20	2.20	2.20	2.20	2.20	1.60	1.40	1.20	1.80	1.60	1.40	1.40	2.00	1.80
Weighted Average	3.00	2.00	2.00	2.00	2.00	1.00	1.00	1.00	2.00	1.00	2.00	2.00	2.00	2.00

i. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
0	-	2	1	-	-	50	-	-	50

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

j. Text Book and Reference Book:

1. Electrical Design Estimating and Costing By Raina K B Dr. S. K. Bhattacharya | New Age International Publisher First, Reprint 2010
2. Electrical Estimating and Costing By Allagappan, N. S. Ekambarram | Tata Mc-Graw Hill Publishing Co. Ltd
3. A Course in Electrical Installation Estimating and Costing By Gupta, J.B. S.K. | Kataria and Sons Reprint Edition
4. Dhanpat Rai and Sons Electrical Estimating and Costing By 3. Singh, Surjit Ravi Deep Singh | Dhanpat Rai and Sons

k. Mapping of Experiment List with Course Learning Outcomes:

Exp. No.	Name of the Experiment
1	Prepare a tender notice for purchasing a transformer of 200 KVA for commercial installation.
2	Prepare a quotation for purchasing different electrical material required
3	Prepare a comparative statement for above material Prepare purchase order for the same.
4	Design drawing, estimating and costing of hall / Cinema Theatre / commercial installation Prepare report and draw sheet.
5	Design electrical installation scheme for any one factory / small industrial unit. Draw detailed wiring diagram. Prepare material schedule and detailed estimate. Prepare report and draw sheet.
6	Estimate with a proposal of the electrical Installation of streetlight scheme for small premises after designing.
7	Estimate with a proposal of the L.T. line installation. Prepare report and draw sheet.
8	Estimate with a proposal of the 500 KVA, 11/0.433 KV outdoor substation and prepare a report

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a. Course Name: Solar Power Technologies

b. Course Code: 03607285

c. **Prerequisite:** Basic knowledge of solar related terms.
d. **Rationale:** This course aims to teach students advanced knowledge related to solar related latest technology.
e. **Course Learning Objective:**

CLOBJ 1	Acquire the skills and knowledge required to effectively maintain non-electric solar equipment, ensuring the optimal functionality and longevity of solar devices that do not rely on electrical power.
CLOBJ 2	Develop proficiency in the maintenance procedures specific to Concentrated Solar Power (CSP) plants, including the monitoring and care of components to maximize efficiency and address potential issues.
CLOBJ 3	Demonstrate the ability to maintain solar Photovoltaic (PV) systems, covering routine inspections, troubleshooting, and preventive measures to sustain the performance of solar PV installations.
CLOBJ 4	Gain expertise in the maintenance of solar PV electronics and Maximum Power Point Tracking (MPPT) systems, focusing on the electronic components and control systems integral to efficient solar energy conversion.
CLOBJ 5	Develop the skills necessary to maintain both off-grid and on-grid solar power plants, addressing the unique considerations and challenges associated with each system type to ensure reliable and sustainable solar energy generation.

f. **Course Learning Outcomes:**

CLO 1	Maintain the solar non-electric equipment.
CLO 2	Maintain CSP plants
CLO 3	Maintain solar PV systems.
CLO 4	Maintain solar PV electronics and MPPT systems.
CLO 5	Maintain off-grid and on-grid solar power plants.

g. **Mapping of Course Learning Outcomes and Bloom's Taxonomy:**

Course Learning Outcomes	
CLO 1	Maintain the solar non-electric equipment.
CLO 2	Maintain CSP plants
CLO 3	Maintain solar PV systems.
CLO 4	Maintain solar PV electronics and MPPT systems.
CLO 5	Maintain off-grid and on-grid solar power plants.

h. **Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Outcomes:**

CLOs	PLOs												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CLO 1	2.00	2.00	1.00	2.00	1.00	1.00	2.00	2.00	3.00	2.00	1.00	3.00	2.00	2.00
CLO 2	3.00	2.00	1.00	1.00	1.00	2.00	1.00	3.00	2.00	2.00	1.00	3.00	1.00	2.00
CLO 3	2.00	3.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00	2.00	1.00	3.00	2.00	3.00
CLO 4	2.00	2.00	2.00	1.00	3.00	1.00	2.00	1.00	1.00	1.00	1.00	3.00	1.00	1.00
CLO 5	2.00	3.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00	2.00	1.00	3.00	2.00	3.00
Weighted Average	2.25	2.25	1.25	1.25	1.50	1.25	1.50	1.75	2.00	1.75	1.00	3.00	1.50	2.00

i. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	-	3	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination.

j. Course Content:

Sr.	Topics	Weightage (%)	Teaching hours
1	**Solar Energy** Solar Map of India: Global solar power radiation, Different types of Solar water heaters, Construction, working, specifications and installation, Solar Heating systems, Solar drying and different types of Solar cookers Solar lighting, Preventive maintenance of all of the above.	15	6
2	**Concentrated Solar Power (CSP)** Concentrated Solar Power (CSP) plants or solar thermal electric systems, Parabolic Trough: Construction, working and specifications, Parabolic Dish: Construction, working and specifications, Power Tower, Fresnel Reflectors: Construction, working and specifications, Solar Stirling engines, Preventive maintenance of all of the above	20	8
3	**Solar PV Systems** Solar PV cell: Types construction, working, Typical specifications of solar cells, Solar PV working principle: Series and parallel	20	8

	connections of solar modules, Solar Photovoltaic (PV) system: components layout and working., Solar modules, arrays and their standard specifications, Roof top and streetlight solar PV systems and typical specifications, Maintenance of these systems		
4	**Solar PV Electronics** Solar Charge controllers: working and specifications, switchgear and cables, Batteries: Different types for solar PV systems, maintenance and specifications, Solar Inverters: working and specifications, Signal conditioning systems: working and specifications, Solar Power tracking: construction, working, tilt angle, solar radiation, I-V, P-V characteristics, maximum power point tracking (MPPT), Maintenance of these systems.	**25**	**12**
5	**Solar PV Off-grid and Grid Tied Systems** Solar off grid systems: layout and specifications, Solar Grid tied (on grid) systems: Working principle of grid-tied dc-ac inverter, grid synchronization and active power export, Net metering: main features and working Solar-wind Hybrid systems: Layout and specifications.	**20**	**8**

k. Text Book and Reference Book:

1. Solar Photovoltaics: Fundamentals, Technologies and Applications By Solanki, Chetan Singh
2. Renewable Energy Technologies By Solanki, Chetan Singh | PHI Learning, New Delhi, 2010
3. Renewable Energy Sources and Emerging Technologies By Kothari, D.P | PHI
4. Energy Technology By O.P. Gupta | Khanna Publishing House

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a. Course Name: Solar Power Technologies Lab

b. Course Code: 03607286

c. Prerequisite: Basic practical knowledge of solar related experiments.

d. Rationale: This course aims to teach students practical knowledge related to solar related latest technology.

e. Course Learning Objective:

CLOBJ 1	Develop the ability to identify various solar non-electric equipment, demonstrating proficiency in recognizing and naming essential components within solar energy systems.
CLOBJ 2	Acquire skills in troubleshooting Concentrated Solar Power (CSP) plants and solar Photovoltaic (PV) systems, demonstrating the capability to analyze system issues, identify root causes, and implement effective solutions.
CLOBJ 3	Gain practical knowledge and competence in undertaking the maintenance of solar PV electronics and Maximum Power Point Tracking (MPPT) systems,

	ensuring the reliable and efficient operation of these critical components within solar energy infrastructure.
CLOBJ 4	Develop a comprehensive understanding of the working principles of off-grid and on-grid solar power plants, coupled with the ability to evaluate and optimize their performance for enhanced efficiency and sustainability.

f. Course Learning Outcomes:

CLO 1	Identify the solar non-electric equipment.
CLO 2	Troubleshoot CSP plants. Troubleshoot a solar PV system.
CLO 3	Undertake the maintenance of solar PV electronics and MPPT systems
CLO 4	Understand and optimized working of off-grid and on- grid solar power plants.

g. Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes	
CLO 1	Identify the solar non-electric equipment.
CLO 2	Troubleshoot CSP plants. Troubleshoot a solar PV system.
CLO 3	Undertake the maintenance of solar PV electronics and MPPT systems
CLO 4	Understand and optimized working of off-grid and on- grid solar power plants.

h. Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Outcomes:

CLOs	**PLOs**												**PSO**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CLO 1	3.00	2.00	2.00	2.00	1.00	1.00	1.00	1.00	2.00	1.00	2.00	2.00	2.00	2.00
CLO 2	3.00	3.00	2.00	2.00	2.00	1.00	1.00	1.00	2.00	1.00	2.00	1.00	2.00	2.00
CLO 3	3.00	2.00	3.00	2.00	2.00	1.00	1.00	1.00	2.00	1.00	2.00	1.00	2.00	2.00
CLO 4	3.00	2.00	2.00	3.00	2.00	2.00	2.00	1.00	2.00	2.00	1.00	1.00	2.00	2.00
Weighted Average	3.00	2.25	2.25	2.25	1.75	1.25	1.25	1.00	2.00	1.25	1.75	1.25	2.00	2.00

i. Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
0	**-**	**2**	**1**	**-**	**-**	**50**	**-**	**-**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

j. Text Book and Reference Book:

1. Solar Photovoltaics: Fundamentals, Technologies and Applications by Solanki, Chetan Singh
2. Renewable Energy Technologies by Solanki, Chetan Singh | PHI Learning, New Delhi, 2010
3. Renewable Energy Sources and Emerging Technologies by Kothari, D.P | PHI
4. Energy Technology by O.P. Gupta | Khanna Publishing House

k. Mapping of Experiment List with Course Learning Outcomes:

Exp. No.	Name of the Experiment
1	Prepare report after watching video of dismantle solar power heaters
2	Prepare report after watching video of assemble solar power heaters
3	Prepare report after watching video of assemble the parabolic dish CSP plant
4	Prepare report after watching video of dismantle the parabolic dish CSP plant.
5	Troubleshoot a CSP plant
6	Prepare report after watching video of assemble the solar PV system.
7	Prepare report after watching video of dismantle the solar PV system
8	Troubleshoot a solar PV system
9	Troubleshoot a solar PV panels and arrays
10	Troubleshoot solar signal conditioners
11	Troubleshoot solar PV MPPT systems
12	Troubleshoot solar off-grid systems
13	Troubleshoot solar net metering systems
14	Troubleshoot solar-wind hybrid systems.

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a. Course Name: - Biomass and Micro Hydro Power Plants

b. Course Code: 03607287

c. Prerequisite: Basic knowledge of electrical machines

d. Rationale: The course introduces basics of Renewable energy. The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences: Maintain the efficient operation of various types of Biomass and Micro hydro power plants

e. Course Learning Objective:

CLOBJ 1	Classify and differentiate between updraft, downdraft, and fluidized bed gasifiers.

CLOBJ 2	Analyze the working principle of single-phase induction motors, focusing on the role of a single-phase power supply and starting methods.
CLOBJ 3	Identify key components, including turbines, generators, and control systems, in a micro hydro power plant.
CLOBJ 4	Explain methods for integrating large wind power plants into the electrical grid for stability.
CLOBJ 5	Classify turbines (steam, gas, hydraulic) based on construction and applications. Evaluate turbine efficiency, considering design parameters and working conditions.

f. Course Learning Outcomes:

CLO 1	Understand the Construction and working of different types of gasifiers
CLO 2	Understand the preventive maintenance of different types of biomass gasifiers
CLO 3	Understand the working of micro hydro power plant
CLO 4	Understand the working of large wind power plant
CLO 5	Understand the construction and working of different types of turbines.

g. Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes	
CLO 1	Understand the Construction and working of different types of gasifiers
CLO 2	Understand the preventive maintenance of different types of biomass gasifiers
CLO 3	Understand the working of micro hydro power plant
CLO 4	Understand the working of large wind power plant
CLO 5	Understand the construction and working of different types of turbines.

h. Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Outcomes:

CLOs	**PLOs**												**PSO**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CLO 1	3.00	3.00	2.00	1.00	1.00	1.00	2.00	1.00	1.00	3.00	1.00	3.00	1.00	1.00
CLO 2	3.00	2.00	2.00	1.00	2.00	2.00	2.00	1.00	3.00	3.00	1.00	3.00	1.00	2.00
CLO 3	3.00	3.00	2.00	1.00	1.00	3.00	2.00	2.00	2.00	2.00	2.00	3.00	2.00	3.00
CLO 4	3.00	2.00	2.00	2.00	1.00	2.00	1.00	2.00	2.00	3.00	3.00	3.00	2.00	3.00
Weighted Average	3.00	2.50	2.00	1.25	1.25	2.00	1.75	1.50	2.00	2.75	1.75	3.00	1.50	2.25

i. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	-	3	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

j. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**Basics of Biomass-based Power Plants** Properties of solid fuel for biomass power plants: bagasse, wood chips, rice husk, municipal waste Properties of liquid and gaseous fuel for biomass power plants, Jatropha, bio-diesel gobar gas Layout of a Bio-chemical based (e.g. biogas) power plant, Layout of a Thermo-chemical based (e.g. Municipal waste) power plant Layout of a Agrochemical based (e.g. bio-diesel) power plant Selection of biomass power plants.	20%	8
2	**Biomass Gasification Power Plants** The basic principle to convert Agriculture and forestry products and wood processing remains (including rick husks, wood powder, branches, offcuts, corn straws, rice straws, wheat straws, cotton straws, fruit shells, coconut shells, palm shells, bagasse, corncobs) into combustible gas General Construction and working of a typical gasifier Power generating in gas engine: Strengths and limitations of Agriculture and forestry products gasifier Preventive maintenance steps, Different types of biomass gasifiers.	25%	10
3	**Different Types of Gasifiers** Construction and working of the following types of gasifiers, Rice Husk Gasification Power Plant and their specifications, Straw Gasification Power Plant and their specification, Bamboo Waste, Bamboo Chips Gasification Power Plant and their specifications, Coconut shell, coconut peat, coconut husk, Gasification Power Plant and their specifications, Bagasse/Sugar Cane Trash Gasification Power Plant and their specifications, Gobar	25%	10

	gas plant and its specifications, Breakdown maintenance of biomass power plant at the module level.		
4	**Micro-hydro Power Plants** Locations of micro hydro power plant, Energy conversion process of hydro power plant., Classification of hydro power plant: High, medium and low head. General Layouts of typical micro-hydro power plant., Strengths and limitations of micro hydro power plants	**15%**	**7**
5	**Different types of Micro-hydropower plants** Construction and working of High head – Pelton turbine and their specifications, Construction and working of medium head – Francis turbine and their specifications, Construction and working of Low head – Kaplan turbine and their specifications, Preventive and breakdown maintenance of micro-hydro power plants Safe Practices for micro-hydro power plants.	**15%**	**7**

k. Text Book and Reference Book:

1. Biogas Technology: Towards Sustainable Development By Khoiyangbam, R S Navindu; Gupta and Sushil Kumar | TERI, New Delhi
2. Renewable Energy Systems By David M. Buchla; Thomas E. Kissell; Thomas L. Floyd | Pearson Education New Delhi
3. Renewable Energy Sources and Emerging Technologies By Kothari, D.P. et aL | PHI
4. Wind Power Technologies, By Rachel, Sthuthi, Earnest, Joshua | PHI Learning, New Delhi

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a. Course Name: Biomass and Micro Hydro Power Plants Lab

b. Course Code: 03607288

c. Prerequisite: Basic Knowledge of Biomass and Micro Hydro Power Plant

d. Rationale: The course introduces basics of Renewable energy. The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences: Maintain the efficient operation of various types of Biomass and Micro hydro power plants.

e. Course Learning Objective:

CLOBJ 1	By the end of the course, students will be able to recognize and name the key components of different biomass and hydro power plants, demonstrating a comprehensive understanding of their structures and functionalities.
CLOBJ 2	Upon completion of the course, participants should be proficient in performing preventive maintenance tasks on various types of biomass

	gasifiers, showcasing the ability to ensure the continuous and efficient operation of these systems.
CLOBJ 3	Students will develop the skills to diagnose and address breakdowns in different types of biomass gasifiers through hands-on training, enabling them to efficiently restore functionality and minimize downtime.
CLOBJ 4	By the end of the course, participants will have a deep understanding of the operational principles of large wind power plants and the expertise to optimize their performance, emphasizing efficiency, reliability, and output.
CLOBJ 5	Participants will gain insights into the intricacies of small wind turbine systems and acquire the knowledge and skills necessary to optimize their functioning, ensuring maximum energy output and operational efficiency.
CLOBJ 6	Upon completion of the course, students will possess a comprehensive understanding of micro hydro power plants, coupled with the ability to optimize their operation for enhanced efficiency and sustainable energy generation.

f. Course Learning Outcomes:

CLO 1	One can able to identify different components of various biomass and hydro power plant.
CLO 2	Undertake the preventive maintenance of different types of biomass gasifiers.
CLO 3	Undertake the breakdown maintenance of different types of biomass gasifiers.
CLO 4	Understand and optimized working of large wind power plants
CLO 5	Understand and optimized working of small wind turbines.
CLO 6	Understand and optimized working of micro hydro power plants.

g. Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes	
CLO 1	One can able to identify different components of various biomass and hydro power plant.
CLO 2	Undertake the preventive maintenance of different types of biomass gasifiers.
CLO 3	Undertake the breakdown maintenance of different types of biomass gasifiers.
CLO 4	Understand and optimized working of large wind power plants
CLO 5	Understand and optimized working of small wind turbines.
CLO 6	Understand and optimized working of micro hydro power plants.

h. Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Outcomes:

