

Electrical Engineering

Project Management Skills

UNIT NO	Unit skill set (In cognitive domain)	Topics / Subtopics	Hours L-T-P
1 Introduction	Use Basic Science, Maths skills to understand Project management and project planning, execution and control.	Introduction and definition, Features of a Project, Types of Projects, Benefits and Obstacles in Project Management, Project Management Profession, Role of Project manager, Consultants,	02-00-04
		Project and Operation, Project Management Process, Project Scope	
2 Project Administration	Able to develop WBS, PEP and PM processes for Project with given inputs	Project Administration, Project Team, Project Design, Work Breakdown Structure (WBS), Project Execution Plan (PEP), Systems and Procedure Plan, Project Direction, Communication and Coordination, Project Success Case Study I	06-00-12
3 Project Lifecycle	Use project administration and project lifecycle knowledge to Assess and plan for project risk	Project Life Cycle, Phases - Project Planning, Project Execution, Project Closure, Project Risks, Project Cost Risk Analysis, Time and Cost overruns Case Study 2a	04-00-08
4. Project Planning, Project Scheduling and Project Monitoring and Implementation	Able to develop a detailed project plan given the inputs on manpower, funds availability and time availability	Project Planning Function, Structure, Project Scheduling, Project monitoring and Project evaluation Case Study 2b	06-00-12

5.Project Control, Review and Audit	Use Project Management lifecycle knowledge to Control project parameters, review and audit project performance	Project Control, Problems of Project Control, Gantt Charts, Milestone Charts, Critical Path Method (CPM), Network Technique in Project Scheduling, Crashing Project Duration through Network, Project Review, Initial Review, Performance Evaluation, Abandonment Analysis, Project Audit Case Study 2c	06-00-12
6.Digital Project Management	Understand latest trends of digital technologies impacting the domain of project management and application of the same in multiple scenario	Digital Technology trends in Project management, Cloud Technology, IoT, Smart cities, Data and analytics, case studies Case study 3	02-00-04

STATISTICS AND ANALYTICS

UNIT NO	Unit skill set (In cognitive domain)	Topics/Subtopics	Hours L-T-P
UNIT-1 STATISTICAL DATA COLLECTION AND TYPES	<p>Able to collect statistical data. Able to distinguish the data types. Understands the usage of data collection tools</p> <p>Able to specify problem statement for data collection</p> <p>Able to collect data pointing the root cause of the problem statement.</p>	<p>a Definition of data and classification (qualitative quantitative discrete and continuous data).</p> <p>b Data collection tools i) Questionnaires. ii) Survey. iii) Interviews. iv) Focus group discussion.</p> <p>1.3 Data cleaning.</p>	4-0-8
UNIT-2 SUMMARIZATION OF DATA	<p>Sketches bar, pie and histograms on Microsoft Excel spread sheet.</p> <p>Sketches frequency curve and frequency polygon for the data set on Microsoft Excel spread sheet.</p> <p>Sketches bar, pie and histograms on Microsoft Excel spread</p>	<p>a Descriptive statistics v) Datatabulation(frequency table vi) Relative frequency table.</p> <p>b Grouped data vii) Bar graph viii) Pie chart ix) Line graph x) Frequency polygon xi) Frequency curve xii) Relative frequency polygon xiii) Histograms xiv) Box plot xv) Leaf-stem plot</p> <p>To be done in Microsoft excel.</p>	8-016

	<p>sheet.</p> <p>Sketches frequency curve and frequency polygon for the data set on Microsoft Excel spread sheet.</p>		
<p>UNIT-3</p> <p>MEASURE OF LOCATION AND DISPERSION</p>	<p>Able to determine the descriptive statistical variables using Microsoft Excel.</p> <p>Able to determine the absolute measures of dispersion of the given data set.</p> <p>Explain the symmetry and asymmetry of the distributed data.</p>	<p>a Determination of central tendencies Range, Mean, Mode and Median for the data in Microsoft excel.</p> <p>b Determination of absolute measures of dispersion for data like range quartile deviation, mean deviation, standard deviation and variance in Microsoft Excel.</p> <p>c Skewness and kurtosis graphs in Microsoft excel and interpretations of results.</p>	6-012
<p>UNIT-4</p> <p>INTRODUCTION TO PYTHON PROGRAMMING</p>	<p>Able Install and run the Python interpreter.</p> <p>Create and execute Python programs.</p> <p>Understand the concepts of file I/O.</p> <p>Able to read data from a text file using Python.</p> <p>Learn variable declarations in Python.</p> <p>Learn control structures.</p>	<p>4.1 Introduction to PYTHON.</p> <p>4.2 Syntax of PYTHON.</p> <p>4.3 Comments of PYTHON.</p> <p>4.4 Data types of PYTHON.</p> <p>4.5 Variables of PYTHON.</p> <p>4.6 If-else in PYTHON.</p> <p>4.6 Loops in PYTHON.</p> <p>4.7 Arrays and functions in PYTHON.</p>	8-016