CLOs	PLOs												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CLO 1	3.00	2.00	2.00	2.00	1.00	1.00	1.00	1.00	2.00	1.00	2.00	2.00	2.00	2.00
CLO 2	3.00	3.00	2.00	2.00	2.00	1.00	1.00	1.00	2.00	1.00	2.00	1.00	2.00	2.00
CLO 3	3.00	2.00	3.00	2.00	2.00	1.00	1.00	1.00	2.00	1.00	2.00	1.00	2.00	2.00
CLO 4	2.00	2.00	2.00	3.00	2.00	2.00	2.00	1.00	2.00	2.00	1.00	1.00	2.00	2.00
CLO 5	2.00	3.00	2.00	2.00	2.00	1.00	1.00	1.00	2.00	1.00	2.00	1.00	2.00	2.00
CLO 6	3.00	2.00	3.00	2.00	2.00	1.00	1.00	1.00	2.00	1.00	2.00	1.00	2.00	2.00
Weighted Average	2.50	2.25	2.25	2.25	1.75	1.25	1.25	1.00	2.00	1.25	1.75	1.25	2.00	2.00

i. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
0	-	2	1	-	-	50	-	-	50

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

j. Mapping of Experiment List with Course Learning Outcomes:

Sr. NO.	Experiment List
1	Identify different components of a typical Biomass power plant.
2	Identify different biomass resources and evaluate their energy potential
3	Prepare technical report after watching video/visit of assemble the Biogas power plan
4	Prepare technical report after watching video/visit of dismantle the Biogas power plan
5	identify the components of the high head micro hydro power plant
6	Identify the components of the medium head micro hydro power plant
7	Identify the components of the low head micro hydro power plant
8	Prepare technical report after watching video/visit of assemble a high head micro hydro power plant
9	Prepare technical report after watching video/visit of assemble a medium head micro hydro power plant
10	Prepare technical report after watching video/visit of assemble a low head micro hydro power plant

a. **Course Name:** - Wind Power Technologies
b. **Course Code:** 03607289
c. **Prerequisite:** Basic knowledge of Wind power plants and technologies
d. **Rationale:** The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences: Design various kind of wind power plant schemes and charts

e. **Course Learning Objective:**

CLOBJ 1	students will be able to describe the various types of wind power plants and identify the key auxiliaries associated with their operation.
CLOBJ 2	students will possess the skills necessary to perform routine maintenance tasks to ensure the normal working of large wind turbines.
CLOBJ 3	Students will be able to optimize the aerodynamic and electric control systems of large wind power plants, enhancing efficiency and performance
CLOBJ 4	students will demonstrate a comprehensive understanding of the working principles that govern the operation of large wind power plants.
CLOBJ 5	students will be able to explain the construction details and working principles of various types of turbines used in wind power generation.

f. **Course Learning Outcomes:**

CLO 1	Understand the various types of wind power plants and their auxiliaries.
CLO 2	Maintain the normal working of large wind turbines.
CLO 3	Optimize the aerodynamic and electric control of large wind power plants.
CLO 4	Understand the working of large wind power plant
CLO 5	Understand the construction and working of different types of turbines.

g. **Mapping of Course Learning Outcomes and Bloom's Taxonomy:**

Course Learning Outcomes	
CLO 1	Understand the various types of wind power plants and their auxiliaries.
CLO 2	Maintain the normal working of large wind turbines.
CLO 3	Optimize the aerodynamic and electric control of large wind power plants.
CLO 4	Understand the working of large wind power plant
CLO 5	Understand the construction and working of different types of turbines.

h. **Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Outcomes:**

CLOs	PLOs												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CLO 1	3.00	3.00	2.00	1.00	1.00	1.00	2.00	1.00	1.00	3.00	1.00	3.00	1.00	1.00
CLO 2	3.00	2.00	2.00	1.00	2.00	2.00	2.00	1.00	3.00	3.00	1.00	3.00	1.00	2.00
CLO 3	3.00	3.00	2.00	1.00	1.00	3.00	2.00	2.00	2.00	2.00	2.00	3.00	2.00	3.00
CLO 4	3.00	2.00	2.00	2.00	1.00	2.00	1.00	2.00	2.00	3.00	3.00	3.00	2.00	3.00
Weighted Average	3.00	2.50	2.00	1.25	1.25	2.00	1.75	1.50	2.00	2.75	1.75	3.00	1.50	2.25

i. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	-	3	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

j. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**Wind Energy and Wind Power Plants** Wind power scenario in the world and India, Characteristics of Wind Energy: Wind movement, wind profile, roughness, effects of obstacles in wind path., Types of Wind Power Plants (WPPs): Small and large wind turbines; Horizontal and Vertical axis; Upwind and Downwind, One, Two and Three blades; constant and variable Speed; Geared, Direct-Drive and Semi-Geared (Hybrid) WPPs; WECS, WEGs, WTs, WPPs, WPP Tower Types: Lattice; tubular: steel, concrete, hybrid, ladders, cables., WPP substation: Switchgear, transformers, inside layouts of Electric electronic panels at block level	20%	8

2	**Construction and Working of Large Wind Power Plants** Wind Turbine Terminologies: Cut-in, cut-out and survival wind speeds, Threshold wind speeds, rated power, nominal power, Wind Power Curve, Major parts and Functions of WPP: Rotor blades, hub, nacelle, tower, electric sub-station, nacelle layouts of Geared, Direct-Drive and Semi-Geared WPPs, Main shaft, gearbox, electric generator, electronic control panels Rotation principles: Drag and Lift principle, thrust and torque of wind turbine rotor. Different types of Sensors: Anemometer, wind vane, rpm sensors of main shaft and generator, temperature sensors of nacelle, gearbox and generator; cable untwisting and vibration sensors. Different types of Actuators: Electric and hydraulic pitching and yawing mechanisms, cable untwisting and braking mechanisms	**15%**	**7**
3	**Aerodynamic Control, Electric Generators and Grid** Aerodynamic Control of WPPs: Stall Pitch and Active Stall. Braking mechanisms of large WPPs. Electric Generator Types: Working of Squirrel-Cage rotor Induction Generator (SCIG), Wound-Rotor Induction Generator (WRIG), Doubly-Fed Induction Generator (DFIG), wound rotor and permanent magnet synchronous generators. Electric grid connection of WPPs: Local Impacts and system wide impact	**15%**	**7**
4	**Maintenance of Large Wind Power Plants** General maintenance of WPPs: preventive maintenance schedule of actuators such as yaw control, pitch control, braking mechanisms and sensors; oiling and greasing; electric and electronic equipment related; tower related; minor repairs, some tips, Scheduled Maintenance: of Stall and Pitch and Active Pitch controlled WPPs Unscheduled maintenance: operational factors, design faults, wear and tear of components, spurious trip, Major repairs. Software related, warranty and insurance related issues	**10%**	**7**
5	**Construction and Working Small Wind Turbines** Types and working of different type of small wind turbines (SWT): Classification: Horizontal and Vertical axis, Upwind and Downwind, One, Two and Three blades; Constant and Variable Speed; Direct-Drive and Geared; braking of SWTs Parts of SWTs: Rotor, generator, gearbox, tower, electric control panel, tale vane, anemometer, wind vane, temperature and rpm sensors. Working SWTs: Direct-drive and geared. Electrical generators in SWTs: permanent magnet synchronous generators, induction	**15%**	**4**

	generators SWT towers: Lattice tubular type, hydraulic towers, ladders, cables,		
6	**Maintenance of Small Wind Turbines** Small wind turbine assembly. Installation of different types of small wind turbines (SWT): tubular and lattice types. SWT Routine maintenance: Tips; Preventive maintenance schedule of: braking mechanisms, sensors; oiling and greasing related; electric and electronic equipment related; tower related; software related, minor repairs Power	**25%**	**12**

l. Text Book and Reference Book:

1. Wind Turbines Springer-Verlag by Hau, Erich | Berlin Heidelberg, Germany
2. Wind Power Technologies, By Rachel, Sthuthi, Earnest, Joshua | PHI Learning, New Delhi
3. Wind Energy Basics by Gipe, Paul | Chelsea Green Publishing Co
4. Wind Power Plants and Project Development by Wizelius, Tore, Earnest, Joshua | PHI Learning, New Delhi

(17)

a. Course Name: Wind Power Technologies Lab

b. Course Code: 03607290

c. Prerequisite: Basic knowledge of wind power system

d. Rationale: The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences: Design various wind power technologies.

e. Course Learning Objective:

CLOBJ 1	Identify and differentiate between various types of wind power plants and their auxiliaries, with a focus on maintaining the normal functioning of large wind turbines.
CLOBJ 2	Develop skills to optimize both aerodynamic and electric control systems in large wind power plants, ensuring efficient and effective operation.
CLOBJ 3	Acquire troubleshooting expertise to diagnose and rectify common faults in large wind power plants, while also maintaining the regular operation of small wind turbines.
CLOBJ 4	Demonstrate proficiency in troubleshooting small wind turbines, addressing issues to sustain their normal functionality and performance.

f. Course Learning Outcomes:

CLO 1	Identify the various types of wind power plants and their auxiliaries. Maintain the normal working of large wind turbines
CLO 2	Optimize the aerodynamic and electric control of large wind power plants.
CLO 3	Troubleshoot the common faults of large wind power plants. Maintain the normal working of small wind turbines.
CLO 4	Troubleshoot small wind turbines.

g. Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes	
CLO 1	Identify the various types of wind power plants and their auxiliaries. Maintain the normal working of large wind turbines
CLO 2	Optimize the aerodynamic and electric control of large wind power plants.
CLO 3	Troubleshoot the common faults of large wind power plants. Maintain the normal working of small wind turbines.
CLO 4	Troubleshoot small wind turbines.

h. Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Outcomes:

CLOs	**PLOs**												**PSO**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CLO 1	1	3	3	3	3	3	2	2	3	2	3	2	3	1
CLO 2	2	3	3	3	3	3	2	2	3	2	3	2	3	2
CLO 3	3	2	2	3	3	3	2	2	3	3	3	3	3	3
CLO 4	4	3	3	3	3	3	2	2	3	2	3	2	3	4
Weighted Average	2.5	2.75	2.75	3	3	3	2	2	3	2.25	3	2.25	3	2.5

i. Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
0	**-**	**2**	**1**	**-**	**-**	**50**	**-**	**-**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

j. Mapping of Experiment List with Course Learning Outcomes:

Sr. NO.	Experiment List
1	Identify the specified items of a wind farm after watching the video clip
2	Identify the specified parts inside the nacelle of a large wind power plant after watching video clips
3	Check the performance of the PMSG model on MATLAB
4	Troubleshoot the anemometer and wind vane
5	Identify the parts of a direct-drive SWT
6	Identify the parts of a geared SWT
7	Prepare report after watching video or visit of assemble/dismantle a direct-drive SWT
8	Prepare report after watching video or visit of assemble /dismantle a geared SWT
9	Troubleshoot direct-drive SWT
10	Troubleshoot geared SWT

(18)

a. **Course Name:** - Industrial Instrumentation and Condition Monitoring
b. **Course Code:** 03607291
c. **Prerequisite:** Basic knowledge of instrumentation term
d. **Rationale:** This course aims to teach students advanced knowledge related to Industrial Instrumentation and condition monitoring system. The aim of this course is to help the student to attain the following industry identified competency Through various teaching learning experiences. Use instrumentation equipment for condition monitoring and control.

e. **Course Learning Objective:**

CLOBJ 1	students will be able to demonstrate a comprehensive understanding of the construction, working principles, and applications of various switching devices in electronic circuits.
CLOBJ 2	students will possess the skills necessary to perform routine maintenance tasks to ensure the normal working of large wind turbines.
CLOBJ 3	Students will be able to optimize the aerodynamic and electric control systems of large wind power plants, enhancing efficiency and performance
CLOBJ 4	students will demonstrate a comprehensive understanding of the working principles that govern the operation of large wind power plants.
CLOBJ 5	students will be able to explain the construction details and working principles of various types of turbines used in wind power generation.

f. Course Learning Outcomes:

CLO 1	Understand the Construction, working and application of switching devices
CLO 2	Understand the working principle, construction, operation, characteristics and features of transducers.
CLO 3	Select transducers for the measurement of temperature, pressure, speed, vibration, flow, liquid level, displacement, thickness and strain.
CLO 4	Understand basic concept of signal conditioning system
CLO 5	Understand statistical data analysis and computerized data acquisition.
CLO 6	Understand different tests on transformer, circuit breaker, C.T.

g. Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes	
CLO 1	Understand the Construction, working and application of switching devices
CLO 2	Understand the working principle, construction, operation, characteristics and features of transducers.
CLO 3	Select transducers for the measurement of temperature, pressure, speed, vibration, flow, liquid level, displacement, thickness and strain.
CLO 4	Understand basic concept of signal conditioning system
CLO 5	Understand statistical data analysis and computerized data acquisition.
CLO 6	Understand different tests on transformer, circuit breaker, C.T.

h. Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Outcomes:

CLOs	**PLOs**												**PSO**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CLO 1	3.00	3.00	2.00	1.00	1.00	1.00	2.00	1.00	1.00	3.00	1.00	3.00	1.00	1.00
CLO 2	3.00	2.00	2.00	1.00	2.00	2.00	2.00	1.00	3.00	3.00	1.00	3.00	1.00	2.00
CLO 3	3.00	3.00	2.00	1.00	1.00	3.00	2.00	2.00	2.00	2.00	2.00	3.00	2.00	3.00
CLO 4	3.00	2.00	2.00	2.00	1.00	2.00	1.00	2.00	2.00	3.00	3.00	3.00	2.00	3.00
CLO 5	3.00	3.00	2.00	1.00	1.00	3.00	2.00	2.00	2.00	2.00	2.00	3.00	2.00	2.00
CLO 6	3.00	2.00	2.00	2.00	1.00	2.00	1.00	2.00	2.00	3.00	3.00	3.00	2.00	2.00
Weighted Average	3.00	2.50	2.00	1.25	1.25	2.00	1.75	1.50	2.00	2.75	1.75	3.00	1.50	2.25

i. Teaching & Examination Scheme:

Teaching Scheme	**Evaluation Scheme**

L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	-	3	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

j. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**Fundamentals of Instrumentation:** Basic purpose of instrumentation. Basic block diagram (transduction, signal conditioning, signal presentation) and their function. Construction, working and application of switching devices-Push button, Limit switch, Float switch, Pressure switch, Thermostat, Electromagnetic relay	10%	5
2	**Transducers:** Principles and classification of transducers. Advantages of electric transducers. Required characteristics of transducers. Factors affecting the choice of transducers. Construction and principle of resistive transducer Potentiometer – variac and strain gauges- No derivation. Only definition and formula for gauge factor. Types of strain gauges like unboned, bonded and semiconductor. Construction and principle of Inductive transducers- L.V.D.T. and R.V.D.T, their applications. Construction, principle and applications of transducers – Piezo-Electric transducer, photo conductive cells, photo voltaic cells.	15%	7
3	**Measurement of Non-Electrical Quantities:** Temperature measurement – Construction and Working of RTD, Thermistor and Thermocouple, radiation pyrometer, technical specifications and ranges. Pressure measurement – Construction and working of bourdon tube, bellow diaphragm and strain gauge, Combination of diaphragm and inductive transducer, Bourdon tube and LVDT, bellow and LVDT, diaphragm capacitance and bridge Circuit. Construction and Working of Speed Measurement by contacting and non-Contact Type- DC tachometer, photo-electric tachometer and Stroboscope. Construction and Working of Vibration measurement by accelerometer-LVDT accelerometer, Piezo electric type. Construction and Working of Flow measurement by electromagnetic and Turbine Flow meter. Construction and Working of Liquid	25%	10

	level measurement by resistive, inductive, Capacitive gamma rays and Ultrasonic methods. Construction and Working of Thickness measurement by resistive, inductive, capacitive, ultrasonic and nuclear methods.		
4	**Signal Conditioning:** Basic Concept of signal conditioning System. Draw pin configuration of IC 741.Define Ideal OP-AMP and Electrical Characteristics of OP-AMP. Different Parameters of op- amp: -Input offset voltage, Input offset current, Input bias current, Differential input resistance, CMMR, SVRR, voltage gain, output voltage, slew rate, gain bandwidth. Output, short circuit current. Use of op-amp as inverting, non-inverting mode, adder, subtractor, and Working of Differential amplifier and instrumentation amplifier. Filters: Types of RC filters and frequency response -no derivation. Sample and hold circuits – operation and its application.	**20%**	**8**
5	**Data Acquisition System:** Generalized DAS- Block diagram and description of Transducer, signal conditioner, multiplexer, converter and recorder. Draw Single Channel and Multi-channel DAS- Block diagram only. Difference between Signal Channel and Multi-Channel DAS. Data conversion- Construction and Working of Analog to digital conversion- successive approximation method, ramp type method. Digital to Analog conversion- Construction and Working of binary weighted resistance method. Concept of data transmission of electrical and electronic transmission. Principle of Electrical telemetering system Digital display device-operation and its application of seven segment display, dot matrix display, LED and LCD.	**15%**	**7**
6	**Condition Monitoring and Diagnostic Analysis:** Definition of condition monitoring Insulation deterioration Mechanism- factors affecting occurrence and rate of deterioration, types of stresses responsible for deterioration. Different tests on transformer, their purpose, and the necessary condition of machine. Tests on Circuit breaker, purpose and required condition of machine. Tests on CT, purpose, item to be tested and required condition of machine. Power factor, capacitance /tan delta test. Insulation and Polarization index, DC winding resistance test, Turns Ratio test. Tools and equipment used in Condition monitoring.	**15%**	**7**

k. Text Book and Reference Book:

1. Electric and Electronic Measurement and instrumentation, By Sawhney, A.K. | Dhanpat Rai and Co. Author, | Nineteenth revised edition 2011 reprint, 2014
2. Instrumentation devices and system By Rangan, C.S. G.R. Sharma. And V.S.V. Mani | Pen ram International Publishing India Pvt. Ltd. | Fifth edition
3. Electronics and instrumentation, By Mehta, V.K. | S. Chand and company Pvt Ltd Reprint, 2010 | Third edition
4. Industrial instrumentation and control, By Singh, S.K. | Tata McGraw-Hill, 1987

(19)

a. Course Name: Industrial Instrumentation and Condition Monitoring Lab

b. Course Code: 03607292

c. Prerequisite: Basic knowledge of instrumentation related lab knowledge

d. Rationale: This course aims to teach students advanced knowledge related to lab of Industrial Instrumentation and condition monitoring system. The aim of this course is to help the student to attain the following industry identified competency Through various teaching learning experiences: Use instrumentation equipment for condition monitoring and control.

e. Course Learning Objective:

CLOBJ 1	Select relevant instruments used for measuring electrical and non-electrical quantities.
CLOBJ 2	Select relevant transducers/sensors for various applications. Use relevant instruments for measuring non-electrical quantities.
CLOBJ 3	Check the signal conditioning and telemetry system for their proper functioning. Use data acquisition systems in various application.
CLOBJ 4	Undertake condition monitoring for diagnostic analysis of electrical equipment.

f. Course Learning Outcomes:

CLO 1	Select relevant instruments used for measuring electrical and non-electrical quantities.
CLO 2	Select relevant transducers/sensors for various applications. Use relevant instruments for measuring non-electrical quantities.
CLO 3	Check the signal conditioning and telemetry system for their proper functioning. Use data acquisition systems in various applications.
CLO 4	Undertake condition monitoring for diagnostic analysis of electrical equipment

g. Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes	
CLO 1	Select relevant instruments used for measuring electrical and non-electrical quantities.