STATISTICS AND ANALYTICS LAB

SL NO	Practical outcomes/Practical exercises	Unit no	PO	CO	L:T:P
	Learn loop constructs.				
1	Prepare a questionnaire (closed end) containing 25 questions for a specified problem statement: for example experience of an individual in a restaurant.	1	1,2,4,5,7	1	0:0:2
2	Prepare a Google form for a specified problem statement to collect the dataset. (for example questionnaire to conduct online quiz)	1	1,2,4,5,7	1	0:0:2
3	Send out a survey on your problem statement to number of 50 (By Google forms) and collect the data.	1	1,2,4,5,7	1	0:0:2
4	Remove duplicate or irrelevant observations. Remove unwanted observations from the dataset provided, including duplicate observations or irrelevant observations.	1	1,2,4,5,7	1	0:0:2
5	In Microsoft Excel spread sheet draw the frequency distribution table for the given data (data set should contain minimum 50 data).	2	1,2,4,5,7	2	0:0:2
6	In Microsoft Excel spread sheet draw the relative frequency distribution table for the given data (data set should contain minimum 50 data).	2	1,2,4,5,7	2	0:0:2
7	Using Microsoft Excel spread sheet plot bar graph for the data collected from 100 people(for example, conduct a survey on the favorite fruit of a person in your locality(restricting to 5 to 6 fruits). Explain the bar graph with minimum 30 words.	2	1,2,4,5,7	2	0:0:2
8	Using Microsoft Excel spread sheet plot pie chart for the data collected from 50 people(for example, conduct a survey on the smokers with respect to their ages in your locality. Explain the pie chart with minimum 30 words.	2	1,2,4,5,7	2	0:0:2
9	Using Microsoft Excel spread sheet draw a line graph for the given dataset.	2	1,2,4,5,7	2	0:0:2
10	Using Microsoft Excel spread sheet draw frequency polygon and frequency curve for the data collected from 50 people. (For example, marks obtained by the students in your class in 5 subjects in previous examination). Explain your observations from the graph in minimum 30 words.	2	1,2,4,5,7	2	0:0:2
11	Using Microsoft Excel spread sheet construct a box plot for the given dataset. (For example dataset can be the number of passengers in a flat form at different time in a day).	2	1,2,4,5,7	2	0:0:2

12	Using Microsoft Excel spread sheet construct a leaf plot for the given dataset. Explain the graph with minimum 30 words.	2	1,2,4,5,7	2	0:0:2
13	Using Microsoft Excel spread sheet find the Mean, Mode and Median for the data (univariate data) given and also represent them in a Histogram.	3	1,2,4,5,7	2	0:0:2
14	Generate a 50 random data sample (even and odd number dataset) using Microsoft Excel spread sheet and determine the range and Quartiles.	3	1,2,4,5,7	2	0:0:2
15	Collect the current yield of a crop from 50 different persons (problem statement can be changed according to priorities of the tutor) in your locality and determine mean deviation and Quartile deviation in Microsoft excel spread sheet and brief your inference with less than 30 words.	3	1,2,4,5,7	3	0:0:2
16	Collect the data of any 2 livestock population from 50 different houses in your locality (problem statement can be changed according to priorities of the tutor) and determine standard deviation for both the two separately in Microsoft excel spread sheet and brief your inference with less than 30 words.	3	1,2,4,5,7	3	0:0:2
17	Collect the data of two wheeler (with a rider and a pillion) crossing a busy junction in your locality in the peak hours (problem statement can be changed according to priorities of the tutor) and determine the variance of the data in Microsoft excel spread sheet and brief your inference with less than 30 words.	3	1,2,4,5,7	3	0:0:2
18	Using Microsoft Excel spread sheet draw a Skewness graph and kurtosis graph for randomly generated dataset.	3	1,2,4,5,7	3	0:0:2
20	Write a python program to add 2 integers and 2 strings and print the result.	4	1,2,4,5,7	4	0:0:2
21	Write a python program to find the sum of first 10 natural numbers.	4	1,2,4,5,7	4	0:0:2
22	Write a python program to find whether the number is odd or even.	4	1,2,4,5,7	4	0:0:2
23	Write a python program to find the variance and standard deviation for the given data..	4	1,2,4,5,7	4	0:0:2
24	Write a python program to display student marks from the record.	4	1,2,4,5,7	4	0:0:2
25	Write a python program to create a labeled bar graph using matplotlib. pyplot.	4	1,2,4,5,7	4	0:0:2
26	Write a python program to create a labeled pie chart using matplotlib. pyplot.	4	1,2,4,5,7	4	0:0:2
Total Hours					0:0:52=5 2

FUNDAMENTALS OF ELECTRICAL & ELECTRONICS ENGINEERING

Sl No	Unit skill set (In cognitive domain) <i>On successful completion of the class, the students will be able to</i>	Topics/Sub topics	Practical	Hours L-T-P
UNIT-1 Electrical Safety				
1	Comply with the Electrical safety	1. Electrical Symbols 2. Electrical safety <ul style="list-style-type: none"> • Identify Various types of safety signs and what they mean • Demonstrate and practice use of PPE • Demonstrate how to free a person from electrocution • Administer appropriate first aid to victims, bandaging, heart attack, CPR, etc. • Fire safety, causes and precautionary activities. • Use of appropriate fire extinguishers on different types of fires. • Demonstrate rescue techniques applied during fire hazard, correct method to move injured people during emergency • Inform relevant authority about any abnormal situation http://nreeder.com/Flash/sym	1. Electrical symbols related to electrical engineering. 2. Electrical safety	02-00-04
		bols.htm http://bouteloup.pierre.free.fr/iufm/as/de/house/safety.html		
UNIT-2 Electrical Fundamentals				
2	1. Identify and select the different measuring devices. 2. Identify different electrical supply systems 3. Identify open circuit, close circuit and short circuit conditions.	1. Describe the sources of electrical energy. 2. Electrical current, voltage, emf, potential difference, resistance with their SI units. 3. Mention the meters used to measure different electrical quantities. 4. Explain supply systems like AC, DC. 5. Describe open circuit, close circuit and short circuit http://nreeder.com/Flash/units.htm	1. Identification of measuring devices. 2. Measure current, voltage and analyses the effects of shorts and opens in series/parallel circuits.	1:0:2

3	Calculate basic electrical quantities	<ul style="list-style-type: none"> Behavior of V, I in Series and Parallel DC circuits. Relationship between V, I and R. <p>http://nreeder.com/Flash/ohmsLaw.htm</p>	<ol style="list-style-type: none"> Measure the voltage and current against individual resistance in electrical circuit. Compare the theoretical values with actual in the circuit. 	1:0:2
4	Connect resistances in different combination	<ol style="list-style-type: none"> Equation to find the Resistances connected in series Equation to find Resistances connected in parallel series and Resistances connected parallel combinations Simple problems. 	<ol style="list-style-type: none"> Determine the equivalent Resistance of series connected resistances. Determine the equivalent Resistance of parallel connected resistances. 	1:0:2
5	Calculate and measurement of different parameters of an AC quantity.	<p>Ac sinewave: Sinusoidal voltage, current, amplitude, time-period, cycle, frequency, phase, phase difference, and their units.</p> <p>http://nreeder.com/Flash/freqPeriod.htm</p> <p>http://nreeder.com/Flash/oscilloscope.htm</p>	Demonstrate the measurement of frequency, time period and phase difference of AC quantity using CRO and function generator.	1:0:2
6	<ol style="list-style-type: none"> Calculate and measure electric power and energy Identify and differentiate Single phase and Three phase supply 	<ol style="list-style-type: none"> Electrical work, energy, power and power factor <ul style="list-style-type: none"> SI units Mention the meters used to measure them Single phase and Three phase supply <p>http://nreeder.com/Flash/powerLaw.htm</p> 	<ul style="list-style-type: none"> Measure the voltage, current, power and energy using relevant measuring instruments in a single-phase load. Compare the theoretical values with actual in the circuit. Measure the voltages in Single phase and Three phase supply. 	1:0:2

UNIT-3
Protective Devices and Wiring circuits

7	Identify and select Protective Devices for given current and voltage rating	<ol style="list-style-type: none"> Necessity of Protective Devices Various Protective devices and their functions <ul style="list-style-type: none"> fuse wire, Glass cartridge fuse HRC fuse Kit-kat fuse MCB MCCB RCCB ELCB Relay Earthing <ul style="list-style-type: none"> Types Pipe earthing 	<ol style="list-style-type: none"> Identification and Selection of various protective devices Inspection of their installation in the college building/public building. 	1:0:2
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		<ul style="list-style-type: none"> • Plate earthing 		
8	Identify and select the various electrician tools	<ol style="list-style-type: none"> 1. Different types of electrician tools and their function. 2. Describe various wiring tools. 3. State procedure of care and maintenance of wiring tools. 	Identification and selection of different tools.	1:0:2
9	<ol style="list-style-type: none"> 1. Identify and select Wiring systems for a given applications 2. Identify and select the cables used for different current and voltage ratings. 3. Draw the wiring diagram 	<ol style="list-style-type: none"> 1. Describe different types of wiring systems. <ul style="list-style-type: none"> • Surface conduit • concealed conduit • PVC casing capping 2. Wiring systems and their applications. 3. Describe the types of wires, cables used for different current and voltage ratings. 	<ol style="list-style-type: none"> 1. Identification and selection of different Wiring systems. 2. Wire up and test PVC Conduit wiring to control of 2 sockets and 2 lamps. 3. Wire up and test PVC Conduit wiring to control one lamp from two different places. 	2:0:4
10	Estimate and plan electrical wiring	Explain Plan and estimate the cost of electrical wiring for one 3m × 3m room consisting of 2 lamps, 1 ceiling fan, 2 three pin sockets.	Prepare the estimation and plan	1:0:2
UNIT-4 Electrical Machines and Batteries and UPS				
11	<ol style="list-style-type: none"> 1. Identify the types of transformer. 2. verify the transformation ratio. 	Transformer <ul style="list-style-type: none"> • working principle • Transformation ratio • Types and applications with their ratings 	Connect the Single- phase transformer as Step-Up, Step-Down transformer and verify the transformation ratio.	1:0:2