CLO 2	Select relevant transducers/sensors for various applications. Use relevant instruments for measuring non-electrical quantities.
CLO 3	Check the signal conditioning and telemetry system for their proper functioning. Use data acquisition systems in various applications.
CLO 4	Undertake condition monitoring for diagnostic analysis of electrical equipment

h. Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Outcomes:

CLOs	**PLOs**												**PSO**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CLO 1	3	3	3	3	3	2	2	3	2	3	2	3	3	3
CLO 2	3	3	3	3	3	2	2	3	2	3	2	3	3	3
CLO 3	2	2	3	3	3	2	2	3	3	3	3	3	2	2
CLO 4	3	3	3	3	3	2	2	3	2	3	2	3	3	3
Weighted Average	2.75	2.75	3	3	3	2	2	3	2.25	3	2.25	3	2.75	2.75

i. Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
0	**-**	**2**	**1**	**-**	**-**	**50**	**-**	**-**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

j. Mapping of Experiment List with Course Learning Outcomes:

Exp. No.	**Name of the Experiment**
1.	Identify different switches used in instrumentation system.
2.	Measure linear displacement by L.V.D.T.
3.	Measure the strain with the help of strain gauge
4.	Measure temperature by PT-100, thermistor, thermocouple along with simple resistance bridge.
5.	Use Thermocouple to control the temperature of a furnace/machine.
6.	Measure pressure using pressure sensor kit.
7.	Measure angular speed using stroboscope and tachometer.

Exp. No.	Name of the Experiment
8.	Measure the flow using flow meter.
9.	Use op-amp as inverter, non-inverting mode, adder, differentiator and integrator.
10.	Convert digital data into analog data by using analog to digital converters and analog data into digital data by digital to analog converter.
11.	Visit to testing center of electrical testing lab for tan delta and diagnostic tests and determine polarization index
12.	Prepare a Report on various tools and equipment used for condition monitoring of electrical machines.

Semester 5

(1)

l. **Course Name:** Fundamentals of Electrical Switchgear

m. **Course Code:** 03607301

n. **Prerequisite:** Knowledge of basic of Electrical Engineering.

o. **Rationale:** This subject is a core subject and very important for any practicing electrical engineer. The electrical engineer must deal with many switchgears and various elements of power systems. The subject curriculum focuses on the study of fundamentals of switchgears of power system. The subject deals with the principles of circuit breaking and circuit breaker fundamentals. It also covers the working principle of protective switch gears like CT and PT. The topics covered in the curriculum are chosen in such a way that the students get a very good idea of the underlying principles of switchgear of power system.

p. **Course Learning Objective:**

CLOBJ 1	**Understanding CT and PT Principles** Gain a comprehensive understanding of Current Transformers (CT) and Potential Transformers (PT), exploring their fundamental concepts, roles in power systems, and applications in measurement and protection.
CLOBJ 2	**Appreciating the Significance of Neutral Earthing** Develop a profound awareness of the importance of neutral earthing in power distribution systems, emphasizing its role in ensuring system stability, minimizing the risk of electrical faults, and safeguarding against electrical hazards.
CLOBJ 3	**Evaluating Relay Principles and Interrupting Devices** Acquire the skills to compare and assess the merits of various relay principles, hardware configurations, and interrupting devices, enabling informed decision-making in power system protection based on performance criteria.
CLOBJ 4	**Analysing Circuit Breaker Performance for Application Selection**

	Learn to analyse and compare the performance characteristics of different circuit breakers, enabling the ability to make informed selections for specific applications. Consider factors such as fault clearing time, reliability, and environmental impact to ensure optimal circuit breaker choices in power systems.

q. Course Learning Outcomes:

CLO 1	To understand the basic concept of CT and PT.
CLO 2	Students are able to understand the importance of neutral earthing.
CLO 3	Compare merits of various principles, relay hardware and interrupting devices.
CLO 4	Compare the different types of circuit breakers performance based on which selection of circuit breaker can be made for a given

r. Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes	
CLO 1	To understand the basic concept of CT and PT.
CLO 2	Students are able to understand the importance of neutral earthing.
CLO 3	Compare merits of various principles, relay hardware and interrupting devices.
CLO 4	Compare the different types of circuit breakers performance based on which selection of circuit breaker can be made for a given

s. Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Learning Outcomes:

CLOs	**PLOs**												**PSO**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CLO 1	3.00	-	-	-	2.00	-	-	1.00	2.00	-	-	-	3.00	2.00
CLO 2	1.00	1.00	1.00	1.00		3.00	1.00	2.00	1.00	-	-	-	3.00	1.00
CLO 3	2.00	3.00	3.00	2.00	2.00	2.00	1.00	-	2.00	-	1.00	-	2.00	2.00
CLO 4	3.00	3.00	2.00	-	3.00	-	2.00	1.00		-	2.00	-	3.00	2.00
Weighted Average	2.25	1.75	1.5	0.75	1.75	1.25	1	1	1.25	0	0.75	0	2.75	1.75

t. Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	**-**	**-**	**3**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

u. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**C.T. and P.T** Basic Elements of a power system, what is switch Gear? Protective transformer-Necessity, advantage, Difference between protective and instrument transformer. Difference between C.T. and P.T., Difference between power transformer and current transformer; C.T. and P.T.: specification, construction, error, ratted primary and secondary current, rated output, terminal marking, connection, precautions.	**25%**	**10**
2	**Neutral Earthling** Current Limiting reactor, Location of current limiting reactor, Isolated neutral system, Neutral Earthling- importance, disadvantages, advantages, Methods of neutral earthling, Earthling Transformer, Neutral Grounding Practice.	**25%**	**10**
3	**Protective Relays** Selectivity, Speed, Sensitivity, Reliability, Simplicity, Economy. Basic relay terminology- Protective relay, Relay time, pick up, reset current, current setting, plug setting multiplier, Time setting multiplier. Protective relays: Classification, principle of working, construction and operation of – Electromagnetic (Attracted armature type, Solenoid type, Watt-hour meter type) relay, Thermal relay. Block diagram and working of Static relay. Overcurrent relay-Time current characteristics. Microprocessor based over current relays: Block diagram, working. Distance relaying- Principle, operation of Definite distance relays. Directional relay: Need and operation. Operation of current and voltage differential relay.	**25%**	**10**
4	**Circuit Interruption Devices** Isolators- Vertical break, Horizontal break, and Pantograph type. Fuse in electric circuit: fuse element, fuse current rating, minimum fusing current, cut-off current, fusing factor, Fuse material Types of fuses –Re-wirable, cartridge fuses (HRC and LRC), Fuse material Selection of fuse. HRC fuses – Construction, working, characteristics and applications. Arc formation process, methods of arc	**25%**	**12**

	extinction (High resistance and Low resistance), Arc voltage, Recovery voltage, Re-striking voltage, RRRV. HT circuit breakers (Sulphur-hexa Fluoride (SF6), Vacuum circuit breaker) – Working, construction, specifications, and applications. L.T. circuit breaker (Air circuit breakers (ACB), Miniature circuit breakers (MCB), Moulded case circuit breakers (MCCB) and Earth leakage circuit breaker (ELCB)) – Working and applications. Selection of LT and HT circuit breakers (ratings), Selection of MCCB for motors. Gas insulated switchgear.		

v. Text Book and Reference Book:

1. Principles of Power System by V. K. Mehta Rohit Mehta | S. Chand.
2. Switchgear And Protection by S. S. Rao | Khanna publication.
3. Power System Protection by B. Ram, Chander | TMH publication.

(2)

a. Course Name: Summer Internship

b. Course Code: 03607306

c. Prerequisite: Zeal to learn the Subject.

d. Rationale: Students will they do internship in social sector/ Govt. initiated social schemes/NGOs etc. The aim of this Internship program is to develop social emotions, awareness, and values.

e. Course Learning Objective:

CLOBJ 1	**Ethical Transformation and Community Engagement** Develop a deep understanding of ethical values and community engagement through education, aiming to transform students into responsible citizens capable of positively influencing and inspiring others.
CLOBJ 2	**Economic Awareness and Societal Contribution** Gain a comprehensive knowledge of the economic landscape and the role of work in contributing to societal progress and economic stability, fostering an awareness of the broader implications of individual contributions.
CLOBJ 3	**Social Skills and Effective Communication** Cultivate essential social skills through participation in collaborative projects and interpersonal interactions, aiming to shape individuals with adaptable attitudes and effective communication abilities crucial for success in diverse life situations.
CLOBJ 4	**Real-world Responsibility and Professional Attributes**

	Engage in internships to expose students to real-world responsibilities, with a focus on enhancing attributes such as accountability, time management, and professional ethics, essential for building a successful and responsible career.
CLOBJ 5	**Building a Robust Professional Profile** Develop skills and experiences that contribute to a well-rounded professional profile, recognizing that education not only imparts knowledge but also serves as a tangible asset, making resumes more appealing to prospective employers.

f. Course Learning Outcomes:

CLO 1	Turns students into role models for society
CLO 2	Learn to appreciate work and its function in the economy.
CLO 3	Develop social habits and attitudes necessary in life.
CLO 4	Internship experience makes you more responsible.
CLO 5	Adds value to the resume

g. Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes	
CLO 1	Turns students into role models for society
CLO 2	Learn to appreciate work and its function in the economy.
CLO 3	Develop social habits and attitudes necessary in life.
CLO 4	Internship experience makes you more responsible.
CLO 5	Adds value to the resume

h. Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Learning Outcomes:

CLOs	**PLOs**												**PSO**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CLO 1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	-	-	-	1.00	1.00	1.00	1.00
CLO 2	1.00	2.00	1.00	1.00	3.00	1.00	1.00	-	1.00	-	2.00	1.00	1.00	1.00
CLO 3	1.00	2.00	-	1.00	1.00	-	1.00	1.00	1.00	-	2.00	1.00	1.00	1.00
CLO 4	2.00	3.00	3.00	-	3.00	1.00	2.00	3.00	-	2.00		3.00	1.00	1.00
CLO 5	2.00	-	3.00	-	3.00	1.00	2.00	-	1.00	-	3.00	3.00	3.00	3.00
Weighted Average	1.4	1.6	1.6	0.6	2.2	0.8	1.4	0.8	0.6	0.4	1.6	1.8	1.4	1.4

i. Teaching & Examination Scheme:

Teaching Scheme	**Evaluation Scheme**

L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
-	-	-	2	-	-	100	-	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

(3)

a. **Course Name:** Major Project – I
b. **Course Code:** 03607308
c. **Prerequisite:** Zeal to learn the Subject.
d. **Rationale:** The main aim of this subject is to transform theoretical knowledge into practical.
e. **Course Learning Objective:**

CLOBJ 1	**Practical Application Mastery** Apply theoretical knowledge to real-world scenarios, equipping students with the skills to transform abstract concepts into practical applications, showcasing a nuanced understanding of implementation across diverse contexts.
CLOBJ 2	**Innovation and Creative Problem-Solving** Generate innovative solutions by fostering creative thinking and problem-solving skills, empowering students to approach challenges with inventive strategies, thus contributing to advancements and ingenuity in their field.
CLOBJ 3	**Instilling a Lifelong Learning Mindset** Cultivate a sense of curiosity and enthusiasm for learning, encouraging intrinsic motivation that propels continuous exploration and discovery. This objective aims to nurture a sustained passion for acquiring new knowledge throughout the students' careers.
CLOBJ 4	**Leadership and Collaborative Problem-Solving Proficiency** Demonstrate effective leadership and problem-solving skills within collaborative environments. This objective guides students in leading teams, navigating challenges, and devising strategic solutions through critical thinking and analytical prowess.

f. **Course Learning Outcomes:**

CLO 1	Makes Transformation of Theoretical Knowledge and its Applications.
CLO 2	Improves Innovative Spirit.
CLO 3	Boosts Curiosity and Liking for Studies
CLO 4	Improves Team Leading and Problem-Solving Skills

g. **Mapping of Course Learning Outcomes and Bloom's Taxonomy:**

Course Learning Outcomes	
CLO 1	Makes Transformation of Theoretical Knowledge and its Applications.
CLO 2	Improves Innovative Spirit.
CLO 3	Boosts Curiosity and Liking for Studies
CLO 4	Improves Team Leading and Problem-Solving Skills

h. Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Learning Outcomes:

CLOs	PLOs												PSO	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CLO 1	3.00	3.00	3.00	3.00	3.00	2.00	1.00	3.00	3.00	3.00	2.00	3.00	3.00	1.00
CLO 2	3.00	3.00	3.00	3.00	3.00	2.00	1.00	3.00	3.00	3.00	2.00	3.00	2.00	2.00
CLO 3	2.00	2.00	2.00	2.00	2.00	3.00	1.00	3.00	3.00	3.00	2.00	3.00	1.00	1.00
CLO 4	3.00	3.00	3.00	3.00	3.00	3.00	2.00	3.00	3.00	3.00	3.00	3.00	3.00	2.00
Weighted Average	2.75	2.75	2.75	2.75	2.75	2.5	1.25	3	3	3	2.25	3	2.25	1.5

i. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
-	**-**	**12**	**6**	**-**	**-**	**60**	**-**	**40**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

4)

b. Course Name: Microcontroller Application Lab
c. Course Code: 03608314
d. Prerequisite: Basic knowledge of Industrial automation
e. Rationale: This course aims to teach students advanced knowledge of industrial automation environment

Course Learning Objective:

CLOBJ 1	understanding of binary arithmetic principles to effectively utilize microprocessor capabilities for mathematical computation.

CLOBJ 2	achieve proficiency in programming by utilizing various addressing modes and data transfer instructions specific to the target microprocessor and microcontroller.
CLOBJ 3	develop a critical understanding of the differences between various standards and guidelines and their implications for selecting appropriate microprocessors and microcontrollers for specific applications.

f. Course Learning Outcomes:

CLO 1	Assess and solve basic binary math operations using the microprocessor and explain the microprocessors and Microcontroller's
CLO 2	internal architecture and its operation within the area of manufacturing and performance.
CLO 3	Apply knowledge and demonstrate programming proficiency using the various addressing modes and data transfer instructions

g. Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes	
CLO 1	Lectures and readings can cover industry standards and guidelines relevant to microprocessors and microcontrollers.
CLO 2	Case studies can present scenarios where students must choose the most suitable microprocessor or microcontroller for given performance requirements.
CLO 3	Practical exercises can involve analysing datasheets and technical specifications to understand how different features impact performance and suitability for specific applications.

h. Mapping of Course Learning Outcomes and Program Learning Outcomes and

CLOs	**PLOs**												**PSO**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CLO 1	3.00	3.00	2.00	2.00	2.00	2.00	2.00	1.00	1.00	-	-	-	2.00	2.00
CLO 2	3.00	3.00	2.00	2.00	2.00	1.00	2.00	1.00	1.00	-	-	-	2.00	2.00
CLO 3	3.00	3.00	2.00	2.00	2.00	2.00	2.00	1.00	1.00	-	-	-	2.00	2.00
Weighted Average	3.00	2.60	2.00	2.00	2.00	1.80	2.00	1.00	1.00	-	-	-	2.00	2.00

Program Specific Learning Outcomes:

Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
-	-	2	1	-	-	30	-	20	50

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation- Continuous Evaluation, **ESE-** End Semester Examination.

i. Mapping of Experiment List with Course Learning Outcomes:

Sr. NO.	Experiment List
1	identify and connect various switches and sensors.
2	Implement START STOP logic using two inputs and one output.
3	Developed a ladder program for a timer relay (TON) and counter application.
4	Implement AC motor speed control with Variable Frequency Drive (VFD
5	Measure and control the temperature of a liquid using an automation module.
6	Develop and test a ladder program for conveyor control.
7	configure Human-Machine Interface (HMI) for system monitoring and control
8	Develop and test a ladder program using advanced PLC features
9	Develop and test a ladder program for lift control.
10	Develop and test a ladder program for servo motor control
11	Develop and test a ladder program for servo motor control.
12	develop and test a ladder program and configure advanced PLC and HMI.
13	Develop and test a ladder program for a basic industrial process using advanced PLC features. Configure an HMI for monitoring and control.