12	1. Start and run the induction motor. 2. Troubleshoot DOL/Stardelta starter and induction motor	1. Induction motor <ul style="list-style-type: none"> Types Induction motor and applications Difference between single and three phase motors Necessity of starters for AC motors Describe different types of starters and applications 2. What are different causes and remedies for a failure of starter and induction motor.	1. Construct a suitable circuit to start and reverse the direction of three phase induction motor using DOL/ Stardelta starter. 2. Troubleshoot the DOL/S tar-delta starter and induction motor	2:0:4
13	Select and test the battery for a given application	Battery <ul style="list-style-type: none"> Types of batteries (Lead acid battery, lithium, sealed maintenance free (SMF) battery, Modular battery). Selection criteria of batteries for different applications. Ampere-Hour Capacity. Efficiency 	Testing Condition of a Lead-acid battery	1:0:2
14	Select the size of the UPS for a given application	UPS <ul style="list-style-type: none"> List the types and applications Selection criteria of UPS Sizing of UPS 	Sizing of UPS	1:0:2
UNIT-5 Introduct ion to Electronic Devices and Digital Electronics				
15	Identify and differentiate Conductors, insulators and semiconductors.	Compare Conductors, insulators and semiconductors with examples http://nreeder.com/Flash/resistor. htm	Identification of types and values of resistors-color codes. Determine the value of resistance by color code and compare it with multimeter readings.	1:0:2
16	Identify and test PN junction Diode	PN junction diode <ul style="list-style-type: none"> Symbol Characteristics • Diode as switch. Types of diodes and ratings Applications 	Identify the terminals of a Diode and test the diode for its condition.	1:0:2
17	Build and test bridge rectifier circuit	Rectifier <ul style="list-style-type: none"> Need for AC to DC conversion Bridge rectifier with and without C filter, Rectifier IC. 	Construct and test bridge rectifiers using semiconductor diode and rectifier IC. Compare the waveforms using CRO.	1:0:2
18	1. Identify and test Transistor 2. Build and test transistor as an electronic switch	Transistor (BJT) <ul style="list-style-type: none"> Symbol Structure Working principle 	1. Identification of transistor terminals and test. 2. Construct and test the transistor as an electronic switch	1:0:2

19	1. Identify and test various Sensors and actuators.	1.Sensors <ul style="list-style-type: none"> • Concept • Types: Temperature, Pressure, Water, Light, Sound, Smoke, proximity Sensors, Flow, humidity, voltage, vibration, IR (Principle/working, ratings/ specifications, cost, and applications) 2.Actuators <ul style="list-style-type: none"> • Concept • Types and applications. • Relay as an actuator. 	1. Connect and test an IR proximity sensor to a Digital circuit. 2. Connect and test a relay circuit using an Optocoupler. (Photo Diode & Transistor)	2:0:4
20	1. Identify and test different digital IC	<ul style="list-style-type: none"> • Comparison of analog and digital signal • Digital systems, examples. • Binary numbers, Boolean identities and laws. • Digital system building blocks: Basic logic gates, symbols and truth tables. • IC-Definition and advantages. 	<ul style="list-style-type: none"> • Test a Digital IC. • Identification and selection of suitable ICs for basic gates. • Verify NOT, AND, OR, NOR, EXOR and NAND gate operations (two inputs). 	2:0:4
21	Know the application of Microcontroller and PLC	<ul style="list-style-type: none"> • Microcontroller as a programmable device, and list of real-world applications. • PLC and Their applications. 	<ul style="list-style-type: none"> • Identify different application microcontroller. • Identify commercially available PLC and their specifications 	1:0:2
TOTAL				26-052=78 Hours

FUNDAMENTAL OF ELE. & ELECTRONICS PRATICAL

Sl. No.	Practical Out Comes/Practical exercises	Unit No.	PO	CO	L: T:P Hrs.
1	1. Collect/draw standard prominent electrical symbols related to electrical engineering. 2. Identify Various types of safety signs and what they mean	1	1,4	1	0:0:2
2	<ul style="list-style-type: none"> • Identify Various types of safety signs and what they mean • Demonstrate and practice use of PPE • Demonstrate how to free a person from electrocution • Administer appropriate first aid to victims, bandaging, heart attack, CPR, etc. • Fire safety, causes and precautionary activities. • Use of appropriate fire extinguishers on different types of fires. • Demonstrate rescue techniques applied during fire hazard, correct method to move injured people during emergency • Inform relevant authority about any abnormal situation 	1	1,4	1	0:0:2
3	1. Identification Measuring devices <ul style="list-style-type: none"> • Ammeter • Voltmeter • Wattmeter • Ohmmeter • Digital Multimeter • Megger • Tong tester 2. Measure current, voltage and analyses the effects of shorts and opens in series / parallel circuits.	2	1,4	2	0:0:2
4	Measure the voltage and current against individual resistance in electrical circuit. Compare the theoretical values with actual in the circuit.	2	1,4	2	0:0:2
5	1. Determine the equivalent Resistance of series connected resistances. 2. Determine the equivalent Resistance of parallel connected resistances.	2	1,4	2	0:0:2
6	Demonstrate the measurement of frequency, time period and phase difference of AC quantity using CRO and function generator.	2	1,4	2	0:0:2