(5)

a. **Course Name:** Microcontroller and Application
b. **Course Code:** 03608315
c. **Prerequisite:** Knowledge of basic of Electrical Engineering.
d. **Rationale:** Microcontroller is the sole of all embedded electronic equipment and is used in most of the areas of electronics. They include product ranges from tiny consumer electronic products to complex industrial process controllers. A diploma engineer needs to maintain such systems. Programming practices will further help the students to develop indigenous microcontroller-based applications. Hence this course is designed to achieve the above.
e. **Course Learning Objective:**

CLOBJ 1	**Comparative Analysis of Microcontrollers and Microprocessors**

	Analyse the unique components of microcontrollers and microprocessors, fostering a critical understanding of their architectural distinctions to enable students to assess their suitability for specific applications.
CLOBJ 2	**Practical Application of Microcontroller 8051 Hardware Concepts** Apply hardware concepts in the design and programming of microcontroller 8051, ensuring students can implement theoretical knowledge into practical applications, thereby enhancing their proficiency in embedded systems development.
CLOBJ 3	**Efficient Algorithm Design for Data Transfer Operations** Create algorithms for optimizing data transfer operations, requiring students to synthesize their understanding of microcontroller architecture and programming, showcasing their ability to design effective data communication strategies.
CLOBJ 4	**Robust Control Structure Design for Microcontroller Programming** Design algorithms for arithmetic, logical, branching, and looping operations, demanding students to synthesize and evaluate their knowledge, demonstrating competency in developing robust and optimized control structures in microcontroller programming.
CLOBJ 5	**Integration of Peripheral Devices in Embedded Systems** Integrate diverse peripheral devices with microcontroller 8051, necessitating students to synthesize knowledge, apply interface protocols, and evaluate the compatibility of peripherals. This objective showcases proficiency in real-world embedded system integration.

f. Course Learning Outcomes:

CLO 1	Compare the different blocks of microcontroller with microprocessor.
CLO 2	Use hardware concepts of microcontroller 8051
CLO 3	Develop logic for data transfer operations.
CLO 4	Develop logic for arithmetic, logical, branching and looping operations.
CLO 5	Interface various peripheral devices and systems with microcontroller 8051

g. Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes	
CLO 1	Compare the different blocks of microcontroller with microprocessor.
CLO 2	Use hardware concepts of microcontroller 8051
CLO 3	Develop logic for data transfer operations.
CLO 4	Develop logic for arithmetic, logical, branching and looping operations.
CLO 5	Interface various peripheral devices and systems with microcontroller 8051

h. Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Learning Outcomes:

CLOs	PLOs												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CLO 1	3.0	-	-	-	-	2.0	-	-	-	-	-	-	1.0	1.0
CLO 2	3.0	1.0	3.0	1.0	1.0	1.0	1.0	3.0	-	-	-	-	1.0	1.0
CLO 3	1.0	3.0	-	2.0	2.0	-	2.0	1.0	-	-	-	-	1.0	1.0
CLO 4	1.0	3.0	3.0	2.0	3.0	-	3.0	2.0	-	-	-	-	1.0	1.0
CLO 5	-	3.0	3.0	-	-	2.0	-	-	-	-	-	-	1.0	1.0
Weighted Average	1.6	2	1.8	1	1.2	1	1.2	1.2	0	0	0	0	1.0	1.0

i. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	-	3	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

j. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**Introduction of Microcontroller Microprocessor** general idea and Block diagram, Introduction to Microcontroller, Block diagram of a Microcontroller.	15%	03
2	**Architecture of Microcontroller 8051** Block diagram of 8051, function of each block, Pin diagram, function of each pin, Concept of Internal memory, and External memory (RAM and ROM), Internal RAM structure, Reset and clock circuit, Various registers and SFRs of 8051	25%	09
3	**8051 Instruction Set and Programs** Overview of 8051 instruction set, Various addressing modes, Classification of instructions, Data transfer instructions, Arithmetic instructions, Logical instructions, branching instructions, Bit manipulation instructions, Stack, subroutine and interrupt related instructions, Programs based on above instructions.	30%	10

4	**Assembly Language Programming** Software development steps, Software development tools like Editor, Assembler, Linker, Loader and Hex converters, Role of various files created at various levels in running an Assembly program using simulators like RIDE or KEIL, Various directives of Assembly language programming, Programs using directives.	**10%**	**02**
5	**8051 Interfacing** Interface LED & LCD display, Interface keyboards to 8051 based Micro controllers, Interface the micro controller System to A/D and D/A Converters.	**20%**	**04**

k. Text Book and Reference Book:

1. The 8051 Microcontroller and Embedded Systems by Muhammad Ali Mazidi, Janice Gillispie Mazidi, and Rolin D. McKinlay | Pearson Publication.
2. PIC Microcontroller and Embedded Systems: Using Assembly and C for PIC18 by Muhammad Ali Mazidi, Rolin D. McKinlay, and Danny Causey | Pearson Publication.
3. ARM Microcontroller Interfacing: Hardware and Software by Warwick A. Smith | CRC Press Publication.

(6)

a. Course Name: Fundamental of Internet of Things

b. Course Code: 03606287

c. Prerequisite: Basic knowledge of computer networks.

d. Rationale: Fundamental of Internet of Things (FioT) is presently an important technology with wide ranging interest from Government, academia, and industry. IoT cuts across different application domain verticals ranging from civilian to defence sectors which includes agriculture, space, health care, manufacturing, construction, water, mining, etc.

e. Course Learning Objective:

CLOBJ 1	Acquire foundational knowledge of IoT concepts, demonstrating the ability to identify key components and principles through comprehension and recall, establishing a solid understanding of fundamental IoT concepts.
CLOBJ 2	Develop analytical skills to evaluate communication protocols and sensor networks, enabling the differentiation, categorization, and assessment of various IoT connectivity methods for optimal data transmission.
CLOBJ 3	Demonstrate practical application and synthesis of diverse IoT techniques, showcasing the capability to implement various approaches in real-world scenarios, fostering hands-on understanding and proficiency in deploying IoT solutions.

CLOBJ 4	Engage in critical thinking and analysis to assess and appraise emerging trends and technologies in IoT, cultivating the ability to judge, critique, and make informed decisions about the adoption of novel advancements in the field.

f. Course Learning Outcomes:

CLO 1	Understand basics of internet of things.
CLO 2	Analyze communication protocol and network sensors.
CLO 3	Apply different IOT techniques.
CLO 4	Evaluate new trends and technologies in IOT

g. Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes	
CLO 1	Understand basics of internet of things.
CLO 2	Analyze communication protocol and network sensors.
CLO 3	Apply different IOT techniques.
CLO 4	Evaluate new trends and technologies in IOT

h. Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Learning Outcomes:

CLOs	**PLOs**												**PSO**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CLO 1	3.00	1.00	1.00	1.00	1.00	3.00	3.00	1.00	2.00	-	3.00	-	3.00	1.00
CLO 2	2.00	3.00	2.00	2.00	3.00	1.00	2.00	3.00	1.00	-	2.00	-	3.00	3.00
CLO 3	1.00	1.00	3.00	1.00	1.00	2.00	1.00	2.00	3.00	-	1.00	-	2.00	3.00
CLO 4	1.00	1.00	1.00	2.00	1.00	1.00	1.00	1.00	1.00	-	2.00	-	2.00	2.00
Weighted Average	1.75	1.5	1.75	1.5	1.5	1.75	1.75	1.75	1.75		2.00		2.5	2.25

i. Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	**-**	**-**	**3**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

j. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**Introduction to Internet of Things** Define the term "Internet of Things", State the technological trends which have led to IoT, Describe the impact of IoT on society, IoT Protocols, IoT communication Models.	**15%**	**06**
2	**Design consideration of IoT** Enumerate and describe the components of an embedded system, Describe the interactions of embedded systems with the physical world, Name the core hardware components most used in IoT devices, Communication Protocols, Sensor networks	**30%**	**14**
3	**Interfacing by IoT devices** Describe the interaction between software and hardware in an IoT device, Explain the use of networking and basic networking hardware, Describe the structure of the Internet, Application of IoT, Introduction of Raspberry pi, Introduction of Arduino.	**30%**	**14**
4	**Ethics in IoT** Characterizing the IoT, Importance of IoT privacy, Security, Environment – Physical thing, Electronics, Internet service.	**25%**	**8**

k. Text Book and Reference Book:

1. Internet of Things (A Hands-on-Approach) by y Vijay Madisetti and Arshdeep Bhaga| VPT.
2. Internet of things- from research and innovation to market deployment by By Dr. Ovidiu Ver mason | river publishers

(7)

a. Course Name: Electrical Testing and Commissioning

b. Course Code: 03607331

c. Prerequisite: Basic knowledge of electrical instruments and testing tools.

d. Rationale: This course aims to teach students advanced methods for testing and commissioning of Electrical Machines.

e. Course Learning Objective:

CLOBJ 1	Implement safety measures in electrical equipment, ensuring compliance with industry standards and procedures for earthing and insulation.
CLOBJ 2	Demonstrate proficiency in selecting and utilizing tools and equipment for the installation, testing, and maintenance of electrical machines and transformers.

CLOBJ 3	Apply knowledge of IS codes to conduct systematic tests and commissioning of electrical equipment, showcasing a comprehensive understanding of industry standards and regulations.
CLOBJ 4	Develop troubleshooting plans for electrical machines using critical thinking and problem-solving skills to identify and address issues systematically.
CLOBJ 5	Create and implement comprehensive maintenance strategies, integrating preventive and breakdown measures for effective long-term equipment management.

f. Course Learning Outcomes:

CLO 1	Follow safety procedures with respect to earthling and insulation of electrical equipment
CLO 2	Select proper tools, equipment, for installation, testing, maintenance of electrical machines and transformers.
CLO 3	Test and commission electrical equipment in accordance with IS codes.
CLO 4	Make plans for troubleshooting electrical machines.
CLO 5	Undertake regular preventive and breakdown maintenance

g. Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes	
CLO 1	Demonstrate a commitment to safety protocols by implementing proper earthing and insulation measures in electrical equipment, ensuring a thorough understanding of safety standards and procedures.
CLO 2	Evaluate and choose appropriate tools and equipment for the installation, testing, and maintenance of electrical machines and transformers, showcasing proficiency in equipment selection and application.
CLO 3	Apply knowledge of IS codes to systematically test and commission electrical equipment, exhibiting a comprehensive understanding of industry standards and regulatory requirements.
CLO 4	Formulate effective troubleshooting plans for electrical machines, utilizing critical thinking and problem-solving skills to identify and address issues systematically.
CLO 5	Develop and implement comprehensive maintenance strategies, integrating preventive and breakdown measures, showcasing proficiency in long-term equipment management.

h. Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Learning Outcomes:

CLOs	PLOs												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CLO 1	3.00	2.00	2.00	3.00	2.00	3.00	2.00	3.00	2.00	2.00	2.00	2.00	3.00	2.00
CLO 2	2.00	3.00	2.00	2.00	3.00	3.00	2.00	2.00	3.00	2.00	2.00	2.00	2.00	3.00
CLO 3	2.00	2.00	3.00	2.00	2.00	2.00	3.00	2.00	2.00	2.00	2.00	2.00	2.00	1.00
CLO 4	2.00	2.00	2.00	3.00	2.00	2.00	2.00	3.00	2.00	2.00	2.00	2.00	3.00	2.00
CLO 5	2.00	2.00	2.00	2.00	3.00	2.00	2.00	2.00	3.00	2.00	2.00	2.00	2.00	3.00
Weighted Average	2.20	2.20	2.20	2.40	2.40	2.40	2.20	2.40	2.40	2.00	2.00	2.00	2.40	2.20

i. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	-	3	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

j. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**Electrical Safety and Insulation** Electrical Safety and Insulation Do's and don'ts regarding safety in domestic electrical appliances as well for substation/power station operators, Electrical safety in industry/power stations/ substations at the time of operation/ control/maintenance, Fire detection alarm, fire-fighting equipment, Factors affecting life of insulating materials, classifications of insulating materials as per IS:1271-1958, Measuring insulation resistance by different methods such as i) Polarization, ii) Dielectric absorption, iii) Megger and to predict the condition of insulation Reconditioning of insulation, Insulating oil – properties of insulating oil, causes of deterioration of oil, testing of transformer oil as per IS 1866-1961.	**20%**	**08**
2	**Installation and Erection** Concept of foundation for installation of machinery. Requirements of foundation for static and rotating electrical machinery, Concept of levelling and aligning Procedure for levelling and aligning alignment of direct	**20%**	**08**

	coupled drive, effects of mis-alignment, Installation of transformer as per I.S.-1886-1967 and procedure of installation of transformer, Requirements of installation of pole mounted transformer, Requirements of installation of rotating electrical machines as per I.S. 900 – 1965, Devices and tools required for loading, unloading, lifting, and carrying heavy equipment and Precautions to be taken while handling them.		
3	**Testing and Commissioning** Concept of testing, Objectives of testing. Roles of I.S.S. in testing of electrical equipment, Types of tests and concepts, Routine tests, type tests, supplementary test, special tests, Methods of testing, Direct/Indirect/Regenerative testing, Tolerances for the various items for equipment –transformer, induction motor, dc motor, synchronous Machines, Commissioning, Tests before Commissioning for transformer, induction motor, alternator, Testing of transformer as per I.S.1886-1967 and I.S.2026- 1962, Testing of three-phase Induction motor as per I.S.325 – 1970. Testing of single-phase induction motor as per I.S.990-1965, Testing of synchronous machines as per ISS, Testing of D.C. machines.	**25%**	**12**
4	**Troubleshooting Plans** Internal and external causes for failure / abnormal operation of equipment. List of mechanical faults, electrical faults and magnetic faults in the electrical equipment, remedies, applications, Use of tools like bearing puller filler gauges, dial indicator, spirit level, megger, earth tester and growler, Common troubles in electrical equipment's and machines, Preparation of trouble shooting charts for D.C. Machines, AC Machines, and transformers.	**15%**	**06**
5	**Maintenance** Concept of maintenance, types of maintenance, Routine, preventive and breakdown maintenance, Causes of failure of electrical machines, Preventive maintenance-procedure or developing maintenance schedules for electrical machines, Factors affecting preventive maintenance schedules, Concept of TPM, Pillars of TPM, Identification of different types of faults developed such as mechanical/ electrical/ magnetic faults, Maintenance schedules of the following as per I.S.S. a) Distribution transformer as per	**20%**	**08**

	I.S.1886-1967 b) Single phase and three phase Induction motors as per I.S.900-1965. C) Batteries.		

k. Text Book and Reference Book:

1. Testing Commissioning Operation & Maintenance of Electrical Equipment's, By S. Rao |Khanna Publication|6th edition (2010).
2. Design And Testing of Electrical Machines by M. V. Deshpande |PHI Learning Pvt. Ltd., 2010 |2010, Pub. Year 2010.

(8)

a. Course Name: Electric Vehicles
b. Course Code: 03607333
c. Prerequisite: Basic Knowledge of Electrical Vehicle
d. Rationale: About this course, Electric vehicles are the future of transportation. Electric mobility has become an essential part of the energy transition, and will imply significant changes for vehicle manufacturers, governments, companies, and individuals. Fulfilling their promise will imply a significant change in the technical, digital, and social dimensions of transport and energy infrastructure.

e. Course Learning Objective:

CLOBJ 1	Explore the evolution of electric vehicles from their inception to present, covering key components like batteries, electric motors, and power electronics.
CLOBJ 2	Analyse the intricate dynamics of hybrid and electric vehicles, focusing on the integration of electric and internal combustion engines, energy regeneration, and overall system optimization for enhanced efficiency.
CLOBJ 3	Demonstrate proficiency in maintaining DC-DC converters in electric vehicles, ensuring their optimal performance to regulate voltage and power distribution within the vehicle's electrical system.
CLOBJ 4	Showcase expertise in maintaining DC-AC converters in electric vehicles, emphasizing the critical role of inverters in converting DC power from the battery to AC power for the electric motor, with a focus on efficiency and reliability.
CLOBJ 5	Gain insights into battery properties, including energy density, voltage, and cycle life, to make informed decisions on battery selection, management, and maintenance in electric vehicles.

f. Course Learning Outcomes:

CLO 1	Understand the basics of electrical vehicle history and components.
CLO 2	Interpret the Dynamics of hybrid and Electric vehicles.
CLO 3	Maintain the DC-DC converters in EV applications.
CLO 4	Maintain the DC-AC converters in EV applications.
CLO 5	Understand the properties of batteries.

g. Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes	
CLO 1	Understand the basics of electrical vehicle history and components.
CLO 2	Interpret the Dynamics of hybrid and Electric vehicles.
CLO 3	Maintain the DC-DC converters in EV applications.
CLO 4	Maintain the DC-AC converters in EV applications.
CLO 5	Understand the properties of batteries.

h. Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Learning Outcomes:

CLOs	**PLOs**												**PSO**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CLO 1	3.00	-	-	-	-	-	-	-	-	-	3.00		3.00	2.00
CLO 2	1.00	3.00	1.00	1.00	1.00	2.00	1.00	1.00	2.00	-	-	3.00	1.00	1.00
CLO 3	1.00	1.00	3.00	-	2.00	3.00	-	-	-		-	-	1.00	1.00
CLO 4	-	2.00	-	3.00		2.00	2.00	2.00	2.00		-	-	1.00	1.00
CLO 5	-	-	-	-	3.00	-	-	-	-	2.00	-	-	1.00	1.00
Weighted Average	0.8	0.6	0.6	0.6	0.6	0.4	0.4	0.4	0.4	0.4	0.6	0.6	1.4	1.2

i. Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	**-**	**-**	**3**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

j. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**Introduction to Hybrid Electric** Vehicles Evolution of Electric vehicles Advanced Electric drive vehicle technology Vehicles-Electric vehicles (EV), Hybrid Electric drive (HEV), Plug in Electric vehicle (PIEV), Components used Hybrid Electric Vehicle Economic and environmental impacts of Electric hybrid vehicle Parameters affecting Environmental and economic analysis Comparative study of vehicles for economic, environmental aspects.	**20%**	**08**
2	**Dynamics of hybrid and Electric vehicles types** General description of vehicle movement Factors affecting vehicle motion- Vehicle resistance, tyre ground adhesion, rolling resistance, aerodynamic drag, equation of grading resistance, dynamic equation Drive train configuration, Automobile power train, classification of vehicle power plant Performance characteristics of IC engine, electric motor, need of gear box Classification of motors used in Electric vehicles Basic architecture of hybrid drive trains, types of HEVs Energy saving potential of hybrid drive trains HEV Configurations-Series, parallel, Series-parallel, complex.	**25%**	**10**
3	**DC-DC Converters for EV and HEV Applications** EV and HEV configuration based on power converters Classification of converters: unidirectional and bidirectional Principle of step-down operation Boost and Buck- Boost converters Principle of Step-Up operation Two quadrant converters; multi quadrant converters.	**25%**	**10**
4	**DC-AC Inverter & Motors for EV and HEVs** DC-AC Converters Principle of operation of half bridge DC-AC inverter (R load, R-L load) Single phase Bridge DC-AC inverter with R load, R-L load Electric Machines used in Evs and HEVs, principle of operation, working & control Permanent magnet motors, their drives, switched reluctance motor Characteristics and applications of above motors.	**15%**	**07**
5	**Batteries** Overview of batteries, Types of batteries, Battery Parameters: Battery Charging, Discharge rate, State of charge, State of Discharge, Depth of Discharge; Technical characteristics, Battery pack Design, Properties of Batteries, alternative novel energy sources-solar photovoltaic cells, fuel cells, super capacitors, overview of	**15%**	**07**

	electronic control unit ECU, Schematics of hybrid drive train, control architecture Regenerative braking in EV.		

k. Text Book and Reference Book:

1. Electric and Hybrid Vehicles: Design Fundamentals by Iqbal Husain | CRC Press
2. "Power Electronics: Devices, Circuits, and Industrial Applications" by V. R. MOORTHI | Oxford University Press, USA.
3. "Power Electronics: Devices, Converters, Applications" by V. Subrahmanyam | "NEW AGE INTERNATIONAL PUBLISHERS LTD.-NEW DELHI".
4. Power Electronics – Circuits, Devices and Applications by Muhammad H. Rashid | Prentice Hall of India

(9)

a. Course Name: Electrical Testing and Commissioning Lab
b. Course Code: 03607332
C. prerequisite: Basic knowledge of electrical instruments and testing tools
d.rationale: This course aims to teach students advanced methods for testing and commissioning of Electrical Machine
e. course Learning Objective:

CLOBJ 1	objective involves the application of knowledge about safety procedures. Students are required to apply these procedures in real-world situations concerning earthing and insulation.
CLOBJ 2	Selecting appropriate tools and equipment involves the practical application of knowledge. Students need to apply their understanding to choose the right tools for specific tasks related to electrical machines and transformers.
CLOBJ 3	Testing and commissioning involve the practical application of knowledge to ensure compliance with standards (IS code). Students need to apply their understanding to carry out these activities effectively
CLOBJ 4	Making plans for troubleshooting requires synthesis and creation. Students need to combine their knowledge of electrical machines with problem-solving skills to create effective plans for addressing issues
CLOBJ 5	Undertaking maintenance involves applying knowledge and skills to perform both preventive and breakdown maintenance activities in practical situations.

1. course Learning Outcome:

CLO 1	Follow safety procedures with respect to earthling and insulation of electrical equipment

CLO 2	elect proper tools, equipment, for installation, testing, maintenance of electrical machines and transformers.
CLO 3	Test and commission electrical equipment in accordance with IS code
CLO 4	Make plans for troubleshooting electrical machines.
CLO 5	Undertake regular preventive and breakdown maintenance

2. Mapping Of Course Learning Outcome and Bloom's Taxonomy:

Course Learning Outcomes	
CLO 1	This outcome involves the application of knowledge. Students need to apply safety procedures in practical situations related to earthing and insulation.
CLO 2	Selecting appropriate tools and equipment requires applying knowledge to specific tasks, demonstrating a practical understanding of the tools needed for installation, testing, and maintenance.
CLO 3	Testing and commissioning activities involve applying knowledge to ensure compliance with standards (IS code). Students need to apply their understanding to carry out these activities effectively.
CLO 4	Making plans for troubleshooting requires the synthesis of knowledge and skills. Students need to create effective plans by combining their understanding of electrical machines with problem-solving skills.
CLO 5	Making plans for troubleshooting requires the synthesis of knowledge and skills. Students need to create effective plans by combining their understanding of electrical machines with problem-solving skills.

3. Mapping of Course Learning Outcomes and Program

CLOs	**PLOs**												**PSO**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CLO 1	3.00	3.00	2.00	1.00	1.00	1.00	2.00	1.00	1.00	3.00	1.00	3.00	1.00	1.00
CLO 2	3.00	2.00	2.00	1.00	2.00	2.00	2.00	1.00	3.00	3.00	1.00	3.00	1.00	2.00
CLO 3	3.00	3.00	2.00	1.00	1.00	3.00	2.00	2.00	2.00	2.00	2.00	3.00	2.00	3.00
CLO 4	3.00	2.00	2.00	2.00	1.00	2.00	1.00	2.00	2.00	3.00	3.00	3.00	2.00	3.00
CLO 5	3.00	2.00	2.00	2.00	1.00	2.00	1.00	2.00	2.00	3.00	3.00	3.00	2.00	3.00
Weighted Average	3.00	2.00	2.00	2.00	1.00	2.00	1.00	2.00	2.00	3.00	3.00	3.00	2.00	3.00

Learning Outcomes and Program Specific Outcomes:

4. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
-	-	2	1	-	-	30	-	20	50

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination.

5. **Mapping of Experiment List with Course Learning Outcomes**

Exp. No.	Name of the Experiment
1	This outcome involves assessing the breakdown strength of transformer oil, which requires critical evaluation and judgment
2	Performing an insulation resistance test involves applying knowledge and skills to carry out a specific test on a motor or transformer
3	Preparing troubleshooting charts requires the synthesis of information and the creation of organized materials for diagnosing issues with electrical machines
4	Measuring impedance voltage and load losses involves applying knowledge and skills to perform specific measurements on a three-phase transformer.
5	Finding regulation and efficiency, and comparing results involve analysing data and drawing conclusions based on the obtained measurements
6	Determining the efficiency of a D.C. machine using Swinburne's test involves applying knowledge to carry out a specific test procedure.
7	Determining the efficiency of a D.C. machine using Hopkinson's test involves applying knowledge to carry out a specific test procedure.
8	Performing a reduced voltage running up test involves applying knowledge and skills to carry out a specific test procedure according to a standard.
9	Measuring no-load losses and no-load current involves applying knowledge and skills to carry out specific measurements on a transformer according to a standard.
10	Performing a no-load test involves applying knowledge and skills to carry out specific measurements on a single-phase Induction motor according to a standard.
11	Performing a temperature rise test involves applying knowledge and skills to carry out a specific test procedure on a single-phase transformer.

(10)

a. **Course Name:** Electric Vehicles Lab
b. **Course Code:** 03607334
c. **Prerequisite:** Basic Knowledge of Electrical Vehicle
d. **Rationale:** About this course, Electric vehicles are the future of transportation. Electric mobility has become an essential part of the energy transition, and will imply significant changes for vehicle manufacturers, governments, companies and individuals. Fulfilling their promise will imply a significant change in the technical, digital and social dimensions of transport and energy infrastructure.

e. Course Learning Objective

CLOBJ 1	This objective involves recalling and understanding factual information about the history of electric vehicles and their basic components.
CLOBJ 2	This objective involves comprehending the characteristics and features of batteries. Students are expected to grasp the fundamental properties of batteries, such as voltage, capacity, charging and discharging characteristics, chemical composition, and other relevant aspects.
CLOBJ 3	This objective involves comprehending the characteristics and features of batteries. Students are expected to grasp the fundamental properties of batteries, such as voltage, capacity, charging and discharging characteristics, chemical composition, and other relevant aspects.
CLOBJ 4	Similar to the second objective, understanding the properties of electrical vehicle drive systems involves comprehending the various aspects and features that characterize these systems.
CLOBJ 5	This objective involves comprehending the concepts related to hybrid electric vehicles. Students need to understand the principles and features that differentiate hybrid electric vehicles from other types

f. course Learning Outcome:

CLO 1	Understand the basics of electrical vehicle history and components.
CLO 2	Understand the properties of batteries.
CLO 3	Understand the electrical machine properties and classifications.
CLO 4	Understand the properties of electrical vehicle drive systems
CLO 5	Understand the concepts of hybrid electric vehicles.

g. Mapping Of Course Learning Outcome and Bloom's Taxonomy:

Course Learning Outcomes	
CLO 1	This learning outcome involves recalling and understanding factual information about the history of electric vehicles and their basic components. It focuses on remembering key details.
CLO 2	This outcome requires students to comprehend the characteristics and features of batteries. It involves understanding the fundamental properties, such as voltage, capacity, charging and discharging characteristics, chemical composition, and other relevant aspects.
CLO 3	Understanding the properties and classifications of electrical machines involves comprehending the basic principles and characteristics that define different types of electrical machines.

CLO 4	Similar to the second outcome, understanding the properties of electrical vehicle drive systems involves comprehending the various aspects and features that characterize these systems.
CLO 5	This learning outcome involves comprehending the concepts related to hybrid electric vehicles. Students need to understand the principles and features that differentiate hybrid electric vehicles from other types.

h. Mapping of Course Learning Outcomes and Program Learning Outcomes and Program outcome:

CLOs	**PLOs**												**PSO**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CLO 1	3.00	3.00	2.00	1.00	1.00	1.00	2.00	1.00	1.00	3.00	1.00	3.00	1.00	1.00
CLO 2	3.00	2.00	2.00	1.00	2.00	2.00	2.00	1.00	3.00	3.00	1.00	3.00	1.00	2.00
CLO 3	3.00	3.00	2.00	1.00	1.00	3.00	2.00	2.00	2.00	2.00	2.00	3.00	2.00	3.00
CLO 4	3.00	2.00	2.00	2.00	1.00	2.00	1.00	2.00	2.00	3.00	3.00	3.00	2.00	3.00
CLO5	3.00	2.00	2.00	2.00	1.00	2.00	1.00	2.00	2.00	3.00	3.00	3.00	2.00	3.00
Weighted Average	3.00	2.50	2.00	1.25	1.25	2.00	1.75	1.50	2.00	2.75	1.75	3.00	1.50	2.25

i. Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
-	**-**	**2**	**1**	**-**	**-**	**30**	**-**	**20**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

j. Mapping of Experiment List with Course Learning Outcomes:

Exp. No.	**Name of the Experiment**
1	Creating a block diagram involves synthesizing knowledge about electric vehicle components and their relationships.
2	Analyzing and comparing vehicles for economic and environmental aspects require a deeper understanding of battery properties and their impact
3	Creating a schematic diagram involves synthesizing knowledge about hybrid electric vehicles and identifying components, linking to understanding electrical machine properties.

Exp. No.	Name of the Experiment
4	Applying knowledge of electrical vehicle drive systems to observe and report on a charging station.
5	Applying knowledge of battery properties to inspect and install an inverter for a lead-acid battery.
6	Understand the properties of batteries
7	Applying knowledge to collect specifications of converters and inverters used in electric vehicles and in a simple electrical circuit.
8	applying knowledge to troubleshoot and maintain electric vehicle batteries.
9	Creating a test procedure involves synthesizing knowledge about the equipment used in electric vehicles.
10	Creating a list of safety procedures and schedules requires synthesizing knowledge about safety procedures in handling hybrid electric vehicles (HEVs) and electric vehicles (Evs).

(11)

Course Name: Electrical Traction

a. **Course Code:** 03607335
b. **Prerequisite:** Knowledge of different electrical motors
c. **Rationale:** The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences. The country is leading towards the railway electrification and also moving towards metro, monorail system. Student is required to know about the electric traction scheme and its latest trends. This subject is offered highlighting the current and future trends in traction systems, auxiliary equipment, electric locomotives, control of traction motors and future trends.

CLOBJ 1	**Introduction of traction layout and system:** Gain a conceptual understanding of speed-time curves and their significance in track electrification systems. Develop knowledge of how different electrification methods affect train speed over time.
CLOBJ 2	**Analysis of speed -time curve for track electrification system:** Acquire analytical skills to interpret and analyse speed-time curves. Understand the relationship between track electrification choices and train speed dynamics.
CLOBJ 3	**Understanding power supply arrangement:** Understand the relationship between track electrification choices and train speed dynamics. Knowledge to improve efficiency and performance in train operations.
CLOBJ 4	**Maintenance of overhead equipment for electrical traction:**

	Develop proficiency in executing maintenance procedures to ensure the reliability and functionality of overhead equipment.
CLOBJ 5	**Maintenance of traction motor &traction lighting system**: Acquire the ability to maintain accurate records of maintenance activities related to traction motors and lighting systems. Develop skills to assess the efficiency of maintenance practices on the reliability and performance of traction motors and lighting systems

d. Course Learning Outcomes:

CLO 1	Interpret the traction layout and its systems.
CLO 2	Analyze about the speed time curve for different track electrification system.
CLO 3	Understand the power supply arrangements.
CLO 4	Maintain the function of the overhead equipment for electric traction.
CLO 5	Maintain the traction motor and train lighting system.

e. Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes	
CLO 1	Interpret the traction layout and its systems.
CLO 2	Analyze about the speed time curve for different track electrification system.
CLO 3	Understand the power supply arrangements.
CLO 4	Maintain the function of the overhead equipment for electric traction.
CLO 5	Maintain the traction motor and train lighting system.

f. Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Learning Outcomes:

CLOs	**PLOs**												**PSO**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CLO 1	3	3	2	1	1	2	2	2	2	2	2	2	3	3
CLO 2	3	3	2	1	1	2	2	2	2	2	2	2	3	3
CLO 3	3	3	3	2	2	3	3	3	3	3	3	3	3	3
CLO 4	2	2	3	3	2	2	3	2	2	2	2	2	2	2
CLO 5	1	1	2	2	3	2	2	2	2	2	2	2	1	1
Weighted Average	2.4	2.4	2.4	1.8	1.8	2.2	2.4	2.2	2.2	2.2	2.2	2.2	2.4	2.4

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
-	-	2	1	-	-	30	-	20	50

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Basics of Traction General description of Electrical Traction system in India. Advantages and Disadvantages of Electric Drive, Diesel Electric Drive, Battery Drive Problems associated with AC traction System and remedies for it. General arrangement of D.C., A.C. single-phase, 3phase, Composite systems Metro rail system.	10	5
2	Mechanics of Train Movement Analysis of speed time curves for main line, suburban and urban services Relationship between principal quantities in speed time curves Requirement of tractive effort Specific energy consumption and Factors affect.	10	5
3	Power Supply Arrangements Constituents of supply system: Substation: layout, list of equipment and their functions Feeding post: list of equipment and their functions Feeding and sectioning. Arrangements Sectioning and paralleling post Sub sectioning and Paralleling post Elementary section Major equipment at substation, Miscellaneous equipment at control post or Switching station Protection system for traction transformer and 25 kV centenary construction	15	7
4	Current collecting Equipment Different types of conductor rail system Different types of overhead equipment. OHE Centenary Construction. OHE Supporting Structure, Overhead system- Trolley collector, Bow collector, Pantograph Collector. Types and construction of pantograph	15	7
5	Traction Motors and Train Lighting Desirable characteristics of traction motor. Types of motors used for traction with their characteristics and features. Control of motors used for traction and methods to control. Requirements of braking, types of braking Electric braking, Regenerative braking. Systems of train lighting,	30	10

	Single battery, double battery parallel block system. SG, HOG, End on generation		
6	Electric Locomotive Classification and Nomenclature of Electric Locomotive Block diagram of AC locomotive Power Circuit of AC Locomotive Equipment (List and Function only) used in auxiliary circuit of AC Locomotive Loco bogie classification according to wheel arrangements Maintenance of AC systems	**20**	**8**

i. Text Book and Reference Book:

1. " Utilization of Electric Power & Electric Traction By G C Garg | Khanna Book Publishing Co New Delhi
2. "Utilization of Electric Power & Electric Traction By J.B. Gupta | KATSON BOOKS

(12)

a. Course Name: Industrial Automation & Control
b. Course Code: 03607337
c. Prerequisite: Basic knowledge of electrical engineering
d. Rationale: This course aims to teach students various teaching learning experiences: for maintain Industrial Automation Systems
e. Course Learning Objective:

CLOBJ 1	Recognize and differentiate between various types of automation systems.
CLOBJ 2	Demonstrate the ability to establish physical connections between I/O devices and PLC modules
CLOBJ 3	Utilize PLC programming software to configure and map I/O modules.
CLOBJ 4	Develop troubleshooting skills to identify and resolve common issues in the I/O device-PLC interface

f. Course Learning Outcomes:

CLO 1	Identify different types of automation systems.
CLO 2	2. Interface I/O devices with the PLC modules.
CLO 3	3. Develop PLC ladder programs for various applications.
CLO 4	4. Prepare simple SCADA application.

g. Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes

CLO 1	Recognizing and differentiating between various types of automation systems. Establishing physical connections between I/O devices and PLC modules.
CLO 2	Demonstrating the ability to connect and interface I/O devices with PLC modules. Classifying automation systems based on their control mechanisms, complexity, and applications.
CLO 3	Developing ladder programs for various applications, showcasing the ability to translate control requirements into PLC programming. Establishing physical connections between I/O devices and PLC modules to ensure proper communication and functionality.
CLO 4	Differentiating between various types of automation systems based on their features and functionalities

h. Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Learning Outcomes

CLOs	**PLOs**												**PSO**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CLO 1	3.00	-	-	-	-	-	-	-	-	-	3.00		3.00	2.00
CLO 2	1.00	3.00	1.00	1.00	1.00	2.00	1.00	1.00	2.00	-	-	3.00	1.00	1.00
CLO 3	1.00	1.00	3.00		2.00	3.00	-	-	-	-	-	-	1.00	1.00
CLO 4	-	2.00	-	3.00	-	2.00	2.00	2.00	2.00	-	-	-	1.00	1.00
CLO 5	-	-	-	-	3.00	-	-	-	-	2.00	-	-	1.00	1.00
Weighted Average	1.0	1.2	0.8	0.8	1.2	1.4	0.6	0.6	0.8	0.4	0.6	0.6	1.4	1.2

i. Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	**-**	**-**	**3**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

j. Course Content:

Sr. No.	**Content**	**Weightage**	**Teaching Hours**
1	Introduction to Industrial Automation: Need and benefits. Types of automation system: Fixed, Programmable,	**10**	**4**

	Flexible, Different systems used for Industrial automation: PLC, HMI, and SCADA		
2	PLC Fundamentals Evolution of PLC, Basic Components and Their Symbols, Fuses, Switches – Pushbutton, Mushroom head switches, Selector Switches, Limit Switches, Indicator Lamps, Relays, Time Delay Relays – Delay-On Timer (TON) Relay, Delay-Off Timer (TOF) Relay. Building blocks of PLC: CPU, Memory organization, Input-output modules (discrete and analog), Specialty I/O Modules, Power supply. Fixed and Modular PLC and their types, Redundancy in PLC module I/O module selection criteria Interfacing different I/O devices with appropriate I/O modules	**25**	**11**
3	PLC Programming and Applications Fundamentals of Ladder diagrams – Basic diagram framework, wiring and reference designators. Boolean logic and relay logic – AND, OR, AND OR and OR AND. PLC I/O addressing PLC programming Instructions: Relay type instructions, The Latch (with sealing/latching contacts), Timer instructions: On delay, off delay, retentive, Counter instructions: Up, Down, High speed, Logical instructions, Comparison Instructions, Data handling Instructions, Arithmetic instructions. PLC programming language: Functional Block Diagram (FBD), Instruction List. Structured text, Sequential Function Chart (SFC), Ladder Programming. Simple Programming examples using ladder logic: Language based on relay, timer counter, logical, comparison, arithmetic and data handling instructions. PLC Based Applications: Interfacing of different sensors, Motor sequence control, Traffic light control, Elevator control, Tank Level control, Conveyor system, Stepper motor control with PLC.	**50**	**23**
4	HMI And SCADA In Automation Introduction to HMI: Definition of HMI, History of HMI, Application of HMI, Difference between HMI and SCADA. Introduction to SCADA: Definition of SCADA, History of SCADA, Application area of SCADA, Advantages and disadvantages of SCADA.	**15**	**7**

k. Text Book and Reference Book:

1. "Advance Industrial Automation by Himanshu Kumar
2. "Everything about factory automation by Avinash Malakar.