7	Measure the voltage, current, power and energy using relevant measuring instruments in a Single-phase load. Compare the theoretical values with actual in the circuit.	2	1,4	2	0:0:2
	Measure the voltages in Single phase and Three phase supply.				
8	1. Identification and selection of various protective devices. <ul style="list-style-type: none"> • HRC fuse • Kit kat fuse • MCB • MCCB • RCCB • ELCB • Relay Videos/Presentations/Discussion on different protective devices. 2. Inspection of their installation in the college building/public building.	3	1,4	3	0:0:2
9	Identification and selection of different tools. Handson use of the tools for appropriate applications. Combination plier, Cutting Plier, Nose plier, screw driver set, line tester, Poker, Hand Drill, Power Drill, Concrete Drill, Megger, Earth tester, Continuity tester, crimping tool, wire cutter, Wire splicer, wire stripper standard wire gauge, soldering iron, wooden mallet, ball pin hammer, testing board	3	1,4	3	0:0:2
10	1. Identification and selection of different tools. Handson use of the tools for appropriate applications. Surface conduit <ul style="list-style-type: none"> • concealed conduit • PVC casing capping 2. Wire up and test PVC Conduit wiring and practice control of 2 sockets and 2 lamps.	3	1,4	3	0:0:2
11	Wire up and test PVC Conduit wiring to control one lamp from two different places.	3	1,4	3	0:0:2
12	Plan and estimate the cost of electrical wiring for one 3mx3m room consisting of 2 CFL 1ceiling fan, 2 three pin sockets.	3	1,4	3	0:0:2
13	Connect the Single- phase transformer as Step-Up, Step-Down transformer and verify the transformation ratio.	4	1,4	4	0:0:2
14	Construct a suitable circuit to start and reverse the direction of three phase induction motor using DOL/star-delta starter.	4	1,4	4	0:0:2
15	Troubleshoot the DOL/Star-delta starter and induction motor	4	1,4	4	0:0:2
16	Testing Condition of a Lead-acid battery	4	1,4	4	0:0:2
17	Estimate the UPS rating for a computer lab with 50 computers/domestic.	4	1,4	4	0:0:2
18	1. Identification of types and values of resistors-color codes. 2. Determine the value of resistance by color code and compare it with multimeter readings	5	1,4	5	0:0:2

19	Identify the terminals of a Diode and test the diode for its condition.	5	1,4	5	0:0:2
20	Construct and test bridge rectifiers using semiconductor diode and rectifier IC. Compare the waveforms using CRO.	5	1,4	5	0:0:2
21	Identification of transistor terminals and test. Construct and test the transistor as an electronic switch.	5	1,4	5	0:0:2
22	Connect and test an IR proximity sensor to a Digital circuit.	5	1,4	5	0:0:2
23	Connect and test a relay circuit using an Optocoupler. (Photo Diode & Transistor)	5	1,4	5	0:0:2
24	Test an IC. Verify the truth-table AND, OR, NOT logic gates.	5	1,4	5	0:0:2
25	Verify the truth-table NAND, NOR, EX-OR, EX-NOR logic gates.	5	1,4	5	0:0:2
26	1. Identify MCS-51 variants 2. Identify commercially available PLC and their specifications.	5	1,4	5	0:0:2
Total					0:0:52 =52Hrs

Transformer & Alternators

Week	Lecture (KnowledgeCriteria)	Tutorial (Activity Criteria)	Practice (Performance Criteria)
	3 hours/week	1 hour/week	4 hours/week (2 hours/batch twice in a week)
1	<p>1. Magnetic circuit, MMF, reluctance and mention their units, Absolute permeability and Relative permeability and mention their units, relationship between Flux, MMF and Reluctance. simple problems on magnetic circuit</p> <p>2. AC fundamentals Concept of capacitive reactance, inductive reactance, and impedance. Current and Power in a pure resistive, inductive and capacitive circuit.</p>	Refer Table 1	<p>1. Simulate pure resistive, pure inductive and pure capacitive circuit and observe the phase difference between waveforms of Voltage & Current.</p> <p style="text-align: center;">OR</p> <p>1a. Setup pure Inductor circuit. Measure V & I for a range of frequencies, calculate inductive reactance (X_L) and record them in a table. Plot a graph showing X_L as a function of the angular frequency. Observe the phase difference between V and I.</p> <p>1b. Setup pure capacitor circuit. Measure V & I for a range of frequencies, calculate</p>

			capacitive reactance (X_c) and record them in a table. Plot a graph showing X_c as a function of the angular frequency. Observe phase difference between V and I .
	3. Current, Power and Power factor of R-L, R-C, R-L-C series and parallel circuits. Concept and Applications of resonance.		2. Simulate R-L, R-C, R-L-C series circuits and observe the phase difference between waveforms of Voltage & Current. OR 2. Set up RLC circuit. a. Measure V & I for range of frequencies and record measurements in table. b. Calculate corresponding impedance (Z), power factor and record in a table. c. Plot graph of Z vs angular frequency and power factor vs angular frequency. c. Estimate resonance frequency graphically and compare with theoretical value.
2	TRANSFORMERS 1. Basics: a. Working Principle of Transformer. b. Construction. c. Operation.	Refer Table 1	Demonstrate workplace safety norms to be followed when handling electrical machines. 1a. Identification of different types of transformers based on i. Construction ii. No. of phases iii. Application. 1b. Identification of different parts of transformer
	2. Classification of Transformers: a. Based on Construction b. Based on No. of phases c. Based on application Shell and Core type: Construction and application.		
	3. Main Parts of Transformer: a. Tank b. Core c. Winding d. Insulation: i. Oil ii. Paper e. Bushings (HT/LT/NT) f. Conservator g. OLTC (ON Load/OFF Load Tap Changers) h. Breather i. Safety Devices: i. Pressure Relief Device ii. Buchholz Relay j. Instruments: i. Oil Temperature Indicator (OTI)/Transmitter ii. Winding Temperature Indicator (WTI)/Transmitter iii. Conservator Oil level Indicator/Transmitter		2. Identify the terminals of a single-phase transformer, test it for open circuit, short circuit and ground faults using a test lamp /megger, check the insulation resistance, identify and locate the possible faults. Suggest remedies.
3	1. Derive emf equation, and explain transformation ratio (K). Explain Operation of a transformer on No-load with a vector diagram.	Refer Table 1	Follow Safety rules and Safe working practices 1a. Polarity test on single-phase transformer. 1b. Ratio test on single-phase transformer.
	2. Operation of a transformer On-load with vector diagrams. Draw equivalent Circuit of transformer.		

	3. Problems on emf equation, transformer on NO-load and ON-load conditions.		2. Determine the efficiency and regulation of a single-phase transformer by direct loading.
4	1. Losses in Transformer -List Various losses in a transformer. - Voltage regulation and efficiency in the transformer. - Write an equation for voltage regulation and efficiency. -Condition for maximum efficiency. - All day efficiency. -Problem on all-day efficiency.	Refer Table 1	Follow Safety rules and Safe working practices. 1. Pre-determine the regulation and efficiency of a single-phase transformer by conducting O.C. and S.C. tests, draw the equivalent circuit.
	2. Pre-determine the Regulation and Efficiency of 1-ph transformer by conducting O.C. and S.C. tests.		2. Parallel operation of two single-phase transformers and analyse load sharing pattern for a given KVA rating.
	3. Necessity and conditions for parallel operation. - Parallel operation of single phase transformers with their load sharing.		
5	1. Generation of 3-ph voltage, phase sequence, Star and Delta Connection in 3-ph system, Relation between line voltage and phase voltage in 3-ph Star, Relation between line voltage and phase voltage in 3-ph Delta system. Equation for a 3-ph power	Refer Table 1	Follow Safety rules and Safe working practices 1. Identify the terminals of a three-phase transformer, test it for open circuit, short circuit and ground faults using a test-lamp/megger, check the insulation resistance, identify and locate the possible faults. Suggest remedies.
	2. Working principle & construction of three-phase transformers. Connection type: i. Star-Delta ii. Delta-Star iii. star-star iv. Delta-Delta v. Open delta vi. Scott.		2. Connect three single-phase transformers for three-phase operation of delta-delta/ delta-star/ star-star/ star-delta. Measure phase and line voltages.
	3. Vector Group i. Brief introduction of Vector Grouping ii. Type of Vector group: a. Yy0, Dd0 b. Yd1, Dy1 c. Yd6, Dy6 d. Yd11, Dy11. Problems on 3 phase star and delta circuits.		
	1. Special purpose transformers Construction and working of current transformer (CT). Ref.7.2(9)		Follow Safety rules and Safe working practices 1a. Identify different types of special purpose transformers. 1b. Measure high current & voltage using CT and PT.

	2. Construction, working of potential transformer (PT)		2a. Ratio and polarity test on CT and PT
	3. Construction, working of Pulse, Toroidal, Isolation transformer and Auto transformer		2b. Verify the voltage of autotransformer with different tapings. Ref.7(10,11,12)
7	1. Study Code of practice for selection, installation and maintenance of transformers. IS 10028	Refer Table 1	Follow Safety rules and Safe working practices 1. Practice on use of IS/IEC standards.
	2. Study IS 1180 and IS 2026 standards: a. scope of IS 1180 and IS 2026 b. List transformers covered and not covered by IS 1180 c. List manufacturer of IS 1180 transformers.		
	3. IEC 60071-1 to IEC 60071-12 standards for power transformers		2. Practice on use of IS/IEC standards
8	1. Testing and Troubleshooting of given transformer-1	Refer Table 1	Follow Safety rules and Safe working practices 1. Demonstrate testing and troubleshooting of given transformer/Visit to nearby transformer test centre Ref.7(13)
	2. Testing and Troubleshooting of given transformer -2		2. Demonstrate installation and commissioning of Transformer.
	3. Installation and Commissioning of transformer		
9	1a. Working principle and construction of DC generator. 1b. Alternator: working principle, Construction of salient pole and non-salient pole alternator.	Refer Table 1	Follow Safety rules and Safe working practices 1a. Identify parts of the DC generator and build up voltage of the shunt generator.
	2. Full pitch Armature windings and Fractional pitch Armature windings. Advantages and disadvantages of Full pitch and Fractional pitch Armature windings.		1b. Identify the parts of an Alternator, note down the nameplate details and interpret it.
	3. Relationship between P,N,f and Derivation of emf equation, Simple problems on E.M.F equation.		2. Identify the terminals, and test the field and armature windings of an Alternator for open circuit, short circuit and ground faults using test lamp /megger, check insulation resistance, Identify and locate the possible faults and suggest remedies.
10	1. Armature reaction in an alternator with sketches, Effects of p.f of load on armature reaction and Effects of	Refer Table 1	Follow Safety rules and Safe working practices

	armature reaction on terminal voltage. 2. Procedure for conducting O.C & S.C. tests on an alternator with circuit arrangements. 3. Effective resistance, leakage reactance & synchronous reactance. Calculate the synchronous impedance by O.C. & S.C test results. Equation for the no-load terminal voltage at different power factors. Voltage regulation definition and methods.		Determine regulation of 3-phase alternator by conducting O.C & S.C tests by EMF method.
11	1. Vector diagram of alternator on Load at different power factors. 2. Necessity and Conditions for parallel operation of three-phase alternators. 3. Parallel operation of three-phase alternators using synchroscope.	Refer Table 1	Follow Safety rules and Safe working practices Conduct parallel operation of 3-ph alternators by Dark Lamp OR Bright Lamp OR Synchroscope method.
12	1. Meaning and types of excitations. Static excitation system Ref.7(14) 2. Effect of unequal voltage on load sharing. Effect of change in excitation and prime mover input power on distribution of load. 3. Hunting and its prevention in alternators. Necessity of cooling in alternators. Cooling agents. – Hydrogen cooling.		Follow Safety rules and Safe working practices 1. Demo (Video) on Static excitation system. Ref.7(14)
13	1. Maintenance of the transformer. 2. Installation and Maintenance of alternator. Ref.7(15) 3. Construction of an Energy efficient transformer. -Star rating of a transformer. -Benefits Of Higher Efficiency in Transformers. -Calculate Cost saving by buying an energy efficient transformer.		2. Demo (Video) on cooling of Alternators
			Follow Safety rules and Safe working practices 1a. Perform general preventive maintenance of the transformer. 1b. Demonstrate installation of Alternator and Perform general preventive maintenance of Alternators. Ref.7(16)
			2a. Demo on different energy efficient transformers. 2b. Visit (or Virtual visit) to the transformer manufacturing industry.
	39	13	52

Residential Electrical Wiring Practice

Unit No.	Practical Outcomes / practical exercises)	Unit No.	Hours		
			L	T	P
1	1) Demonstrate and practice use of PPE 2) Demonstrate how to free a person from electrocution 3) Demonstrate rescue techniques applied during fire hazard, correct method to move injured people during emergency 4) Use of appropriate fire extinguishers on different types of fires	1	0	0	2
2	Identify, specify, dismantle and assemble different types of Lighting accessories (Switches, Socket Outlets, Plugs and Lamp holders)	2	0	0	2
3	Identify, Measure the wire sizes and find the Current rating of different types of Single core Copper and Aluminum cables.	2	0	0	2
4	Identify, specify, dismantle and assemble different types of Conduits and its accessories, LT Switchgears and Protective devices. (Main Switch, Distribution Boards, Fuse, MCB, RCCB).	2	0	0	2
5	<ul style="list-style-type: none"> • Interpret the various BIS symbols used in electrical wiring diagrams. • Interpret Manufactures Catalogue for Cables and wiring accessories. • B.I.S Regulations, Recommendations and the National Electrical Code of practice pertaining to wiring installations. 	2	0	0	2
6	<ul style="list-style-type: none"> • Identify the Phase wire, Neutral wire, Earth wire and Half wire in a switchboard. • Estimatethe permissible load in sub circuits and calculation of cable sizes. 	2	0	0	2
7	Prepare a layout diagram, circuit / schematic diagram, installation plan and wiring diagram for the following: <ol style="list-style-type: none"> a) A bed room with 2 Lamps, 1 fan and one 5A socket. b) A living room with 4 Lamps, 2 fans and three 5A socket. c) A Kitchen with one 15A socket, one 5A socket, one light point and one Exhaust fan. d) A bathroom with one 15A socket, one 5A socket and one 	2	0	0	2

Unit No.	Practical Outcomes / practical exercises)	Unit No.	Hours		
			L	T	P
	light point.				
8	Practice conduits bending, drawing of cables through conduits. (on a board in PVC Surface conduit wiring system)	2	0	0	2
9	Practice the different wirings methods and joints. <ul style="list-style-type: none"> • Switch loop in • Junction box Loop in • Ceiling Rose Loop in • Simple Twist Joint • Married Joint in Stranded conductors 	3	0	0	2
10	Identify the phase and neutral terminals of the supply and perform the following test on domestic wiring installation: <ul style="list-style-type: none"> • Continuity test (OC & SC Test) • Polarity test • Earth and ground test • Insulation and leakage test 	3	0	0	2
11	<ul style="list-style-type: none"> • Two lamps controlled independently. • Two lamps in series controlled by one switch. 	3	0	0	2
12	One lamp, one fan and one three pin socket controlled from one switchboard.	3	0	0	2
13	One lamp controlled from three different places. (Intermediate wiring)	3	0	0	2
14	Consumer main board with Energy meter, Double pole iron Clad Switch and Distribution Board.	3	0	0	2
15	An electrical installation having one room having 2 light points, 1 fan point and one 5A socket. One light point and fan are controlled from two locations. (One lighting sub circuit and multiple switchboards)	3	0	0	2
16	An electrical installation having <ul style="list-style-type: none"> • Two rooms with 1 light point, one fan point and one 5A socket. 	3	0	0	4

Unit No.	Practical Outcomes / practical exercises)	Unit No.	Hours		
			L	T	P
	<ul style="list-style-type: none"> One living room with two 5A sockets, 1 fan points and 2 light points. (Two lighting sub-circuits and multiple switchboards)				
17	An electrical installation having four 15A sockets and 4 light points. (Two Power sub-circuits and one lighting sub-circuit)	3	0	0	4
18	Design a 2BHK residential installation scheme and estimate the materials required. Draw the layout diagram; installation plan and wiring diagram according to National electrical code for the following wiring installations. Also prepare the bill of materials.	3	0	0	2
19	<ul style="list-style-type: none"> Perform the basic electrical tests on the given wiring system and identify the problems such as bad connection, incorrect wiring and equipment failure if any. Locate various faults in residential wiring and rectify them. Check the function of each component for proper functioning. 	4	0	0	4
20	Prepare pipe earthing and measure the earth resistance using earth tester / Megger.	4	0	0	4
21	Prepare plate earthing and measure the earth resistance using earth tester / Megger.	4	0	0	4
					5
					2

Environmental Sustainability

Unit No & Name	Detailed Course Content	CO	PO	Contact Hrs
1. Ecosystem	Structure of ecosystem, Biotic & Abiotic components, Aquatic (Lentic and Lotic) and terrestrial ecosystem.	CO1	1,5,7	1
	Global warming - Causes, effects.	CO1	1,5,7	2
	Green House Effect, Ozone depletion - Causes, effects	CO1	1,5,7	3
2. Air and Pollution	Air pollution, Natural sources of air pollution, Man Made sources of air pollution	CO2	1,5,7	4
	Air pollutants and Types, Effects of Particulate Pollutants and control by Cyclone separator	CO2	1,5,7	5
	Effects of Particulate Pollutants and control by Electrostatic Precipitator, Air (prevention and control of pollution) act 1981.	CO2	1,5,7	6
3. Noise pollution	Noise pollution: sources of pollution, Measurement of Noise pollution level.	CO3	1,5,7	7
	Effects and Control of Noise pollution. Noise pollution (Regulation and Control) Rules, 2000	CO3	1,5,7	8
4. Water and Soil Pollution:	Sources of water pollution. Types of water pollutants, Characteristics of water pollutants.	CO4	1,5,7	9
	Control measures of water pollution.	CO4	1,5,7	10
	Definition and list unit operations in water and WasteWater Treatment process, Water (prevention and control of pollution) act 1974.	CO4	1,5,7	11
	Water conservation – Importance of Rain Water Harvesting	CO4	1,5,7	12
	Soil pollution, Causes and Effects due to Fertilizers, Pesticides and Insecticides	CO4	1,5,7	13
	Preventive measures of Soil Pollution due to Excessive use of Fertilizers, Pesticides and Insecticides.	CO4	1,5,7	14
5. Renewable sources of Energy	Solar Energy: Basics of Solar energy. Solar collectors and advantages of Advanced solar collectors.	CO5	1,5,7	15
	Solar water heater, Solar stills and their uses.	CO5	1,5,7	16
	Biomass: Overview of biomass as energy source. Thermal characteristics of biomass as fuel.			17
	Wind energy: Current status and future prospects of wind energy. Wind energy in India.	CO5	1,5,7	18
	Need of new Energy sources, Different type's new energy sources. Environmental benefits of New Energy Sources-Hydrogen energy	CO5	1,5,7	19
	Environmental benefits of New Energy Sources- Ocean energy resources	CO5	1,5,7	20
	Environmental benefits of New Energy Sources-Tidal energy conversion.	CO5	1,5,7	21

6. Solid Waste Management And Environmental Acts	Solid waste generation, Sources, Characteristics of solid waste Solid Waste Management rules 2016	CO6	1,5,7	22
	E- Waste generation Sources and characteristics, E waste management rules 2016	CO6	1,5,7	23
	Plastic Waste generation Sources and characteristics, Plastic Waste Sources and characteristics	CO6	1,5,7	24
	Recycled plastic rules 2016,Importance of Environment (protection) act 1986,	CO6	1,5,7	25
	Occupational health and safety measures.	CO6	1,5,7	26
			Total	26