(13)

a. **Course Name:** Electrical Traction Lab
b. **Course Code:** 03607336
c. **Prerequisite:** Knowledge of different traction systems and track electrification system
d. **Rationale:** The aim of this course is to help the student to attain the operation of different locomotive used in Indian railway. Gain the knowledge about different advanced control system used in traction system.

e. **Course Learning Objective:**

CLOBJ 1	Traction motors are electric motors used in locomotives to provide the necessary motive power. They typically operate on the principle of electromagnetic induction, converting electrical energy into mechanical energy to drive the train.
CLOBJ 2	Traction substations are facilities that supply power to the overhead lines or third rails to energize the traction motors. The layout involves transformers, switchgear, and other equipment, components in a traction substation include transformers to step up or down voltage, circuit breakers for protection, and other devices to control and distribute electrical power
CLOBJ 3	signalling systems are crucial for safe train operation. They include trackside signals, interlocking systems, and communication systems to ensure trains operate safely and efficiently, Supervisory control systems help monitor and control various aspects of the traction system, ensuring optimal performance and safety.
CLOBJ 4	regular maintenance is essential to ensure the reliability and safety of signalling and control systems. This includes periodic inspections, testing, and troubleshooting to address any issues promptly.

f. **Course Learning Outcomes:**

CLO 1	Understand basic principle and operation of Traction motors used in locomotive.
CLO 2	Interpret the traction substation layout and its equipment's
CLO 3	Maintain the signalling and supervisory control systems used in traction services.
CLO 4	Knowledge about different traction system and track electrification arrangement used in Indian railway.

g. Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes	
CLO 1	Understand basic principle and operation of Traction motors used in locomotive.
CLO 2	Interpret the traction substation layout and its equipment's
CLO 3	Maintain the signalling and supervisory control systems used in traction services.
CLO 4	Knowledge about different traction system and track electrification arrangement used in Indian railway.

6. Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Learning Outcomes:

CLOs	PLOs												PSO	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CLO 1	3.00	3.00	2.00	2.00	2.00	2.00	2.00	1.00	1.00	-	-	-	2.00	2.00
CLO 2	3.00	3.00	2.00	2.00	2.00	1.00	2.00	1.00	1.00	-	-	-	2.00	2.00
CLO 3	3.00	3.00	2.00	2.00	2.00	2.00	2.00	1.00	1.00	-	-	-	2.00	2.00
CLO 4	3.00	2.00	2.00	2.00	2.00	2.00	2.00	1.00	1.00	-	-	-	2.00	2.00
Weighted Average	3.00	2.60	2.00	2.00	2.00	1.80	2.00	1.00	1.00	-	-	-	2.00	2.00

Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
-	**-**	**2**	**1**	**-**	**-**	**30**	**-**	**20**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation- Continuous Evaluation, **ESE-** End Semester Examination.

Course Content:

h. Mapping of Experiment List with Course Learning Outcomes:

Sr. NO.	Experiment List
1	Investigate the existing traction systems in Indian Railways, including DC and AC systems.

2	Discuss the impact of emerging technologies like artificial intelligence and IoT in railway traction.
3	Solve numerical problems related to speed-time curves in the context of railway operations.
4	Calculate the energy savings achieved through series-parallel control of DC motors.
5	Discuss the characteristics that make DC series motors suitable for traction
6	Investigate and detail the various types of current collecting equipment used in railway electrification, such as pantographs and third rails.
7	Prepare a report on the functionality and efficiency of the lighting system.
8	Study the power diagram of an AC locomotive, analysing the distribution and consumption of power among different components.
9	Prepare a comprehensive report detailing the operations and maintenance practices.
10	Study the major equipment used in AC traction substations, including transformers, circuit breakers, and protection systems.

(14)

a. **Course Name:** industrial Automation and Control Lab
b. **Course Code:** 03607338
c. **Prerequisite:** Basic knowledge of Industrial automation
d. **Rationale:** This course aims to teach students advanced knowledge of industrial automation environment
e. **Course Learning Objective:**

CLOBJ 1	Understand the components of a PLC, including the CPU, I/O modules, and power supply. Learn how to connect sensors to the input modules of the PLC.
CLOBJ 2	Explore the types of I/O devices used in industrial automation (actuators, valves, motors, etc.). Understand the communication protocols between PLCs and I/O devices.
CLOBJ 3	Gain proficiency in designing ladder logic programs for different industrial applications. Understand the principles of relay logic and how it translates to ladder logic.
CLOBJ 4	Study different types of motor drives (Variable Frequency Drives, Servo Drives, etc.).
CLOBJ 5	Understand the role and importance of SCADA in industrial automation.

f. **Course Learning Outcomes:**

CLO 1	Identify and connect various parts of the given PLC and front panel status indicators with different sensors.
CLO 2	Interface I/O devices with the PLC modules.
CLO 3	Develop PLC ladder programs for various applications.
CLO 4	Select the suitable motor drives for different applications.
CLO 5	Prepare simple SCADA applications

g. Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes	
CLO 1	Identify and connect various parts of the given PLC and front panel status indicators with different sensors.
CLO 2	Interface I/O devices with the PLC modules.
CLO 3	Develop PLC ladder programs for various applications.
CLO 4	Select the suitable motor drives for different applications.
CLO 5	Prepare simple SCADA applications

h. Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Learning Outcomes:

CLOs	**PLOs**												**PSO**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CLO 1	3.00	3.00	2.00	2.00	2.00	2.00	2.00	1.00	1.00	-	-	-	2.00	2.00
CLO 2	3.00	3.00	2.00	2.00	2.00	1.00	2.00	1.00	1.00	-	-	-	2.00	2.00
CLO 3	3.00	3.00	2.00	2.00	2.00	2.00	2.00	1.00	1.00	-	-	-	2.00	2.00
CLO 4	3.00	2.00	2.00	2.00	2.00	2.00	2.00	1.00	1.00	-	-	-	2.00	2.00
CLO 5	3.00	2.00	2.00	2.00	2.00	2.00	2.00	1.00	1.00	-	-	-	2.00	2.00
Weighted Average	3.00	2.60	2.00	2.00	2.00	1.80	2.00	1.00	1.00				2.00	2.00

i. Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
-	**-**	**2**	**1**	**-**	**-**	**30**	**-**	**20**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation- Continuous Evaluation, **ESE-** End Semester Examination.

j. Mapping of Experiment List with Course Learning Outcomes:

Sr. NO.	Experiment List
1	Identify and connect various switches and sensors.
2	Implement START STOP logic using two inputs and one output.
3	Developed a ladder program for a timer relay (TON) and counter application.
4	Implement AC motor speed control with Variable Frequency Drive (VFD
5	Measure and control the temperature of a liquid using an automation module.
6	Develop and test a ladder program for conveyor control.
7	configure Human-Machine Interface (HMI) for system monitoring and control
8	Develop and test a ladder program using advanced PLC features
9	Develop and test a ladder program for lift control.
10	Develop and test a ladder program for servo motor control
11	Develop and test a ladder program for servo motor control.
12	Develop and test a ladder program and configure advanced PLC and HMI.
13	Develop and test a ladder program for a basic industrial process using advanced PLC features. Configure an HMI for monitoring and control.

Semester 6

(1)

a. **Course Name:** Indian Constitution
b. **Course Code:** 03600351
c. **Prerequisite:** Zeal to learn Subject
d. **Rationale:** The course aims to give brief knowledge of Indian Constitution and administration of different bodies of India. To make governance better an engineer must conduce to E-governance through computers and knowledge of cyber laws. An engineer must know the limits of state action and regulations by acquainting himself with the laws that applied by the bureaucrats. Since an engineer works at different places and sights, he must have the basic knowledge of centre -state relations with reference to policy of financing the key projects. The knowledge of Constitution is necessary for him in order to ensure that the rules and regulations under which public and private sector works, do not violate the provisions of the Constitution. Knowledge of corporate culture is necessary for him. He must understand the compulsions of the public private partnership and philosophy of state ownership of key industries.
e. Course Learning Objective:

CLOBJ 1	Understand the historical context and significance of the Indian Constitution, including the Preamble and its interpretation.
CLOBJ 2	Comprehend the structure and roles of the Union Government, including the President, Prime Minister, and Parliament.
CLOBJ 3	Gain insight into the functions and powers of State Governments, including the roles of Governors, Chief Ministers, and State Legislatures.

CLOBJ 4	Familiarize with the structure and functions of local administration, including District Administration, Municipal Corporations, and Zila Panchayats.
CLOBJ 5	Understand the role and functioning of the Election Commission, including the Chief Election Commissioner and State Election Commissions, in conducting free and fair elections in India.

f. Course Learning Outcomes:

CLO 1	Understanding the Constitution.
CLO 2	Ability to understand, Union Government State Government , Local Administration and Election Commission.

g. Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes	
CLO 1	Understanding the Constitution.
CLO 2	Ability to understand, Union Government State Government , Local Administration and Election Commission.

h. Mapping of Course Learning Outcomes and Program Learning Outcomes and ProgramSpecific Learning Outcomes:

CLOs	**PLOs**												**PSO**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CLO 1	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	1.0	1.0
CLO 2	1.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	1.0	1.0
Weighted Average	2.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	1.0	1.0

i. Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
2	**-**	**-**	**-**	**20**	**20**	**-**	**-**	**-**	**40**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

j. Course Content:

Sr. No.	**Content**	**Weightage**	**Teaching Hours**

1	**THE CONSTITUTION -INTRODUCTION:** The History of the Making of the Indian Constitution Preamble and the Basic Structure, and its interpretation Fundamental Rights and Duties and their interpretation, State Policy Principles.	**25%**	**7**
2	**UNION GOVERNMENT:** Structure of the Indian Union, President -Role and Power, Prime Minister and Council of Ministers, Lok Sabha and Rajya Sabha	**20%**	**5**
3	**STATE GOVERNMENT:** Governor -——————————————Role and Power, Chief Minister and Council of Ministers, State Secretariat.	**20%**	**4**
4	**LOCAL ADMINISTRATION:** District Administration, Municipal Corporation, Zila Panchayat	**15%**	**4**
5	**ELECTION COMMISSION:** Role and Functioning, Chief Election Commissioner, State Election Commission	**20%**	**4**

k. Text Book and Reference Book:

1. An Introduction to the Constitution of India
D.D. Basu; Prentice Hall, New Delhi
2. An Introduction to the Constitution of India
M. V. Pylee; Vikas New Delhi

(2)

a. Course Name: Building Electrification

b. Course Code: 03607351

c. Prerequisite: Basic knowledge of electrical wiring

d. Rationale: This course aims to teach students advanced knowledge of industrial wiring

e. Course Learning Objective:

CLOBJ 1	Identify various types of electrical accessories, wires, cables, and wiring systems used in electrification.
CLOBJ 2	Determine the appropriate size of wires and cables based on load calculations and safety standards.
CLOBJ 3	Understand the principles of residential electrification and relevant electrical codes and standards.
CLOBJ 4	Acquire knowledge of residential electrification principles, including wiring layouts and safety considerations.
CLOBJ 5	Analyze load requirements for individual floors in a building.

CLOBJ 6	Understand the principles of lighting design for residential spaces.

f. Course Learning Outcomes:

CLO 1	Select accessories, wires, cables and wiring systems for electrification.
CLO 2	Selection of suitable size of wires and cables and their jointing methods.
CLO 3	Design electrical wiring installation system for residential units.
CLO 4	To understand about residential electrification and different tests to be carried out.
CLO 5	To analyze load calculation for floor wise and multistory buildings.
CLO 6	Design proper illumination scheme for residential units.

g. Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes	
CLO 1	Select accessories, wires, cables and wiring systems for electrification.
CLO 2	Selection of suitable size of wires and cables and their jointing methods.
CLO 3	Design electrical wiring installation system for residential units.
CLO 4	To understand about residential electrification and different tests to be carried out.
CLO 5	To analyze load calculation for floor wise and multistory buildings.
CLO 6	Design proper illumination scheme for residential units.

h. Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Learning Outcomes:

CLOs	PLOs												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CLO 1	1.00	1.00	3.00	1.00	1.00	3.00	3.00	3.00	3.00	3.00	1.00	3.00	3.00	1.00
CLO 2	2.00	2.00	3.00	1.00	1.00	1.00	2.00	2.00	2.00	3.00	1.00	1.00	3.00	2.00
CLO 3	1.00	1.00	3.00	1.00	2.00	3.00	2.00	1.00	1.00	2.00	1.00	2.00	3.00	2.00
CLO 4	3.00	2.00	1.00	3.00	1.00	1.00	1.00	3.00	2.00	3.00	1.00	3.00	1.00	3.00
CLO 5	2.00	3.00	1.00	3.00	2.00	2.00	2.00	2.00	2.00	3.00	3.00	2.00	1.00	3.00
CLO 6	1.00	1.00	3.00	1.00	1.00	3.00	3.00	2.00	3.00	3.00	1.00	3.00	3.00	1.00
Weighted Average	1.67	1.67	2.33	1.67	1.33	2.17	2.17	2.17	2.17	2.83	1.33	2.33	2.33	2.00

i. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	-	3	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

j. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**Wiring Tools and Accessories** Various tools required for wiring- screwdrivers, pliers, Try square, saws, hacksaw, chisel, hammers, mallet, rawl punch, hand drill machine, portable drilling machine, files, plumb bob, line thread, electricians' knife, test lamp, tester and their BIS specifications, application, care & maintenance of tools. Classification of electrical accessories controlling, holding, safety, outlet BIS symbols of following electrical accessories. Switch – Their types according to construction such as surface switch, flush switch, and pull switch, rotary switch, knife switch, pendent switch, Main switch (ICDP, ICTP). Their types according to working such as single pole, double pole,	15%	6

	two-way, two-way center off, intermediate, series parallel switch Holders- Their types such as bayonet cap lamp holder, pendent holder, batten lamp holder, angle holder, bracket holder, tube light holder, screw type Edison and goliath Edison lamp holder, swivel lamp holder. Socket outlets and plugs- two pin, three-pin, multi pin sockets, two-pin and three-pin plug. Others- Iron connector, adaptor, and ceiling rose, distribution box, neutral link, bus-bar chamber. Wooden/ mica boards, Molded/ MS Concealed boxes of different sizes. Modular accessories.		
2	**Electrical Wires and Underground Cables** Conductors: - wire, cable, bus bar, stranded conductor, cable, armoured cable, flexible cable, solid conductor, PVC wires, CTS wire, LC wire, FR (Fire retardant) wire, Size of wire according to BIS. Tools used for measurement of wire size, Wire jointing methods. Classification of cables, low tension, high tension, and extra high-tension cables, solid, oil filled and gas filled type Cable insulation materials – vulcanized rubber (VIR), polyvinyl chloride (PVC), cross linked polythene (XLPE), impregnated paper, Selection of suitable cable size and type from standard data Cable jointing methods Cable laying methods. Factors determining selection of electric cables	**15%**	**6**
3	**Wiring Methods and wiring layout** Factors determining the selection of wiring methods. Classification of wiring methods. PVC casing-capping wiring, wiring rules according to IS: 732-1983 Conduit wiring- Types of conduits, comparison between Metal and PVC conduit, types of conduit wiring (Surface/Concealed). Conduit wiring accessories, BIS rules for Metal and PVC conduit wiring. Comparison of various wiring systems. General BIS rules for domestic installations. Design, working and drawing of following electrical circuits: Simple light and fan circuits, Stair case wiring, Go-down wiring circuit, Bedroom lighting circuit, Corridor lighting circuit, Series parallel circuit, Master switch control circuit, Different lighting circuit using – Intermediate switch, Call bell circuit using bell indicator, Design of wiring circuits according to user's requirement	**15%**	**6**
4	**Residential Building Electrification** Domestic Dwellings/Residential Buildings: reading of Civil Engineering building drawing, Interpretation of	**25%**	**10**

	electrical installation plan and electrical diagrams, electrical symbols as per IS: 732, solar rooftop by directional, green building concept. Electrical installation for residential building as per part I section 9 of NEC-2011 Difference between residential and industrial load, rules/requirements related to lighting load followed in electrical installations, Positioning of equipment. Lighting and power circuits: Light and fan circuit, Power circuit Wiring and circuit Schematic diagram according to IS: 2042(Part-I)-1962: multiline and single line representation Load assessment: Selection of size of conductor, Selection of rating of main switch and protective switch gear. Design and drawing, estimation and costing of a residential installation having maximum 5 KW load; Sequence to be followed for preparing estimate; Calculation of length of wire and other materials, labour cost. Testing of wiring installation as per IS: 732-1982: Insulation resistance - between earth and conductors, between conductors, polarity test of single pole switches. Testing of earth continuity path. Residential building Service Connection- types Underground and overhead. Calculation of Material required for service connection		
5	**Electrification of Multistoried Buildings** Wiring layout of an electrical installation Calculate number of sub circuits from the total circuit requirement. Calculation total electrical load on distribution work Floor wise estimation of material requirements: i. Specification of wiring material and accessories. ii. Estimation of total cost of electrification using schedule of rates (SOR). iii. Case Studies Requirements of approval from electrical inspection for high rise Multistoried building Load calculation for lifts, escalators, air conditioners: wiring diagram, Case studies (Problems)	**15%**	**6**
6	**Illumination in Residential Installation** Concept of Luminous flux, Luminous intensity, Lumen, Illumination or illuminance, Lux, Space-height ratio, utilization factor, depreciation factor, luminous efficiency-values for different luminaries. Laws of Illumination-Inverse Square Law, Cosine Law, illumination received directly underneath, horizontal screen and screen moved horizontally at certain distance Factors affecting the illumination. Different types of lighting arrangements,	**15%**	**6**

	Luminous flux of different types of light sources, Lux level required for different places as per SP 72: 2010.		

k. Text Book and Reference Book:

1. **Dhanpat Rai and Sons Electrical Estimating and Costing**, By 3. Singh, Surjit Ravi Deep Singh | Dhanpat Rai and Sons
2. **Electrical Design Estimating and Costing**, By Raina K B Dr. S. K. Bhattacharya | New Age International Publisher First, Reprint 2010
3. **Electrical Estimating and Costing**, By Allagappan, N. S. Ekambarram | Tata Mc-Graw Hill Publishing Co. Ltd

(2)

k. Course Name: Building Electrification Lab
l. Course Code: 03607352
m. Prerequisite: Basic knowledge of electrical wiring
n. Rationale: This course aims to teach students advanced knowledge of industrial wiring.
o. Course Learning Objective:

CLOBJ 1	Select appropriate accessories, wires, cables, and wiring systems for electrification projects, considering factors such as load requirements, safety standards, and environmental conditions.
CLOBJ 2	Design comprehensive electrical wiring installation systems tailored specifically for residential units, incorporating principles of efficiency, safety, and compliance with relevant codes and regulations.
CLOBJ 3	Develop proper illumination schemes for residential units, considering factors such as aesthetics, energy efficiency, and user comfort and safety.
CLOBJ 4	Prepare accurate and detailed wiring layouts on wiring boards, effectively translating design specifications into practical installation plans.
CLOBJ 5	Demonstrate proficiency in locating and diagnosing faults in electrical wiring installations, utilizing appropriate diagnostic tools and techniques to ensure timely and effective resolution of issues.
CLOBJ 6	Implement proper earthing techniques for building electrification projects, ensuring the safety and integrity of electrical systems by effectively managing electrical currents and preventing hazards associated with grounding faults.

p. Course Learning Outcomes:

CLO 1	Select accessories, wires, cables and wiring systems for electrification.
CLO 2	Design electrical wiring installation system for residential unit.
CLO 3	Design proper illumination scheme for residential unit.
CLO 4	Prepare wiring layouts on wiring board.
CLO 5	Locate and diagnose faults in electrical wiring installation.
CLO 6	Do proper earthling for building electrification.

q. Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes	
CLO 1	Select accessories, wires, cables and wiring systems for electrification.
CLO 2	Selection of suitable size of wires and cables and their jointing methods.
CLO 3	Design electrical wiring installation system for residential units.
CLO 4	To understand about residential electrification and different tests to be carried out.
CLO 5	To analyze load calculation for floor wise and multistory buildings.
CLO 6	Design proper illumination scheme for residential units.

r. Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Learning Outcomes:

CLOs	PLOs												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CLO 1	2	1	1	1	2	1	1	1	1	2	1	1	3	1
CLO 2	1	1	3	1	1	1	3	1	2	1	3	1	3	1
CLO 3	1	2	1	1	2	2	1	1	2	3	1	2	3	1
CLO 4	2	1	1	3	3	1	2	1	1	1	3	1	1	2
CLO 5	3	1	1	3	1	1	1	1	2	3	1	2	3	1
CLO 6	1	3	1	1	1	1	2	2	1	1	1	2	1	3
Weighted Average	1.67	1.50	1.33	1.67	1.67	1.17	1.67	1.17	1.50	1.83	1.67	1.50	2.33	1.50

s. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
0	-	2	1	-	-	30	-	20	50

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

t. Mapping of Experiment List with Course Learning Outcomes:

Sr. NO.	Experiment List
1	Prepare series testing board.
2	Select the electric wire using measuring and testing instruments for particular applications.
3	Identify cables of different current ratings.
4	Prepare wiring installation on a board showing control of one lamp, one fan and one socket from one switch board in PVC surface conduit wiring system.
5	Prepare wiring installation on a board.
6	Control one lamp from two different places using PVC surface conduit wiring system.
7	Prepare wiring installation on a board. Control one lamp from three different places using PVC surface conduit wiring system.
8	Prepare wiring installation on a board

9	Perform go-down wiring for three blocks using PVC casing capping
10	Design 2 BHK residential installation scheme and estimate the material required. And draw the details required for installation on A4 size sheet.
11.	Test wiring installation using megger.

(3)

a. **Course Name:** Power System Protection
b. **Course Code:** 03607359
c. **Prerequisite:** Knowledge of Transmission and Distribution and Switchgear equipment's.
d. **Rationale:** The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences. An electrical power system consists of generators, transformers, and transmission and distribution lines. In case of fault, an automatic protective scheme consisting of circuit breakers and protective relays isolate the faulty section providing protection to the healthy section. Safety of machines/equipment and human beings is the major criteria of every protection scheme. It is essential that the diploma pass out students should develop skills of operating various controls and switchgear in power system. They are also required to carry out remedial measures for faults/abnormalities in machines/equipment in power system using appropriate diagnostic instruments/devices. This course attempts to develop these skills in students and hence it is a core course for all electrical engineers.

e. **Course Learning Objective:**

CLOBJ 1	Recognize and classify different types of faults that can occur in a power system, including short circuits, open circuits, and ground faults.
CLOBJ 2	Understand the principles of protection systems for transmission lines and busbars.
CLOBJ 3	Gain knowledge of protection systems specific to alternators and transformers.
CLOBJ 4	Understand the protection requirements and schemes for motors in a power system.
CLOBJ 5	Acquire knowledge of protection schemes designed to mitigate overvoltage conditions in power systems.

f. **Course Learning Outcomes:**

CLO 1	Identify various types of faults in the power system.
CLO 2	Maintain protection systems of the Transmission Line and Busbar.
CLO 3	Maintain protection systems of alternators and transformers.
CLO 4	Maintain protection schemes for motors and transmission lines.
CLO 5	Maintain protection schemes for power systems against overvoltages.

g. Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes	
CLO 1	Identify various types of faults in the power system.
CLO 2	Maintain protection systems of the Transmission Line and Busbar.
CLO 3	Maintain protection systems of alternators and transformers.
CLO 4	Maintain protection schemes for motors and transmission lines.
CLO 5	Maintain protection schemes for power systems against overvoltages.

h. Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Learning Outcomes:

CLOs	**PLOs**												**PSO**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CLO 1	1.00	1.00	1.00	3.00	1.00	1.00	1.00	1.00	3.00	3.00	1.00	1.00	1.00	1.00
CLO 2	3.00	3.00	1.00	3.00	1.00	1.00	2.00	3.00	1.00	2.00	2.00	3.00	3.00	2.00
CLO 3	1.00	3.00	2.00	3.00	3.00	1.00	1.00	3.00	2.00	1.00	2.00	3.00	2.00	1.00
CLO 4	2.00	1.00	2.00	3.00	1.00	3.00	3.00	1.00	2.00	3.00	1.00	2.00	3.00	3.00
CLO 5	1.00	1.00	1.00	3.00	1.00	1.00	1.00	1.00	1.00	1.00	3.00	1.00	1.00	1.00
Weighted Average	1.60	1.80	1.40	3.00	1.40	1.40	1.60	1.80	1.80	2.00	1.80	2.00	2.00	1.60

i. Teaching & Examination Scheme:

Teaching Scheme	**Evaluation Scheme**

L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	-	2	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

j. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**Basics of Protection**: Single line diagram of power system Necessity and function of protective system Basic arrangement of Protective System Normal operations of power system Abnormal conditions with its causes Types of faults and their causes back-up protection its types and necessity, Zones of Protection.	15%	4
2	**Protection of Transmission Line and Busbar**: Need of transmission line protection Different types of transmission line protection Classification of protection line/feeder Non directional time graded protection system Non directional current graded protection system Directional time graded protection of parallel feeder Protection of ring mains Distance Protection Transley relay scheme Carrier current protection of Bus-bars Frame leakage protection for protection of bus bars Circulating current protection of bus bars.	30%	10
3	**Protection of Alternator and Transformer**: Alternator Protection Faults in Alternator Differential Protection, over current, Earth fault, Overheating and Field Failure Protection, Reverse Power Protection Transformer Protection Faults, Differential, over current, Earth Fault, Over heating protection, Limitations of differential protection. Buchholz Relay: Construction, Operations, Merits and Demerits.	20%	9
4	**Protection of Motor**: Abnormalities and faults in motor Requirement of protection of motor, Types of protection of motor Protection chart for induction motor.	20%	4

5	**Over voltage Protection**: Causes of overvoltage Methods of reducing over voltage Operating principle, working and construction of lightning arrester Insulation coordination.	**15%**	**3**

k. Text Book and Reference Book:

1. **Power System Protection and Switchgear**, By B. Ram and D. N. Vishwakarma | McGraw Hill Education, Pub. Year 2010
2. **Principles of Power System**, By V. K. Mehta Rohit Mehta | S. Chand
3. **Switchgear And Protection**, By S. S. Rao | Khanna publication

(4)

a. Course Name: Power System Protection Lab
b. Course Code: 03607360
c. Prerequisite: Knowledge of electrical power system and switchgear equipment's.
d. Rationale: The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences.

e. Course Learning Objective:

CLOBJ 1	Recognize and classify different types of faults that can occur in a power system, including short circuits, open circuits, and ground faults.
CLOBJ 2	Understand the principles of protection systems for transmission lines and busbars.
CLOBJ 3	Gain knowledge of protection systems specific to alternators and transformers.
CLOBJ 4	Understand the protection requirements and schemes for motors in a power system.
CLOBJ 5	Acquire knowledge of protection schemes designed to mitigate overvoltage conditions in power systems.

f. Course Learning Outcomes:

CLO 1	Maintain switchgear and protection schemes used in electrical power systems.
CLO 2	Test the performance of different protective relays.
CLO 3	Maintain protection systems of alternators and transformers.
CLO 4	Maintain protection schemes for motors and transmission lines.

CLO 5	Maintain protection schemes for power systems against overvoltages.

g. Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes	
CLO 1	Identify various types of faults in the power system.
CLO 2	Maintain protection systems of the Transmission Line and Busbar.
CLO 3	Maintain protection systems of alternators and transformers.
CLO 4	Maintain protection schemes for motors and transmission lines.
CLO 5	Maintain protection schemes for power systems against overvoltages.

h. Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Learning Outcomes:

CLOs	**PLOs**												**PSO**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CLO 1	1.00	1.00	1.00	3.00	1.00	1.00	1.00	1.00	3.00	3.00	1.00	1.00	1.00	1.00
CLO 2	3.00	3.00	1.00	3.00	1.00	1.00	2.00	3.00	1.00	2.00	2.00	3.00	3.00	2.00
CLO 3	1.00	3.00	2.00	3.00	3.00	1.00	1.00	3.00	2.00	1.00	2.00	3.00	2.00	1.00
CLO 4	2.00	1.00	2.00	3.00	1.00	3.00	3.00	1.00	2.00	3.00	1.00	2.00	3.00	3.00
CLO 5	1.00	1.00	1.00	3.00	1.00	1.00	1.00	1.00	1.00	1.00	3.00	1.00	1.00	1.00
Weighted Average	1.60	1.80	1.40	3.00	1.40	1.40	1.60	1.80	1.80	2.00	1.80	2.00	2.00	1.60

i. Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
-	**-**	**2**	**1**	**-**	**-**	**30**	**-**	**20**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

j. Mapping of Experiment List with Course Learning Outcomes:

Sr. NO.	Experiment List
1	To Perform relay coordination in parallel feeder schemes.
2	Test any one relay and plot its characteristic.
3	To study about various faults, occur in transformer and alternator.
4	To study about different protection schemes for bus-bars.
5	To study about different protection schemes for transmission line.
6	Simulate differential protection scheme for transformer with power system simulation kit.
7	Simulate transmission line protection by using the impedance relay/over current relay for various faults. (On transmission line protection simulation Kit).
8	Test and perform reverse power protection of an alternator.
9	Dismantle Thyrite type arrester and identify different parts.
10	Study and demonstrate horn-gap lightning arrester in laboratory.
11.	Visit nearby sub-station and prepare a technical report.
12.	Check polarity of C.T. and P.T.
13.	Interpret various protective scheme used for transmission lines and feeders (from blue print and visit).
14.	Interpret the protection scheme for an alternator in power station (from blue print and visit).

(5)

a. Course Name: Industrial Drives
b. Course Code: 03607355
c. Prerequisite: Basic knowledge of different types of electric drives
d. Rationale: The electrical engineering applications in many industries use small and large AC and DC motors in some crucial application systems. Further electrical speed control in almost all industrial applications is incomplete without the use of the specific electric drive. This course will empower the students with the necessary skills to identify operate and maintain the AC and DC drives.

e. Course Learning Objective:

CLOBJ 1	Analyze and interpret speed-torque characteristics for various types of electric drives.
CLOBJ 2	Understand the principles of DC drives and their integration with converters.
CLOBJ 3	Comprehend the operation and control mechanisms of DC drives integrated with choppers.

CLOBJ 4	Familiarize with the principles and components of AC drives.
CLOBJ 5	Understand the role and functionality of microcontroller-based systems in motor control.

f. Course Learning Outcomes:

CLO 1	Identify the relevant electric drive for the required speed torque characteristics.
CLO 2	Maintain the functioning of DC Drives using converters.
CLO 3	Maintain the functioning of DC Drives using choppers.
CLO 4	Maintain the functioning of AC Drives.
CLO 5	Use microcontroller-based systems for motor control.

g. Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes	
CLO 1	Identify the relevant electric drive for the required speed torque characteristics.
CLO 2	Maintain the functioning of DC Drives using converters.
CLO 3	Maintain the functioning of DC Drives using choppers.
CLO 4	Maintain the functioning of AC Drives.
CLO 5	Use microcontroller-based systems for motor control.

h. Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Learning Outcomes:

CLOs	PLOs												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CLO 1	2.00	1.00	3.00	3.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00	3.00	3.00	1.00
CLO 2	2.00	3.00	3.00	3.00	2.00	2.00	2.00	3.00	3.00	3.00	3.00	2.00	3.00	1.00
CLO 3	2.00	3.00	3.00	3.00	3.00	2.00	1.00	1.00	2.00	3.00	1.00	1.00	3.00	2.00
CLO 4	1.00	2.00	1.00	2.00	1.00	1.00	3.00	2.00	1.00	3.00	3.00	3.00	1.00	2.00
CLO 5	2.00	2.00	3.00	1.00	2.00	1.00	1.00	1.00	2.00	2.00	1.00	1.00	1.00	1.00
Weighted Average	1.80	2.20	2.60	2.40	1.80	1.40	1.60	1.60	1.80	2.40	2.00	2.00	2.20	1.40

i. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	-	3	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

j. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**Basics of Electric Drives** Electric drive, types and choice of electric drives, Parts of electrical drive-source, power modulator, electric motor and control unit, Motor duty class, Classification-continuous, short time, intermittent period, Speed-torque characteristics of DC motors, Speed-torque characteristics of three phase induction motor.	10%	6
2	**DC Drives using converter** Single phase SCR Drives Half wave converter, Full wave converter, Semi converter, Dual converter, Three Phase SCR Drives Half wave converter, Full wave converter, Semi converter, Dual converter, Power factor in SCR motor drives, Reversible SCR Drives.	25%	10
3	**DC Drive using choppers**	20%	9

	Basic chopper circuit using SCR, Classification based on output voltage and quadrant of operation, Chopper Controlled DC Drives. Class A Chopper Drive, Class B Chopper Drive, Class C Chopper Drive, Class D Chopper Drive, Class E Chopper Drive, Application of chopper control drive in Solar and battery powered vehicles.		
4	**AC Drives** Stator voltage control method using thyristor circuit, Variable frequency control method using square wave inverter, Constant V IF control method, Rotor resistance control using chopper, slip power recovery system, Solar powered pump drives, Drives required at each stage for following Application Textiles mills, Steel rolling mills, Paper mills, Sugar mills.	**25%**	**10**
5	**Advanced techniques of motor control** Phase locked loop control of DC motor, AC/DC drive using microprocessor control, AC/DC drive using microcontroller control, Synchronous motor drives, Ratings and specifications of stepper moto.	**20%**	**8**

k. Text Book and Reference Book:

1. **Fundamentals of Electrical Drives**, By Gobal K. Dubey
2. **Control of Electrical Drives**, By Werner Leonhard | Springer | 3rd edition

(6)

a. Course Name: Industrial Drive Lab

b. Course Code: 03607358ASDFF

c. Prerequisite: Basic knowledge of different types of electric drives.

d. Rationale: The electrical engineering applications in many industries use small and large AC and DC motors in some crucial application systems. Further electrical speed control in almost all industrial applications is incomplete without the use of the specific electric drive. This course will empower the students with the necessary skills to identify operate and maintain the AC and DC drives.

e. Course Learning Objective:

CLOBJ 1	Understand the key energy conservation policies and regulations in India.
CLOBJ 2	Familiarize with energy-efficient electrical machines and their characteristics.

CLOBJ 3	Understand the principles of energy-efficient electrical installations.
CLOBJ 4	Understand the concept of co-generation and its application in energy management.
CLOBJ 5	Develop an understanding of the principles and methodologies of energy auditing.

f. Course Learning Outcomes:

CLO 1	Identify the relevant electric drive for the required speed torque characteristics.
CLO 2	Maintain the functioning of DC Drives using converters.
CLO 3	Maintain the functioning of DC Drives using choppers.
CLO 4	Maintain the functioning of AC Drives
CLO 5	Use microcontroller-based systems for motor control.

g. Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes	
CLO 1	Identify the relevant electric drive for the required speed torque characteristics.
CLO 2	Maintain the functioning of DC Drives using converters.
CLO 3	Maintain the functioning of DC Drives using choppers.
CLO 4	Maintain the functioning of AC Drives
CLO 5	Use microcontroller-based systems for motor control.

h. Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Learning Outcomes:

CLOs	PLOs												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CLO 1	3.00	1.00	1.00	1.00	1.00	1.00	2.00	3.00	1.00	1.00	1.00	1.00	2.00	1.00
CLO 2	3.00	2.00	2.00	3.00	2.00	3.00	3.00	3.00	1.00	1.00	1.00	1.00	2.00	1.00
CLO 3	3.00	2.00	2.00	1.00	1.00	1.00	3.00	1.00	1.00	1.00	1.00	1.00	2.00	1.00
CLO 4	2.00	2.00	2.00	2.00	2.00	3.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00	1.00
CLO 5	2.00	1.00	1.00	1.00	1.00	2.00	1.00	2.00	1.00	1.00	1.00	1.00	2.00	1.00
Weighted Average	2.60	1.60	1.60	1.60	1.40	2.00	2.00	2.00	1.00	1.00	1.00	1.00	2.00	1.00

i. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	-	3	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

l. Mapping of Experiment List with Course Learning Outcomes:

Sr. NO.	Experiment List
1	Identify various parts of the given DC Drive.
2	Identify various parts of the given AC Drive.
3	Test the given DC motor to interpret the speed torque characteristics.
4	Control speed of the given DC shunt motor using single phase half wave converter.
5	Control the speed of the given DC shunt motor using single phase full wave converter.
6	Control the speed of the given separately excited DC motor by changing the firing angle of SCR using single phase semi – converter.
7	Control the speed of the given separately excited DC motor by changing the firing angle of SCR using single phase Full converter.
8	Check high power SCR power devices with heat sink arrangement.
9	Measure the output voltage of the given chopper for resistive load by varying the frequency and lor duty cycle of Chopper.
10	Control speed of the given D.C. Series motor by varying armature voltage using step down chopper.
11.	Control the speed of the given D.C. separately excited motor by varying armature voltage using step down chopper.

12.	Control the speed of the given three phase squirrel cage induction motor by varying stator voltage using thyristor circuit.
13.	Control the speed of the given three phase induction motor by using constant V If method and plot the graph between speed and frequency.

(7)

a. **Course Name:** Energy Conservation Technique and Audit
b. **Course Code:** 03607357
c. **Prerequisite:** Basics of Fundamentals of electrical engineering
d. **Rationale:** The consumption of energy is increasing day by day. One way to cope up with the increase in energy demand is to increase the production of energy which demands more investment and the other way is to conserve the energy because energy conserved/saved is energy generated. Energy conservation means reduction in energy consumption but not compromising with the quality or quantity of energy production. Essential theoretical and practical knowledge about the concept of energy conservation, energy management, and different approaches of energy conservation in industries, economic aspects of energy conservation project and energy audit and measuring instruments in commercial and industrial sector will be achieved by this course.

e. **Course Learning Objective:**

CLOBJ 1	Understand the key energy conservation policies and regulations in India.
CLOBJ 2	Familiarize with energy-efficient electrical machines and their characteristics.
CLOBJ 3	Understand the principles of energy-efficient electrical installations.
CLOBJ 4	Understand the concept of co-generation and its application in energy management.
CLOBJ 5	Develop an understanding of the principles and methodologies of energy auditing.

f. **Course Learning Outcomes:**

CLO 1	Interpret energy conservation policies in India.
CLO 2	Implement energy conservation techniques in electrical machines.
CLO 3	Apply energy conservation techniques in electrical installations.
CLO 4	Use Co-generation and relevant tariff for reducing losses in facilities.

CLO 5	Undertake energy audit for electrical system.

g. Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes	
CLO 1	Interpret energy conservation policies in India.
CLO 2	Implement energy conservation techniques in electrical machines.
CLO 3	Apply energy conservation techniques in electrical installations.
CLO 4	Use Co-generation and relevant tariff for reducing losses in facilities.
CLO 5	Undertake energy audit for electrical system.

h. Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Learning Outcomes:

CLOs	**PLOs**												**PSO**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CLO 1	3.00	1.00	1.00	1.00	1.00	1.00	2.00	3.00	1.00	1.00	1.00	1.00	2.00	1.00
CLO 2	3.00	2.00	2.00	3.00	2.00	3.00	3.00	3.00	1.00	1.00	1.00	1.00	2.00	1.00
CLO 3	3.00	2.00	2.00	1.00	1.00	1.00	3.00	1.00	1.00	1.00	1.00	1.00	2.00	1.00
CLO 4	2.00	2.00	2.00	2.00	2.00	3.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00	1.00
CLO 5	2.00	1.00	1.00	1.00	1.00	2.00	1.00	2.00	1.00	1.00	1.00	1.00	2.00	1.00
Weighted Average	2.60	1.60	1.60	1.60	1.40	2.00	2.00	2.00	1.00	1.00	1.00	1.00	2.00	1.00

i. Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	**-**	**-**	**3**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

j. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**Energy conservation basics Energy scenario** Primary and Secondary energy, Energy demand and supply, National scenario. Energy conservation and Energy audit: Concepts and Difference. Energy conservation Act 2001; Relevant clauses of energy conservation. BEE and its role. GEDA and its role. Star labelling: Need and its benefits.	10%	4
2	**Energy conservation in electrical machines** Need for energy conservation in induction motor and transformer Energy conservation techniques in induction motor by: Improving power quality, Motor survey, Matching motor with loading. Minimizing the idle and redundant running of motor, Operating in star mode, Rewinding of motor, Replacement by energy efficient motor, Periodic maintenance. Energy conservation techniques in transformer: Load sharing, Parallel operation, Isolation techniques, Replacement by energy efficient transformers, Periodic maintenance. Energy conservation equipment's: soft starters, Automatic star delta converter, Variable frequency drives Energy efficient motor: Significant features, Advantages, Applications and Limitations. Energy efficient transformers, Amorphous transformers; Epoxy resin cast transformer/Dry type of transformer.	25%	10
3	**Energy conservation in electrical installation system** Aggregated Technical and Commercial Losses (ATC) Power system at state, Regional, National and global level. Technical losses; Causes and Measures to reduce by: Controlling I2R losses, optimizing distribution voltage, Balancing phase currents, Compensating reactive power flow. Commercial loses: Pilferage, Causes and Remedies. Energy conservation equipment's: Maximum demand controller, kVAR controller, Automatic power factor controller (APFC). Energy conservation in lighting system: Replacing lamp sources, using energy efficient luminaries, using light controlled gears, Installation of	25%	10

	separate transformer/servo stabilizer for lighting, Periodic survey and adequate maintenance programs. Energy conservation techniques in fans, electronic regulators. Innovative measures of energy savings in lighting.		
4	**Energy conservation through co-generation and tariff** **Co-generation and Tariff** Concept, Significance for energy conservation. Co-generation: Types of cogenerations on the basis of sequence of energy use (Topping cycle, Bottoming cycle), Types of cogeneration basis of technology (Steam turbine cogeneration, Gas turbine cogeneration, Reciprocating engine cogeneration), Factors governing the selection of cogeneration system, Advantages of cogeneration. Tariff: Types of tariff structure: LT and HT, Special tariffs; Time-off-day tariff, Peak-off-day tariff, Power factor tariff, Maximum demand tariff, Load factor tariff and availability-based tariff (ABT). Application of tariff system to reduce energy bill. Technical losses; causes and measures to reduce.	**20%**	**8**
5	**Energy audit of electrical systems** Energy audit (definition as per Energy Conservation Act), Specific energy consumption. Energy audit instruments and their use. Questionnaire for energy audit projects. Energy flow diagram (Sankey diagram). Simple payback period, Energy audit procedure (walk through audit and detailed audit). Energy audit report format. Energy flow diagram (Sankey diagram).	**20%**	**8**

k. Text Book and Reference Book:

1. **Electrical Power**, By S Rao, S L Uppal | Khanna Publishers
2. **Energy conservation techniques**, By P.M. Dave & M.N. sheth
3. **Course Material for Accredited Energy Managers & Energy Auditors**, Bureau of Energy Efficiency
4. **Energy Audit and Management**, Volume-I, IECC Press

(8)

a. Course Name: Energy Conservation Technique and Audit Lab
b. Course Code: 03607358
c. Prerequisite: Basic knowledge of Energy Conservation Technique and Audit.

d. Rationale: This course aims to teach students advanced knowledge of industrial wiring.

e. Course Learning Objective:

CLOBJ 1	Understand the key energy conservation policies and regulations in India.
CLOBJ 2	Familiarize with energy-efficient electrical machines and their characteristics.
CLOBJ 3	Understand the principles of energy-efficient electrical installations.
CLOBJ 4	Understand the concept of co-generation and its application in energy management.
CLOBJ 5	Develop an understanding of the principles and methodologies of energy auditing.

f. Course Learning Outcomes:

CLO 1	Interpret energy conservation policies in India.
CLO 2	Implement energy conservation techniques in electrical machines.
CLO 3	Apply energy conservation techniques in electrical installations.
CLO 4	Use Co-generation and relevant tariff for reducing losses in facilities.
CLO 5	Undertake energy audit for electrical system.

g. Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes	
CLO 1	Interpret energy conservation policies in India.
CLO 2	Implement energy conservation techniques in electrical machines.
CLO 3	Apply energy conservation techniques in electrical installations.
CLO 4	Use Co-generation and relevant tariff for reducing losses in facilities.
CLO 5	Undertake energy audit for electrical system.

h. Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Learning Outcomes:

CLOs	PLOs												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CLO 1	3.00	1.00	1.00	1.00	1.00	1.00	2.00	3.00	1.00	1.00	1.00	1.00	2.00	1.00
CLO 2	3.00	2.00	2.00	3.00	2.00	3.00	3.00	3.00	1.00	1.00	1.00	1.00	2.00	1.00
CLO 3	3.00	2.00	2.00	1.00	1.00	1.00	3.00	1.00	1.00	1.00	1.00	1.00	2.00	1.00
CLO 4	2.00	2.00	2.00	2.00	2.00	3.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00	1.00
CLO 5	2.00	1.00	1.00	1.00	1.00	2.00	1.00	2.00	1.00	1.00	1.00	1.00	2.00	1.00
Weighted Average	2.60	1.60	1.60	1.60	1.40	2.00	2.00	2.00	1.00	1.00	1.00	1.00	2.00	1.00

i. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
-	-	2	1	-	-	20	-	30	50

j. Mapping of Experiment List with Course Learning Outcomes:

Sr. No.	Experiment List
1	Identify star labelled electrical apparatus and compare the data for various star ratings.
2	Determine the '% loading' of the given loaded Induction motor.
3	Determine the reduction in power consumption in star mode operation of Induction motor compared to delta mode.
4	Use APFC unit for improvement of p. f. of electrical load.
5	Compare power consumption of different types of TL with choke, electronic ballast and LED lamps by direct measurements.
6	Determine the reduction in power consumption by replacement of lamps in a class room / laboratory.
7	Collect electricity bill of a commercial consumer and suggest suitable tariff for conservation and reduction of its energy bill.
8	Estimate energy saving by improving power factor and load factor for given cases.
9	Prepare a sample energy audit questionnaire for the given industrial facility.
10	Prepare an energy audit report.

a. **Course Name:** Software Practice Lab
b. **Course Code:** 03607360
c. **Prerequisite:** Basic Knowledge of Mathematics and computer.
d. **Rationale:** The course provides a gentle introduction to the MATLAB computing environment, and is intended for beginning users and those looking for a review. It is designed to give students a basic understanding of MATLAB, including toolboxes.

e. **Course Learning Objective:**

CLOBJ 1	Understand and utilize the features of the MATLAB development environment proficiently.
CLOBJ 2	Write MATLAB programs adeptly to solve scientific and mathematical problems effectively.
CLOBJ 3	Create modular solutions using custom functions in MATLAB for efficient problem-solving.
CLOBJ 4	Describe and navigate the MATLAB Advanced User Interface (AUI) competently.
CLOBJ 5	Apply diverse MATLAB toolboxes and Simulink to construct and implement algorithms, solving engineering problems efficiently.

f. **Course Learning Outcomes:**

CLO 1	Memorize the features of the MATLAB development environment.
CLO 2	Write simple programs in MATLAB to solve scientific and mathematical problems.
CLO 3	Write functions to find modular solution of problems.
CLO 4	Describe the MATLAB AUI effectively.
CLO 5	Apply knowledge of various tool boxes to construct and implement algorithm for a given problem & use the Simulink to solve engineering problems.

g. **Mapping of Course Learning Outcomes and Bloom's Taxonomy:**

Course Learning Outcomes	
CLO 1	Memorize the features of the MATLAB development environment.

CLO 2	Write simple programs in MATLAB to solve scientific and mathematical problems.
CLO 3	Write functions to find modular solution of problems.
CLO 4	Describe the MATLAB AUI effectively.
CLO 5	Apply knowledge of various tool boxes to construct and implement algorithm for a given problem & use the Simulink to solve engineering problems.

h. Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Learning Outcomes:

CLOs	**PLOs**												**PSO**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CLO 1	2.00	1.00	1.00	1.00	3.00	1.00	2.00	3.00	2.00	2.00	1.00	2.00	3.00	3.00
CLO 2	3.00	2.00	2.00	1.00	3.00	1.00	2.00	3.00	3.00	2.00	2.00	3.00	3.00	3.00
CLO 3	2.00	2.00	2.00	1.00	3.00	1.00	2.00	3.00	3.00	2.00	2.00	3.00	3.00	3.00
CLO 4	2.00	1.00	1.00	3.00	3.00	2.00	2.00	3.00	2.00	3.00	2.00	2.00	2.00	2.00
CLO 5	3.00	3.00	3.00	2.00	3.00	2.00	2.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Weighted Average	2.40	1.80	1.80	1.60	3.00	1.40	2.00	3.00	2.60	2.40	2.00	2.60	2.80	2.80

i. Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
-	**-**	**4**	**2**	**-**	**-**	**100**	**-**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

j. Mapping of Experiment List with Course Learning Outcomes:

Sr. NO.	Experiment List
1	Draw electrical and electronic symbols AutoCAD and take printout.
2	Draw D.C. & A.C machine parts using AutoCAD and take printout.

3	Draw the wiring lay out of floor using AutoCAD and take printout.
4	Draw the substation layout using Auto CAD and take printout.
5	Draw different types of rectifier circuit using CAD and take print out of a) Single phase half wave b) Single phase full wave c) Bridge rectifier.
6	Do basic performance of arithmetic operators in MATLAB.
7	Demonstration of mathematical functions in MATLAB.
8	Performance of Array operation and linear operation in MATLAB.
9	Write a m-file scripts for given example in MATLAB.
10	Design and implementation of Basic electrical model in MATLAB.

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k. **Course Name:** Major Project-II
l. **Course Code:** 03607364
m. **Prerequisite:** Basic Knowledge of Mathematics and computer.
n. **Rationale:** The course provides a gentle introduction to the MATLAB computing environment, and is intended for beginning users and those looking for a review. It is designed to give students a basic understanding of MATLAB, including toolboxes.

o. **Course Learning Objective:**

CLOBJ 1	Develop the ability to apply theoretical knowledge effectively in practical settings, demonstrating proficiency in transforming theoretical concepts into real-world applications.
CLOBJ 2	Foster and enhance innovative thinking and problem-solving skills, encouraging students to explore creative solutions and novel approaches to challenges encountered in their field of study.
CLOBJ 3	Cultivate a sense of curiosity and enthusiasm for learning, promoting active engagement in academic pursuits and fostering a passion for continuous self-improvement and exploration of new ideas.
CLOBJ 4	Enhance leadership and teamwork abilities, equipping students with the skills necessary to lead and collaborate effectively in group settings, while also developing strategies for solving complex problems through collective effort and cooperation.

p. **Course Learning Outcomes:**

CLO 1	Makes Transformation of Theoretical Knowledge and its Applications.

CLO 2	Improves Innovative Spirit.
CLO 3	Boosts Curiosity and Liking for Studies.
CLO 4	Improves Team Leading and Problem-Solving Skills.

q. Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes	
CLO 1	Makes Transformation of Theoretical Knowledge and its Applications.
CLO 2	Improves Innovative Spirit.
CLO 3	Boosts Curiosity and Liking for Studies.
CLO 4	Improves Team Leading and Problem-Solving Skills.

r. Mapping of Course Learning Outcomes and Program Learning Outcomes and Program Specific Learning Outcomes:

CLOs	**PLOs**												**PSO**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CLO 1	3.00	2.00	3.00	2.00	3.00	2.00	1.00	2.00	2.00	2.00	1.00	2.00	3.00	2.00
CLO 2	2.00	3.00	2.00	3.00	2.00	3.00	2.00	2.00	3.00	2.00	3.00	3.00	1.00	3.00
CLO 3	1.00	1.00	3.00	1.00	2.00	2.00	1.00	1.00	2.00	2.00	1.00	3.00	1.00	2.00
CLO 4	2.00	3.00	2.00	3.00	2.00	2.00	2.00	2.00	3.00	2.00	3.00	2.00	2.00	3.00
Weighted Average	2.00	2.25	2.50	2.25	2.25	2.25	1.50	1.75	2.50	2.00	2.00	2.50	1.75	2.50

s. Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
-	**-**	**12**	**6**	**-**	**-**	**60**	**-**	**40**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination