

**Vocational Higher Secondary
Education (VHSE)**

Second Year

**ELECTRICAL AND ELECTRONICS
TECHNOLOGY**

Reference Book - Teachers' Version



Government of Kerala
Department of Education

State Council of Educational Research and Training (SCERT),
KERALA
2016

Foreword

Dear Teachers

This reference book (**Teachers' Version**) is intended to serve as a transactional aid to facilitate classroom transaction and as a ready reference for teachers of Vocational Higher Secondary Schools. It offers some guidelines for the transaction of the course content and for undertaking the practical work listed in the course content. As the curriculum is activity based, process oriented and rooted in constructivism focusing on the realisation of learning outcomes, it demands higher level proficiency and dedication on the part of teachers for effective transaction.

In the context of the Right- based approach, quality education has to be ensured for all learners. The learner community of Vocational Higher Secondary Education in Kerala should be empowered by providing them with the best education that strengthens their competences to become innovative entrepreneurs who contribute to the knowledge society. The change of course names, modular approach adopted for the organisation of course content, work-based pedagogy and the outcome focused assessment approach paved the way for achieving the vision of Vocational Higher Secondary Education in Kerala. The revised curriculum helps to equip the learners with multiple skills matching technological advancements and to produce skilled workforce for meeting the demands of the emerging industries and service sectors with national and global orientation. The revised curriculum attempts to enhance knowledge, skills and attitudes by giving higher priority and space for the learners to make discussions in small groups, and activities requiring hands-on experience.

The SCERT appreciates the hard work and sincere co-operation of the contributors of this book that includes subject experts, industrialists and the teachers of Vocational Higher Secondary Schools. The development of the teachers' version of reference books has been a joint venture of the State Council of Educational Research and Training (SCERT) and the Directorate of Vocational Higher Secondary Education.

The SCERT welcomes constructive criticism and creative suggestions for the improvement of the book.

With regards,

Dr. J. Prasad
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CONTENTS

1. About the Course	6
2. Job Roles (Career Paths)	7
3. Major Skills (with sub skills)	8
4. Learning outcomes of the course	9
5. Course structure	10
6. Syllabus	11
7. List of practical activities	12
8. Learning Outcomes of the Units	13
9. Scheme of Work	16
10. Structure of Modules 3 & 4	17
11. Class room Activities	18
12. Practical Activities (General)	18
13. Overview of Module 3	19
14. Unit-1 - Cells and Batteries	20
15. Grid	20
16. Additional Information	21
17. Assessment activities	22
18. List of items in Portfolio	22
19. Extended Activities	23
20. Unit-2 Electronic components and devices – II	23
21. Grid	24
22. Additional Information	26

23. Assessment Activities	27
24. List of Items in Portfolio	27
25. Unit-3 Solar System installation and servicing	28
26. Grid	28
27. Additional Information	32
28. Assessment Activities	32
29. Extended activities	33
30. Overview of the Module 4	33
31. Unit Grid- Electrical Machines	34
32. Additional Information	35
33. Assessment Activities	35
34. List of items in Portfolio	36
35. Extended activities	36
36. Unit 2- Servicing of Common Appliances	36
37. Unit Grid- Electrical Machines	37
38. Additional Information	39
39. Assessment Activities	39
40. List of items in Portfolio	39
41. Extended activities	39
42. Unit 3- Engineering Graphics	41
43. Unit Grid- Engineering Graphics	44
44. Additional Information	46
45. Assessment Activities	46
46. List of items in Portfolio	46
47. Extended activities	47
48. Sample Practical Activities	51
49. References	62

ABOUT THE COURSE

The course named Electrical and Electronics Technology (EET) comes under engineering group. Electrical and Electronics Engineering field has radically transformed our way of life and so the basic concepts of the same have been dealt with in detail. Students with a flair for domestic appliance servicing and wiring will find the course a rewarding career option. Besides this, students can stabilize their career by equipping themselves with wire man license. This can open the portals of self employment to the pass outs. For those aspiring to apply for government jobs, the course is recognized by PSC and so it opens job opportunities. There are ample opportunities in private sectors too. Due priority is also given to skill development to ensure that students don't take a back seat on their ride to success. So the future seems promising for EET students.

The course EET ensures a radical change at the academic level and so is all geared to set a new mile stone for its students. Our prime focus is on developing much needed man power in industries and opening up opportunities for self employment.

The much awaited syllabus revision has distanced the stagnancy that the course had been in for a long time. Bridging the gap between current industry requirement and skill competency of students is a herculean task. We believe that we have done justice to this issue and addressed it by taking a small step forward. All credit goes to replacing obsolete syllabus with portions incorporating current technology and industry requirement. This seems to be the only sensible solution. Practical skills of students should also be enhanced by paying more attention to hands-on-training.

JOB ROLES (CAREER PATH)

A "job role" is a description of what a person does for a certain type of job. The job roles of the course in different sectors are given below:

GOVT/SEMI GOVT. SECTOR	PRIVATE SECTOR	SELF EMPLOYMENT
<ul style="list-style-type: none"> • Electrician • Wireman • Energy meter reader in KSEB • Lab Technical Assistant. 	<ul style="list-style-type: none"> • Electrician • Wireman • LED light repair Technician • Sales man(Electrical & Electronics goods) • Home Appliance Service technician • Solar PV System installation and service Technician. 	<ul style="list-style-type: none"> • Wireman • Home Appliance service technician • Electrician • Electronic circuit board assembling (soldering technician) • LED light repairing technician • LED Lamp assembling and selling. • Solar PV System installation and service Technician.

Major Skills (with sub skills)

1. Installation and Maintenance of Solar PV system.
 - a) Installation, testing and servicing of Lead acid Batteries.
 - b) Identification of active electronic components.
 - c) Testing of active electronic components.
 - d) Assembling of simple amplifiers and inverters.
 - e) Designing of Solar PV System.
 - f) Installation of Solar PV System.
 - g) Servicing of Solar PV System.
2. Servicing of common home appliances.
 - a) Identification of different D C motors.
 - b) Connection of DOL and Star Delta starters.
 - c) Identification of different single phase induction motors.
 - d) Servicing of Electric iron.
 - e) Servicing of Electric water heater.
 - f) Servicing of Ceiling fan.
 - g) Servicing of Pedestal fan.
 - h) Servicing of Mixy.
 - i) Servicing of Wet grinder.
 - j) Servicing of Washing Machine.
 - k) Servicing of Water pumps.
 - l) Drawing engineering graphics.
 - m) Familiarising Electrical AutoCAD.

LEARNING OUTCOMES OF THE COURSE:

MODULE -3: SOLAR PV SYSTEM INSTALLATION & MAINTENANCE

After completion of this module, the learners will be able to:

- Undertake trouble shooting and maintenance of lead acid cell
- Assemble basic amplifier and inverter circuits
- Carry out installation and maintenance of SPV Module
- Undertake servicing of Solar PV Installations & Solar P V devices

MODULE 4 : HOME APPLIANCE SERVICING

After completion of this module, the learners will be able to:

- Carry out servicing and trouble shooting of Electric iron, water heater
Mixer Grinder, wet grinder, ceiling fan, washing machine and water pump
- Understand the construction and working of D.C and A.C Motors.
- Draw the geometric constructions, orthographic projections
and development of surfaces.
- Familiarise and practice Electrical Auto CAD

COURSE STRUCTURE

MODULE No	NAME OF MODULE	PERIOD
1	Basic Electrical & Electronics Technology	340
2	House Wiring	340
3	Solar PV System Installation & maintenance	340
4	Home Appliances Servicing	340
	TOTAL	1360

SYLLABUS**MODULE-3****SOLAR PV SYSTEM INSTALLATION & MAINTENANCE****Unit-1 Cells and Batteries**

Cells- concept of Primary and secondary Cells- Lead Acid Cell- Steps of Construction, Defects, Self discharge/shelf life, Capacity and efficiency of battery, Charging and Discharging, Care and Maintenance, Interconnection of Cells- Series and parallel, Instruments and tools used for battery testing, Battery bank installation, testing and commissioning. Types of lead acid battery- Liquid vented, Tubular- Sealed or VRLA – AGM & Gel, Applications of Nickel cadmium & Lithium ion cells

(55 Periods)

Unit-2 Electronic components and Devices - II

Transistor-types- testing, connections-Transistor as an amplifier- Basic oscillator circuit. SCR- TRIAC- DIAC-FET-MOSFET-IGBT- construction, terminals-applications & testing. Voltage regulator using zener diode and 78XX series- LCD-photodiode-photo transistor, Thermistor, LDR, Super capacitor and their applications. Inverter & UPS - Basic circuit and working - Familiarising inverter circuit using MOSFET/IGBT.Number systems- binary and decimal - Logic gates-AND, OR, NOT, NAND, NOR & XOR

(85 Periods)

Unit-3- Solar PV System installation and maintenance

Introduction to Energy- Renewable and non-renewable energy sources-Energy situation in Kerala and contribution of different energy sources to the energy mix. Solar Energy- Advantages and disadvantages

(5)

Solar PV Modules- Photo Voltaic effect-Solar cells-Construction , Series and Parallel connections of solar cells, fabrication of solar PV module. Mismatch in cells/module, Shading and hot spots. Factors affecting power of a PV Module. Rating of PV Module.

I-V characteristics of PV module- Open circuit voltage-Short circuit current and maximum power point , Selection of solar module according to requirement. **(60)**

Solar PV system and its installation- Components of solar PV System- Choice of batteries for PV modules.DC to DC Converter, Inverter (DC to AC converter), Charge controllers, Wire sizing in P V systems. Types of PV Systems- Stand alone, Grid connected and Hybrid system. Installation of PV module - Orientation and inclination requirements- Module mounting structures– Selection of appropriate equipment, materials, accessories and tools for installation of battery , inverter and other support systems. Safety precautions for installing a solar photo voltaic system.

(100)

Solar PV system maintenance –Basic Maintenance-cleaning of module and maintenance of battery.

(20)

Solar PV devices - Solar lantern, Solar Street lights – Parts & Working.

(15)

TOTAL (200 Periods)

MODULE-4

HOME APPLIANCES SERVICING

Unit –I- Electrical Machines

DC Machines- DC Generator- Parts, Working principle, Types - DC Motors- Parts, Working principle, Types, Applications-necessity of starters.

A.C Motors-Principle of working and types of 3 phase Induction motors- Starters-Connection of DOL and Star delta starter-Single phase Induction Motors-Types-Working -Circuit Diagram and Applications of PSC, CSIR, Universal, Shaded pole, stepper motor and BLDC Motors.

(50 Periods)

Unit-II Servicing of common home Appliances

Parts, working, testing, precautions and servicing of :

1. Electric iron- Non Automatic and Automatic .
2. Electric Water Heater.
3. Ceiling fan.
4. Wall mount/Pedestal fan.
5. Mixer Grinder (Mixy).
6. Wet grinder.
7. Washing Machine – Semi and Fully automatic.
8. Water pump-Centrifugal and Jet.

Star rating of appliances

(200 Periods)

UNIT - III Engineering Graphics**(90 Periods)****Engineering drawing**

Engineering drawing- Uses-Instruments- Types of lines, Lettering and dimensioning, Geometrical construction –bisecting lines- perpendiculars- dividing line into equal parts, Angles. Construction of triangle, square, rectangle, pentagon and hexagon. Conic sections-concept – definition of ellipse, helix, parabola & hyperbola , construction of ellipse & parabola Involute- triangle & square .Projections of points & lines. Projection of planes (first quadrant only). Orthographic Projection - Orthographic views of simple objects- Pictorial Drawing-Isometric projection-Principle, isometric scale, isometric view. Auxiliary views, Free hands sketching of straight lines, rectangles, squares, circles- Sectional views of simple engineering components and devices. Development of surfaces –concept & applications-development of cylinder and pyramid.

Computer Aided Drafting

Introduction to CAD –starting to use CAD software- Application of CAD in Engineering drawing -opening of CAD-Setting of units and limits-saving of drawing. Draw commands (lines, circles, arc, ellipse, hatch, modify, erase, etc.) Dimensioning and text commands. Drawing of 2D figures, creating a new drawing. Introduction to electrical Auto CAD. Familiarise & practice electrical Auto CAD software

LIST OF PRACTICAL ACTIVITIES

MODULE 3

1. Identify the parts of lead acid battery
2. Dismantling & assembling of lead acid battery.
3. Charging of lead acid battery.
4. Testing the condition of a Fully charged & discharged battery.
5. Precautions to be taken during maintenance of lead acid battery.
6. V I characteristics of a Zener diode.
7. Regulated power supply using IC 78XX and Zener diode
8. Common Emitter amplifier circuit.
9. Verification of truth table of logic gates.
10. Testing of Solar panel and measurement of voltages under different irradiations.
11. Open/short circuit testing of PV module by measuring voltage & current.
12. I-V Characteristics of solar PV Module.
13. Maintenance of solar PV system.
14. Assembling and installing module/panel as per design. (Project work)
15. Selecting & installing battery as per the design.
16. Installation & testing of inverter circuit.
17. Installing wiring system for solar equipment.
18. Assembling & installing solar devices.
19. Series & parallel connection of PV module to obtain desired voltage & power.

MODULE 4

1. Fault finding in an AC motor.
2. Rewinding of single phase AC motors.
3. Wire up a single phase induction motor with DOL starter.

4. Identification of parts, Fault identification & repairing of Non automatic & Automatic Electric Iron.
5. Identification of parts, Fault identification & repairing of Water heater.
6. Identification of parts, Fault detection, repairing & installation of Ceiling fan
7. Identification of parts, Fault identification & repairing of Wall mounted/pedestal fans.
8. Identification of parts, Fault identification & repairing of Electric Mixer.
9. Identification of parts, Fault identification & repairing of Wet Grinder.
10. Identification of parts, Fault identification & repairing of Washing Machine.
11. Servicing /trouble shooting & installation of water pump.
12. Practice geometrical construction.
13. Practice orthographic projection.
14. Sketch orthographic views of simple objects.
15. Practice Electrical Auto CAD.

LEARNING OUTCOMES OF THE UNITS

MODULE -3

SOLAR PV SYSTEM INSTALLATION AND MAINTENANCE

UNIT-1 CELLS AND BATTERIES

After completion of this unit, the learners:

- 3.1.1. Explains the concept of Primary & Secondary cells.
- 3.1.2. Explains the construction of lead acid cell.
- 3.1.3. Carry out charging and discharging of lead acid cell.
- 3.1.4 Explains defects, capacity and efficiency of lead acid battery
- 3.1.5. Carry out interconnection of cells in series and parallel.
- 3.1.6. Carryout maintenance of different batteries.
- 3.1.7. Realises the application of different batteries.

UNIT-2 ELECTRONIC COMPONENTS AND DEVICES-II

After completion of this unit, the learners :

- 3.2.1. Identifies the types and connections of transistors
- 3.2.2. Identifies the use of transistor as an amplifier.
- 3.2.3. Realises the concept of SCR and its applications
- 3.2.4. Explains the construction, working and application of TRIAC, DIAC, FET, MOSFET & IGBT
- 3.2.5. Realises the concept of Zener diode and its use as voltage regulator.
- 3.2.6. Realises the applications of LCD, photo diode, photo transistor, LDR
- 3.2.7. Realises the concept of inverter and its basic circuit.
- 3.2.8. Explains binary and decimal number systems and conversion.
- 3.2.9. Comprehends the working of logic gates such as AND, OR, NOT, NAND, NOR & XOR.

UNIT-3 SOLAR PV SYSTEM INSTALLATION AND MAINTENANCE

After completion of this unit, the learners

- 3.3.1 Realises the concept of Solar energy and its advantages and disadvantages.
- 3.3.2. Comprehends photovoltaic effect and solar cells.
- 3.3.3 Explains the operating principles, types, equivalent circuit of a PN junction solar cell.
- 3.3.4 Realises the concept of photovoltaic module and connections of solar cells in series, parallel.
- 3.3.5 Realises the concept of rating of PV module and factors affecting power.
- 3.3.6 Selects solar module according to requirement.
- 3.3.7 Realises the concept of I V characteristics of PV module and mismatch in PV module.
- 3.3.8 Selects batteries for P V module.
- 3.3.9 Realises the concept of conversion of solar voltage to fixed DC and AC .
- 3.3.10 Identifies the concept of charge controller in the circuit.
- 3.3.11 Comprehends wire sizing in PV systems and PV system configurations.
- 3.3.12 Installs solar panel
- 3.3.13 Carryout maintenance of solar panel and solar PV devices.

MODULE-4**HOME APPLIANCES SERVICING****UNIT-1 ELECTRICAL MACHINES**

After completion of this unit, the learners

- 4.1.1 Comprehends the principle, parts and working of DC generator and types.
- 4.1.2 Comprehends the principle, parts and working of DC motor and necessity of Starter
- 4.1.3 Explains the principle of working of 3 phase induction motors.

4.1.4 Connects different types of starters (DOL, Star Delta)

4.1.5 Realises the working of different single phase motors and BLDC motor.

UNIT-2 SERVICING OF COMMON HOME APPLIANCES

After completion of this unit, the learners

4.2.1 Carry out servicing of Electric iron and water heater.

4.2.2 Carry out servicing & repair of ceiling fan, Wall mount/Pedestal fan.

4.2.3 Carry out servicing & repair of Electric Mixer.

4.2.4 Carry out servicing & repair of Wet Grinder.

4.2.5 Carry out servicing & repair of Washing Machine.

4.2.6 Installs and maintain water pump

UNIT-3 ENGINEERING GRAPHICS

After completion of this unit, the learners

4.3.1 Recognises lettering, numbering, dimensioning.

4.3.2 Applies principles of geometric construction.

4.3.3 Constructs square, rectangle, circle, ellipse, parabola, involutes etc

4.3.4 Explains the principles of orthographic projection with simple sketches.

4.3.5 Sketches the orthographic views of simple objects given its pictorial drawing.

4.3.6 Draws the sectional views of simple engineering objects

4.3.7 Realizes concept of development of surfaces like cylinder and pyramid.

4.3.8 Familiarises electrical auto CAD for electrical circuit designs

SCHEME OF WORK

MONTH	UNIT	PERIOD
June	Cells & Batteries	55
	Electronic components & Devices II	13
July	Electronic components & Devices II	68
August	Electronic components & Devices II	4
	Solar PV System installation & maintenance	64
September	Solar PV System installation & maintenance	68
October	Solar PV System installation & maintenance	68
November	Electrical machines	50
	Servicing of Common Home Appliances	18
December	Servicing of Common Home Appliances	68
January	Servicing of Common Home Appliances	68
February	Servicing of Common Home Appliances	46
	Engineering Graphics	22
March	Engineering Graphics	43
	Electrical Auto CAD	25

STRUCTURE OF MODULE 3**SOLAR PV SYSTEM INSTALLATIONS AND MAINTENANCE**

UNIT No	NAME OF UNIT	PERIOD
3.1	Cells & Batteries	55
3.2	Electronic Components & Devices II	85
3.3	Solar PV System Installation & maintenance	200
	TOTAL	340

30% Theory 70% Practical

STRUCTURE OF MODULE 4**HOME APPLIANCES SERVICING.**

UNIT No	NAME OF UNIT	PERIOD
4.1	Electrical machines	50
4.2	Servicing of Common Home Appliances	200
4.3	Engineering Graphics	90
	TOTAL	340

30% Theory 70% Practical

CLASSROOM ACTIVITIES (GENERAL)

- Group Discussions.
- Animated CDs.
- Demonstrations.
- General Discussions.
- Quiz.
- Chart preparation.
- Seminar.
- Project.
- Collection.
- Catalogue preparation.
- Brain storming
- Interaction with experts/successful entrepreneurs in the field.

16. PRACTICAL ACTIVITIES (GENERAL)

- Practical works.
- Simulated experiments.
- Interaction with industrial experts.
- Exhibition.
- Collection.
- Model preparation.
- Circuit fabrication
- Industrial Visits.
- Survey.
- Case study.
- OJT

OVERVIEW OF MODULE 3

The Third module of EET named SOLAR PV SYSTEM INSTALLATION & MAINTENANCE consists of three units such as cells and batteries, electronic components and devices-II and solar PV system installation and maintenance. Cells and batteries deals with the concepts of primary and secondary cells, construction, maintenance and charging of lead acid cells etc. Electronic components and devices includes identification and testing of electronic components such as transistors, SCR, TRIAC, DIAC, FET, MOSFET etc, fabrication and working of voltage regulators, amplifiers and basic inverter circuits. The third unit deals with the concept of solar energy, solar cells, Rating, configuration and installation and maintenance of PV systems. Maintenance of commonly used solar PV devices is also included in this module.

UNIT-1 CELLS AND BATTERIES:

Introduction

Cells and batteries is the first unit in the third module. This unit is very significant being the part of solar PV System. The unit comprises of construction, maintenance, connections & types of lead acid cells (Liquid vented and maintenance free) The charging and discharging methods and testing of lead acid battery is also dealt with. The applications, advantages and disadvantages of nickel cadmium and lithium ion cells are also included.

Grid- Cells and batteries

Idea/concept/skills	Learning outcome	Suggested activities	Assessment
Cells- concept of Primary and secondary Cells. <u>Skills :</u> Classifying. Observing.	The learner will be able to: <ul style="list-style-type: none"> • Explain the concept of Primary & Secondary cells. 	<ul style="list-style-type: none"> • Collection • Classification • Chart display • Demonstration using ICT 	Classifying skills. Activity log
Lead Acid Cell- Construction. <u>Skills :</u> Classifying Observing Familiarizing	<ul style="list-style-type: none"> • Construct a lead acid cell. 	<ul style="list-style-type: none"> • Dismantling • Parts Identification • Discussion • Diagram developing 	Dismantling & Identification Skills. Involvement in discussion. Activity log.
Lead Acid Cell- Defects, Shelf life/ Self Discharge. <u>Skills :</u> Identifying Observing Rectifying	<ul style="list-style-type: none"> • Identify the defects and their remedial measures 	<ul style="list-style-type: none"> • Dismantling • Discussion • Practical work 	Identification Skills. Involvement in discussion. Activity log.
Capacity and Efficiency of Lead acid cell. <u>Skills :</u> Classifying Observing Familiarizing	<ul style="list-style-type: none"> • Understand the Capacity and Efficiency of Lead acid cell. 	<ul style="list-style-type: none"> • Calculation of capacity. • Discussion 	Calculation. Involvement in discussion. Activity log.
Charging and Discharging <u>Skills:</u> Handling tools and instruments. Wiring.	<ul style="list-style-type: none"> • Carry out charging and discharging of lead acid cell. 	<ul style="list-style-type: none"> • Demonstration • Practical work • Discussion. 	Involvement in practical work. Practical activity log.

<p>Lead Acid Cell- Maintenance.</p> <p>Skills : Observing Tools handling</p>	<ul style="list-style-type: none"> • Carryout maintenance of Lead acid batteries 	<ul style="list-style-type: none"> • Demonstration • Practical work • Discussion. 	<p>Involvement in group discussion Activity log & Practical activity log</p>
<p>Carry out interconnection of cells in series and parallel.</p> <p>Skills: Handling tools and instrument. Wiring.</p>	<ul style="list-style-type: none"> •Carry out interconnection of cells in series and parallel. 	<ul style="list-style-type: none"> • Demonstration • Practical work • Discussion. 	<p>Involvement in practical work. Practical activity log</p>
<p>Instruments and Tools used for battery testing</p> <p>Skills: Handling tools and instrument.</p>	<ul style="list-style-type: none"> •Carry out testing of cells. 	<ul style="list-style-type: none"> • Demonstration • Practical work • Discussion. 	<p>Involvement in practical work. Practical activity log</p>
<p>Battery bank installation, testing and commissioning.</p> <p>Skills: Handling tools and instrument. Wiring.</p>	<ul style="list-style-type: none"> •Carry out installation of battery bank and its commissioning. 	<ul style="list-style-type: none"> • Demonstration • Practical work • Discussion. 	<p>Involvement in practical work. Practical activity log</p>
<p>Types of lead acid cell</p> <p>Skills: Identifying Observing</p>	<ul style="list-style-type: none"> •Identify different types of lead acid cells 	<ul style="list-style-type: none"> • Demonstration • Discussion. 	<p>Involvement in Discussion. Activity log</p>
<p>Advantages, disadvantages and applications of Nickel cadmium & lithium ion cells</p> <p>Skills: Handling tools and instrument. Wiring.</p>	<ul style="list-style-type: none"> • Realise the advantages, disadvantages and applications of Nickel cadmium & lithium ion cells 	<ul style="list-style-type: none"> • Demonstration • Discussion. 	<p>Involvement in practical work. Practical activity log</p>

ADDITIONAL INFORMATION

Mixed connection of Batteries

In mixed type of connections, both the combinations of series and parallel are used together. Here the total number of batteries used is equal to the product of number of batteries in series and number of batteries in parallel.

Illustration

Design the battery system for the voltage requirement of 24 volts and capacity of 400 Ah. The specification of available battery are; voltage of 12 V and capacity of 100 Ah.

Required voltage and capacity. $V_{\text{system}} = 24 \text{ V}$. $C_{\text{system}} = 400\text{Ah}$.

Standard values of available battery . $V_{\text{battery}} = 12 \text{ V}$. $C_{\text{battery}} = 100\text{Ah}$.

The number of batteries required for 24V = (N_s) $= \frac{V_{\text{system}}}{V_{\text{battery}}}$
 $= \frac{24}{12\text{v}}$
 $= 2 \text{ Nos.}$

The number of batteries required for 400Ah = (N_p) $= \frac{C_{\text{system}}}{C_{\text{battery}}}$
 $= \frac{400\text{Ah}}{100\text{Ah}}$
 $= 4 \text{ Nos.}$

Total number of batteries required $= N_s \times N_p$
 $= 2 \times 4$
 $= 8 \text{ Nos.}$

1. During the routine check up of a lead acid cell, the hydrometer shows a reading of 1.16. Write the colour and material of the electrodes of this cell.
2. Classify the following cells as primary and secondary and compare their features (Zinc chloride cell, Lithium – ion cell, Nickel – cad, zinc – carbon cell)

3. In a lead acid cell 12 plates are arranged in 4 compartments. This battery delivers a current of 1.5 ampere for 6 hours. Find
 - a. The capacity of this battery.
 - b. Draw the sectional view of this battery so as to get a total voltage of 8 Volts and mark all parts.
 - c. Draw the change in connection of these cells to get a voltage of 2 volts.
4. How can we obtain 400Ah capacity by using 12volt lead acid batteries of 80Ah

LIST OF ITEMS IN PORTFOLIO

1. Practical Activity Log.
2. Collected Catalogues.
3. OJT report.
4. Class Activity log.

EXTENDED ACTIVITIES

Conduct a field visit to your nearby battery service centre and prepare report on;

- Commonly occurring faults.
- Care and maintenance.
- Testing of batteries.

UNIT-2 ELECTRONIC COMPONENTS AND DEVICES – II

Introduction

In the curriculum of EET, Electronic components and devices are divided in to 2 parts. The first part comprises passive components, diodes and rectifiers. It is included in the first module. The second part of electronics is included in this third module. This part consist of testing, connections and application of transistor ,SCR, TRIAC, DIAC, FET, MOSFET, IGBT, zener diode etc. Digital Electronics is also a part of this unit.

GRID

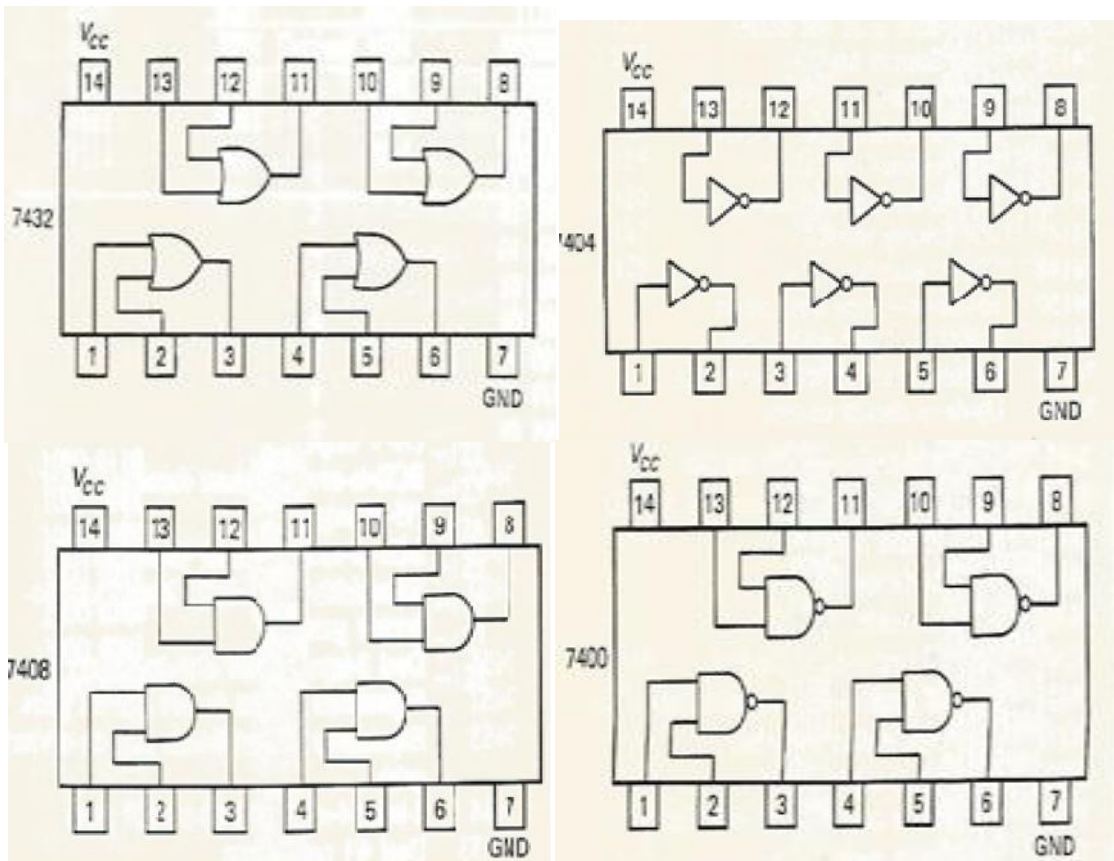
Ideas/ Concepts/Skills	Learning Outcomes	Suggested activities	Assessment
Transistors-types and connections. Skills: Identifying Comparison. Observation. Connecting transistors in circuits	The learner will be able to: <ul style="list-style-type: none"> Identify different types of transistors. Identify different connections of transistors 	Demonstration of different types of transistors. Practical work of connecting transistors in CB,CE & CC	Notes in the activity log, Skill in identification and circuit connection.
Working of Transistor as an amplifier Skills: Observing. Analysing. Connecting transistors in circuits	The learner will be able to: <ul style="list-style-type: none"> Understand the working of transistors as an amplifier Applications of Transistors 	Demonstration of Amplifier circuits Practical work of CE Amplifier.	testing skill. Notes in Practical activity log.
Structure, terminals and applications of SCR,FET,MOSFET, IGBT,DIAC, TRIAC Skills: Observing. Analysing. Identification of terminals	The learner will be able to: Understand the working of SCR,FET MOSFET,IGBT Applications of SCR, FET,MOSFET, IGBT,DIAC, TRIAC	General discussion with demonstration of SCR,FET, MOSFET, IGBT,DIAC, TRIAC	Notes in activity log, Skill in identification of terminals

<p>Working of Zener diode as a voltage regulator & Regulator circuit using 78XX ICs.</p> <p>Skills: Observing. Analysing. connecting components in the circuit.</p>	<p>Realise the concepts of Zener diode and its working as voltage regulator. Voltage regulation using 78XX</p>	<p>General discussion Practical work</p>	<p>Participation in discussion</p> <p>Notes in Practical activity log. Skill in doing Practical work.</p>
<p>LCD , Photodiode , Phototransistor, Thermistor, LDR and Super Capacitor.</p> <p>Skills: Observing. Analysing</p>	<p>Realise the concepts and applications of LCD , Photodiode , Phototransistor, Thermistor, LDR and Super Capacitor.</p>	<p>General Discussion using ICT. Group Discussion with packing types.</p>	<p>Participation in discussion</p> <p>Notes in activity Log.</p>
<p>Basic circuits and working of Inverter and UPS</p> <p>Skills: Observing. Analysing. Identification of circuit components.</p>	<p>Realise the concept and working of basic inverter and UPS circuit and its applications.</p>	<p>Group Discussion. Chart display. Practical work.</p>	<p>Notes in activity log, Involvement in discussion.</p>
<p>Binary and decimal number systems</p> <p>Skills: Observing. Calculating</p>	<p>Convert a binary number to decimal and vice-versa</p>	<p>General discussion Demonstration</p>	<p>Involvement in class work</p>
<p>Logic gates- OR, AND, NOT, NOR, NAND, XOR</p> <p>Skills: Practical Measuring</p>	<p>Identify different logic gates, their symbols, equivalent circuits and truth table.</p>	<p>General discussion Practical work</p>	<p>Notes in activity log, Skill in doing practical.</p>

Additional information

Commonly used gates and their numbers

7400	Quad 2 input NAND gates	7420	Dual 4 input NAND gates
7402	Quad 2 input NOR gates	7421	Dual 4 input AND gates
7404	Hex Inverters	7427	Tripple 3 input AND gates
7408	Quad 2 input AND gates	7430	8 input NAND gate
7410	Tripple 3 input NAND gates	7432	Quad 2 input OR gates
7411	Tripple 3 input AND gates	7486	Quad XOR Gate



ADDITIONAL INFORMATIONS

Table: Output voltage and Nominal input voltage of 78XX series

Types of electronics components

Part number	Output voltage (V)	Nominal input voltage (V)
7805	+5	7.3
7806	+6	8.3
7808	+8	10.5
7810	+10	12.5
7812	+12	14.6
7815	+15	17.7
7818	+18	21.0
7824	+24	27.1

Components code

1N 400X	Diode
BY 127	Diode
BC 547	NPN Transistor
BC 147	NPN Transistor
BC 148	NPN Transistor
BC 149	NPN Transistor
BF 195	NPN Transistor
BE 195	NPN Transistor
SL 100	NPN Transistor
AC 188	PNP Transistor
2N 6005	PNP Transistor
79XX	Voltage Regulator
SN 204	SCR

ASSESSMENT ACTIVITIES

1. Identify the terminals and test the condition of given electronic components.
2. Collect different types of electronic components, identify them, write short notes on them and there by prepare an album.
3. Set up the equivalent circuits of the Logic Gates and verify the output based on Truth Table.

LIST OF ITEMS IN PORTFOLIO (Expected)

- **Practical Activity Log.**
- **Collected Electronic components.**
- **Album.**
- **Class Activity log.**

EXTENDED ACTIVITIES

Assemble an inverter circuit of 300 W capacity using IGBTs.

UNIT-3 SOLAR PV SYSTEM INSTALLATION AND MAINTENANCE

Introduction

Solar PV system installation and maintenance is the third unit in the third module. This unit is the most significant one because the skill certificate is related to this area. This unit consists of the importance of solar energy, its harvesting. The construction , features and installation of solar PV modules and some solar devices are also dealt with.

GRID

Ideas/ Concepts/Skills	Learning Outcomes	Suggested activities	Assessment
Renewable and Non renewable Energy Sources <u>Skills:</u> Observing Realising Comparing	The learner will be able to: Realize the concepts of Renewable and Non renewable energy sources.	Discussion	Notes in the activity log, Participation in discussion.
Energy Situation in Kerala and Energy Mix. <u>Skills:</u> Observing Realising Comparing	The learner will be able to: Realize the concepts of Energy situation in Kerala and Energy Mix.	Discussion	Notes in the activity log, Participation in discussion.
Solar Energy- Advantages and Disadvantages. <u>Skills:</u> Observing Realising Comparing	The learner will be able to: Realize the concepts of solar energy and its advantages & disadvantages.	General discussion	Notes in the activity log, Participation in discussion.
Photo voltaic effects And solar cells <u>Skills:</u> Observing Realising	The learner will be able to: Comprehend photovoltaic effect and solar cells.	General discussion	Notes in the activity log, Participation in discussion.

<p>Construction of solar cell</p> <p><u>Skills:</u> Observing Realising</p>	<p>The learner will be able to: Explain the operating Construction of solar cell.</p>	<p>Demonstration General discussion</p>	<p>Notes in the activity log, Participation in discussion.</p>
<p>PV Modules-connection of solar cells in series and parallel</p> <p><u>Skills:</u> Observing Realising</p>	<p>The learner will be able to: Realise the concept of PV modules and the connection of solar cells in series & parallel</p>	<p>General discussion Demonstration Practical work</p>	<p>Notes in the activity log, Participation in discussion. Skill in doing practical wok.</p>
<p>Mismatch, Shading and Hot spots</p> <p><u>Skills:</u> Observing Realising Comparing</p>	<p>The learner will be able to: Realize the concepts of Mismatch, Shading and Hotspot.</p>	<p>Demonstration Discussion</p>	<p>Notes in the activity log, Participation in discussion.</p>
<p>Rating &factors affecting power rating of PV modules</p> <p><u>Skills:</u> Observing Realising</p>	<p>The learner will be able to: Realise the concept of power and factors affecting power rating of PV modules</p>	<p>General discussion Practical work</p>	<p>Notes in the activity log, Participation in discussion & Practical work</p>

I-V Characteristics of PV modules and mismatch in PV modules <u>Skills:</u> Experimenting Observing Plotting Analysing	The learner will be able to: Plot the I-V Characteristics of PV module Realise the mismatch In PV module	General discussion Practical work	Notes in the activity log, Participation in discussion & Practical work
Selection of solar module <u>Skills:</u> Identifying Comparing Selecting	The learner will be able to: Realise the concept of power and factors affecting power rating of PV modules	General discussion Practical work	Notes in the activity log, Participation in discussion & Practical work
Components of Solar PV system <u>Skills:</u> Experimenting Observing Plotting Analysing	The learner will be able to: Identify the components , their functions and connection.	General discussion Practical work	Notes in the activity log, Participation in discussion & Practical work
Batteries for PV Module <u>Skills:</u> Identifying Comparing Selecting	The learner will be able to: Select batteries for PV module	General discussion	Notes in the activity log, Participation in discussion.
Conversion of solar voltage to	The learner will be able to:	General discussion Practical work	Notes in the activity log,

fixed D.C and A.C <u>Skills:</u> Observing Analysing Selecting	Realise the concept of conversion of solar voltage to fixed D.C and A.C		Participation in discussion & Practical work
Charge Controllers in solar systems <u>Skills:</u> Observing Analysing Selecting	The learner will be able to: Realise the concept of conversion of solar voltage to fixed D.C and A.C	General discussion	Notes in the activity log, Participation in discussion
Wire sizing in PV system and PV system configuration <u>Skills:</u> Observing Analysing Selecting	The learner will be able to Configure PV systems and find wire size in PV systems	General discussion	Notes in the activity log, Participation in discussion.
Classification of PV systems <u>Skills:</u> Experimenting Observing Analysing	The learner will be able to: Different types of PV systems such as Stand alone, Grid connected and Hybrid systems.	General discussion Demonstration Field visit.	Notes in the activity log, Participation in discussion & Field visit report.
Solar PV system installation, Orientation and Inclination, mounting Requirements. <u>Skills:</u> Observing	The learner will be able to: Install solar PV systems having proper orientation, inclination and mounting.	Practical work Demonstration. Field Visit	Practical activity log. Field visit Report. Installation skill Connecting skill

Analysing Installing			
Safety Precautions for installation and servicing. <u>Skills</u> Observing Analysing	Understand and practice safety precautions in installation and servicing.	Demonstration. Discussion	Notes in the activity log, Participation in discussion.
Maintenance of Solar panel <u>Skills:</u> Observing Trouble shooting Analysing Repairing Maintenance.	The learner will be able to: Carry out maintenance of solar panel, module, battery, charge controller, inverter.	General discussion Practical work	Practical activity log Maintenance skill Repairing skill
Maintenance of solar devices. <u>Skills:</u> Observing Trouble shooting Analysing Repairing Maintenance	The learner will be able to: Carry out maintenance of solar devices-solar lantern,solar water heater,solar street light	General discussion Practical work	Practical activity log Maintenance skill Repairing skill

ADDITIONAL INFORMATION

- Solar cell voltage decreases with temperature. Loss of voltage of solar cell should be taken into account in order to estimate number of cells to be connected in series in a PV module.
- For a typical silicon solar cell, the output voltage decreases by 2.3mV/ °C increase in temperature. Standard Test Condition is 25 °C

ASSESSMENT ACTIVITY

- Conduct a seminar on components of solar PV systems, its functions and working. Prepare a detailed report on it.

EXTENDED ACTIVITY

- Assemble a solar lantern/ solar street light.

MODULE 4

HOME APPLIANCE SERVICING

OVER VIEW OF THE MODULE

The fourth module of EET named 'HOME APPLIANCE SERVICING' consists of three units such as Electrical Machines, Servicing of commonly used home appliances and Engineering Drawing. Electrical machines are included in this module to get a basic understanding of the construction, classification and working of D.C Machines & A.C Motors as to build a foundation to attain the module objective. The second unit Home appliances servicing comprises of the construction working and repairing of commonly used home appliances such as Electric iron, water heater, ceiling fan, Mixy, wet grinder and washing machine. The third unit named engineering drawing deals with the basics of engineering graphics, projection of points, planes and surfaces, isometric views, concept of development of surfaces etc. This unit also includes familiarization and use of Electrical Auto CAD.

OVER VIEW OF UNIT- 1 (ELECTRICAL MACHINES)

The first unit in the fourth module named Electrical machines deals with the construction, classification and working of D.C Machines & A.C Motors. It also includes the detailed study of different single phase induction motors. An attempt is also made to introduce the concept of Stepper motor and Brushless D.C Motors.

UNIT GRID- ELECTRICAL MACHINES

Ideas/ Concepts/Skills	Learning Outcomes	Suggested activities	Assessment
Working principle, parts and types of D.C. Generator Skills: Identifying Comparison . Observation.	The learner will be able to: <ul style="list-style-type: none"> • Comprehend the working principle , parts and types of D.C generator. 	Chart display and discussion of different types of D.C Generators	Notes in the activity log, Skill in identification Participation in discussion.
Working principle, parts and types of D.C.Motors and necessity of starters Skills: Observing. Analysing. Skills of sketching and identifying parts	The learner will be able to: <ul style="list-style-type: none"> • Comprehend the working principle, parts and types of D.C motors. • Explain the necessity of D.C.Motor starters 	Demonstration General Discussion	Participation in discussion Activity log
3 Phase induction motors Skills: Observing. Analysing	The learner will be able to: <ul style="list-style-type: none"> • Explain the working of 3 phase induction motors. 	General discussion Chart display	Notes in activity log Participation in discussion.

Connection of A.C Motor starters Skills: Observing. Analysing. Practical.	The learner will be able to: Connect D.O.L and Star-Delta starters	Practical work General discussion	Notes in Practical activity log. Skill in doing Practical work. Participation in discussion.
Working of single phase induction motors, stepper and B.L.D.C Motors. Skills: Observing. Analysing Realising	The learner will be able to: Realise the working of different single phase motors and B.L.D.C Motors	General Discussion using ICT. Demonstration	Participation in discussion Notes in activity Log.

Additional Information

Modern electrical motors are available in many different forms, such as single phase motors, three-phase motors, brake motors, synchronous motors, asynchronous motors, special customized motors, two speed motors, three speed motors, and so on. For each type of motor there are many different mounting arrangements, for example foot mounting, flange mounting or combined foot and flange mounting. The cooling method can also differ very much, from the simplest motor with free self-circulation of air to a more complex motor with totally enclosed air-water cooling with an interchangeable cassette type of cooler. To ensure a long lifetime for the motor, it is important to keep it with the correct degree of protection when under heavy-duty conditions in a severe environment. The two letters IP (International Protection) state the degree of protection followed by two digits, the first of which indicates the degree of protection against contact and penetration of solid objects, whereas the second states the motor's degree of protection against water. The ends of the motor is defined in the IEC-standard as follows: • The D-end is normally the drive end of the motor. • The N-end is normally the non-drive end of the motor.

ASSESSMENT ACTIVITIES

- Prepare a chart showing all single phase motors, their circuit diagrams and field of application in a tabular form.
- Select a starter for a 4 H.P motor and do its connection in the circuit.

- Practical Activity Log.
- chart
- Album.
- Class Activity log.

EXTENDED ACTIVITIES

- Conduct a seminar on brushless D.C Motors and their relevance in reducing the power consumption of appliances.
- Conduct a field visit to a motor winding centre, and familiarize different single phase motors, their parts and windings.

UNIT-2 SERVICING OF COMMON HOME APPLIANCES**OVERVIEW**

This module consists of identification of parts, working, and fault finding and repairing of common home appliances such as electric iron, water heater, ceiling fan, pedestal fan, mixer grinder, wet grinder and washing machines. This unit also explains the installation precaution.

GRID

Ideas/ Concepts/Skills	Learning Outcomes	Suggested activities	Assessment
Servicing of automatic & non automatic Electric iron Skills: <ul style="list-style-type: none"> Identifying Trouble shooting Analysing Repairing Servicing 	The learner will be able to: <ul style="list-style-type: none"> Undertake the servicing of electric iron 	<ul style="list-style-type: none"> Demonstration Practical activity General discussion 	Repairing and servicing skill Practical activity log Participation in discussion.
Servicing of Water heaters Skills: <ul style="list-style-type: none"> Identifying Comparing . Trouble shooting Analysing Repairing Servicing 	The learner will be able to: <ul style="list-style-type: none"> Undertake the servicing of water heaters 	<ul style="list-style-type: none"> Demonstration Practical activity General discussion 	Repairing and servicing skill Practical activity log Participation in discussion.
Servicing of Mixer Grinder Skills: <ul style="list-style-type: none"> Identifying Trouble shooting Analysing Repairing Servicing 	The learner will be able to: <ul style="list-style-type: none"> Undertake the servicing of Mixer Grinders 	<ul style="list-style-type: none"> Demonstration Practical activity General discussion 	Repairing and service skill Practical activity log Participation in discussion.

<p>Servicing of Wet Grinder</p> <p>Skills:</p> <ul style="list-style-type: none"> • Identifying • Trouble shooting • Analysing • Repairing • Servicing 	<p>The learner will be able to:</p> <ul style="list-style-type: none"> • Undertake the servicing of Wet Grinders • 	<ul style="list-style-type: none"> • Demonstration • Practical activity • General discussion 	<p>Repairing and servicing skill</p> <p>Practical activity log</p> <p>Participation in discussion.</p>
<p>Servicing of Semi automatic and fully automatic Washing Machine</p> <p>Skills:</p> <ul style="list-style-type: none"> • Identifying • Trouble shooting • Analysing • Repairing • Servicing. 	<p>The learner will be able to:</p> <ul style="list-style-type: none"> • Undertake the servicing of Washing machines 	<ul style="list-style-type: none"> • Demonstration • Practical activity • General discussion 	<p>Repairing and servicing skill</p> <p>Practical activity log</p> <p>Participation in discussion.</p>
<p>Installation and maintenance of Water pump</p> <p>Skills:</p> <ul style="list-style-type: none"> • Identifying • Trouble shooting • Analysing • Repairing • Servicing. 	<p>The learner will be able to:</p> <ul style="list-style-type: none"> • Undertake the installation & servicing of Water pump 	<ul style="list-style-type: none"> • Demonstration • Practical activity • General discussion 	<p>Repairing and servicing skill</p> <p>Practical activity log</p> <p>Participation in discussion.</p>

Additional Information

Star labeling : An energy-efficiency rating scheme for Electrical appliances/ Buildings. The rating will grade Equipments/ Buildings on their energy efficiency, starting from one star for the least energy-efficient, and going up to five stars, for the most energy-efficient. Star Labels have been created to standardize the energy efficiency ratings of different electrical appliances and indicate energy consumption under standard test conditions.

ASSESSMENT ACTIVITIES

Assessment activities

Practical work on fault identification, repairing and servicing of common appliances.

List of items in Portfolio

5. Practical Activity Log.
6. Collected Catalogues.
7. OJT report.
8. Class Activity log.
9. Trouble shooting chart.
10. F.V Report

EXTENDED ACTIVITIES

- Conduct a field visit to an appliance servicing centre and prepare a detailed report.
- Prepare catalogue for each appliance.
- Conduct seminar on Home appliances and prepare report.

UNIT-3 UNIT OVERVIEW (ENGINEERING GRAPHICS)**Introduction**

It is a graphical language that communicates ideas & information from one mind to another. One of the best ways to communicate ones ideas is through some form of picture or drawing. This is especially true for the engineers. The purpose of this unit is to give the basics of engineering sketching and drawing.

GRID

Idea/concept/skills	Learning outcome	Suggested activities	Assessment
Lettering, numbering and dimensioning Skills : Observing. Sketching	The learner will be able to: <ul style="list-style-type: none"> Recognise lettering, numbering and dimensioning. 	<ul style="list-style-type: none"> Discussion Practical work in Drawing 	Participation in discussion, Preparation of drawing sheet, Activity log.
Principles of geometric Construction. Skills : Realising Observing Sketching	<ul style="list-style-type: none"> Apply principles of Geometric construction 	<ul style="list-style-type: none"> Discussion Diagram developing 	Preparation of drawing sheet, Activity log. Involvement in discussion. Activity log.
Construction of Geometrical shapes. Skills : Observing Sketching	<ul style="list-style-type: none"> Construct Square, Rectangle, Circle, Polygons and Ellipse 	<ul style="list-style-type: none"> Demonstration Group discussion Sketching 	Involvement in discussion Activity log & Preparation of drawing sheet.
Principles of Orthographic projection Skills: Observing. Sketching.	<ul style="list-style-type: none"> Explain the principles of orthographic projection with simple sketches 	<ul style="list-style-type: none"> Demonstration Practical work In sketching. 	Involvement in Discussion. Drawing sheet. Practical activity log.
Orthographic views of simple objects Skills: Observing. Sketching	<ul style="list-style-type: none"> Sketch the orthographic views of simple objects. 	<ul style="list-style-type: none"> Demonstration Discussion Sketching 	Involvement in Discussion. Drawing sheet. Practical activity log.

<p>Sectional views of simple engineering objects and devices</p> <p>Skills: Realising Observing Sketching.</p>	<ul style="list-style-type: none"> • Realise the concepts. • Draw the sectional views of simple engineering objects and devices, 	<ul style="list-style-type: none"> • Demonstration • Discussion • Sketching 	<p>Involvement in Discussion. Drawing sheet. Practical activity log.</p>
<p>Development of surfaces</p> <p>Skills: Observing Realising Sketching</p>	<ul style="list-style-type: none"> • Realise the concepts. • Draw the development of surface. Like cylinder and Pyramid. 	<ul style="list-style-type: none"> • Discussion • Sketching 	<p>Participation in discussion Activity log Drawing sheet</p>
<p>Computer aided drafting and Electrical AutoCAD</p> <p>Skills: Observing Realising Sketching</p>	<ul style="list-style-type: none"> • Familiarise CAD • Use Electrical Auto CAD for electrical design. 	<ul style="list-style-type: none"> • Discussion • Demonstration • Practical work 	<p>Participation in discussion Activity log Working skill</p>

ASSESSMENT ACTIVITY

- Preparation of drawings as per standard notations
- Practicing Electrical Auto CAD

EXTENDED ACTIVITY

- Practice construction of ellipse by rectangular and parallel methods.
- Draw the involutes of line, triangle and square.
- Practice construction of parabola and helix.

ON THE JOB TRAINING

OJT forms an integral part of vocational education. Skill education needs hands on experience and training in the real work environment. According to EET curriculum the learner must acquire skill in the field of LED lamp repairing, House wiring, Home appliance servicing and Installation & maintenance of solar PV systems. For this course OJT can be conducted for 2weeks per year. It can be scheduled either one week after each module or 2 weeks together at the end of both the modules.

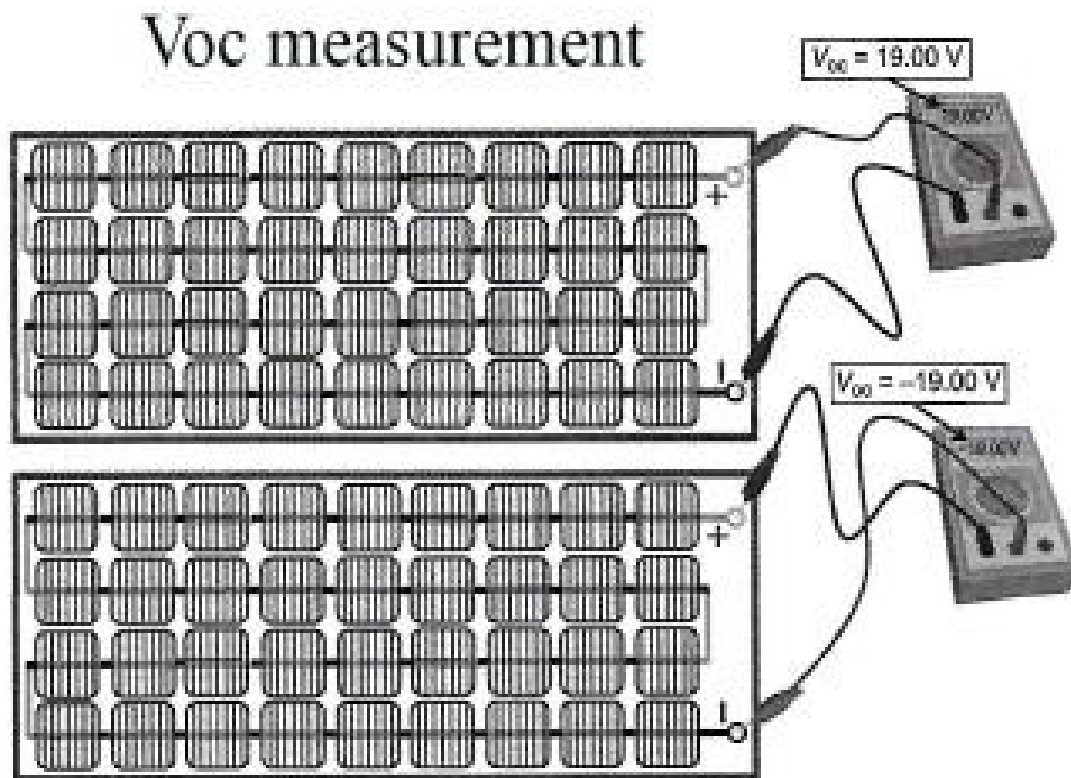
- If a negative sign is shown in the meter, it indicates that the polarity of the module terminal is reversed. Hence reverse the connection and measure again.

PRECAUTIONS

- Always use volt meter/ multi meter of suitable range.
- The polarity of meter should be checked before connecting in the circuit.
- All the connections should be tight.

RESULT

The open circuit voltage of the given SPV is



ACTIVITY-2**I-V CURVE OF A PV MODULE****OBJECTIVE:**

- To plot the I-V Curve of a solar PV Module
- To determine the optimal conditions for operating a PV panel in a circuit with a known load and understand MPPT (maximum power point tracking);
- To investigate the effects of solar insolation, shading, and tilting angle on a solar panel through the I-V characteristics measurement.

INSTRUMENTS/ MATERIALS REQUIRED:

1. DC Ammeter or multimeter (0 -10A)
2. DC Voltmeter or a multimeter (0-24 V)
3. Rheostat
4. Connecting Wires
5. Solar PV Module

PROCEDURE

- Make the electrical connections as shown in figure.
(For measuring I-V curve, the solar PV module has to be connected in series with the rheostat, ie, negative terminal of a solar PV module to one end of rheostat and other end of rheostat should be connected to the positive terminal of the multimeter/ammeter. The negative terminal of the multimeter/ammeter should be connected to the positive terminal of the solar PV module. The voltmeter/multimeter for voltage measurement is directly connected across the solar PV module. If any meter show negative reading, then make changes in the connection.)
- After making the connections, draw an observation table for noting the current, voltage and power (current x voltage).

- Slide the rheostat at one side where the resistance is maximum and the current is minimum and note down the values of current and voltage at that instant.
- Now slightly slide the rheostat, and then readings of current and voltage will change.
- Note down the readings again. Keep on sliding the rheostat and note down the reading until knob of the rheostat reaches the other end.
- Repeat the above steps in two different intensities of sunlight, i.e. in different weathers or different timings of a day.
- Repeat the whole experiment and measure I-V curves at different tilting angles of the solar panel to find out the best tilting angle to track the maximum power.
- Repeat the steps & measure I-V curves by shading 1-2 cells of the panel.
- Plot I-V and P-V ($P = V \times I$) curves of the solar panel. Visually estimate V_m , I_m , and P_{max} (i.e., peak power conditions) from plots.

RESULT:

- Short circuit current (I_{sc}) =
- Open circuit voltage (V_{oc}) =
- Maximum power point (P_m) = ($P_m = I_m \times V_m$) =
- Current at maximum power point (I_m) =
- Voltage at maximum power point =

ACTIVITY-3**INSTALLATION OF SOLAR PV MODULE****OBJECTIVE:**

- To study different types of solar PV Module installations
- To undertake the installation of simple standalone SPV system

TOOLS/INSTRUMENTS/MATERIALS REQUIRED:

DC Volt meter / Multi meter	1 No
Line Tester	1 No
Screw driver set	1 No
Spanner set	1 No
Combination plier	1 No
Battery Tester	1 No
Hydro meter	1 No
Connecting cable	as required
Solar PV Module	

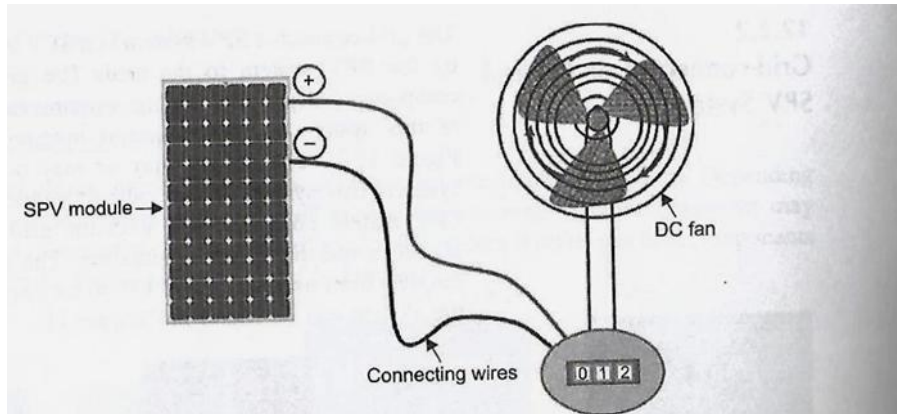
RELATED THEORY

Installation is a process in which the different components are connected in a systematic order to make a perfect working of SPV System to meet pre-determined demands. Different types and different number of components are used in SPV system depending on the requirements.

The self-dependent SPV systems are known as standalone PV systems. They do not depend on grid or any other electric supply. So they are also called Off-grid PV Systems. The stand-alone PV systems are best suited for domestic applications.

In a simplest stand-alone SPV system without a battery, a DC fan and solar PV Module can be connected as shown in figure (a)

Figure (a)



In a large capacity stand-alone SPV System there are so many other components needed for its proper functioning. In this case the installation means the inter connection of all these components properly as shown in figure (b) The stand-alone SPV system can handle power from few KW - 10 KW.

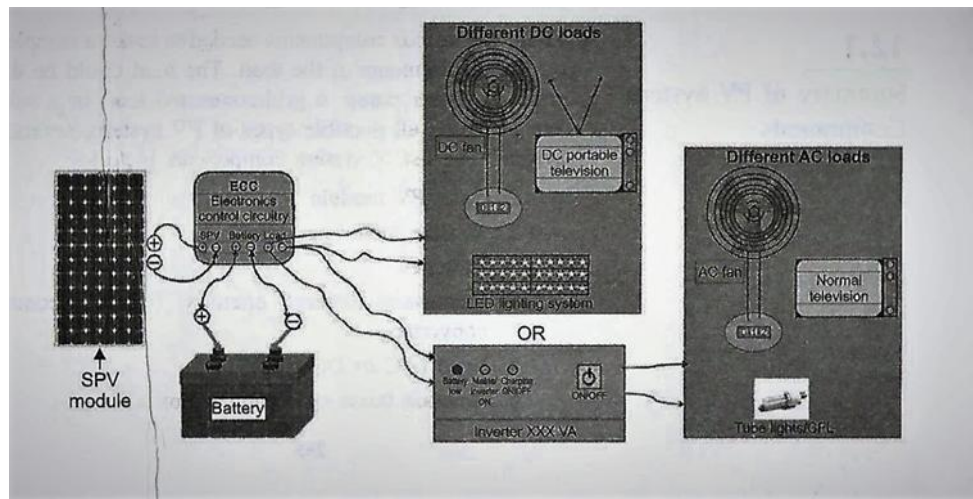


Figure (b)

The grid connected system supplies power generated by the SPV System to the grid. The main additional component of this system is the grid connected inverter which converts the DC into AC. The battery may or may not be present in the grid connected SPV System. The sample connection is as shown in figure ©. Grid connected SPV system can handle very large capacity power (MW).

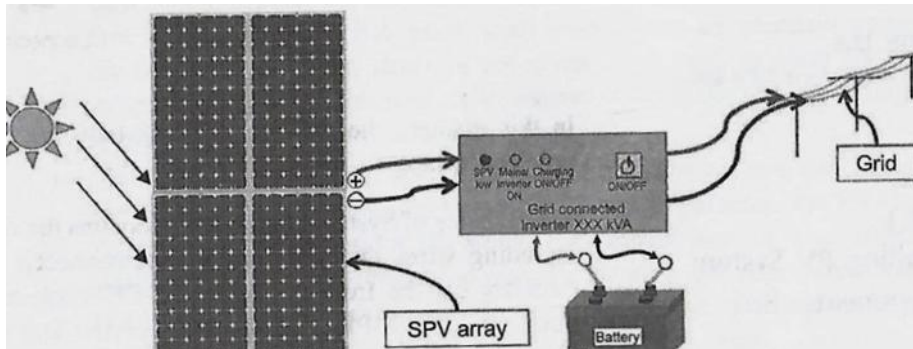


Figure (C)

PROCEDURE

- Select the required number of SPV Modules, batteries, electronic circuitry (DC-DC Converter, MPPT Circuit, inverter and monitoring equipment) and cables for connection.
- Install the battery bank in a room with proper ventilation and safety. The distance between the battery sides and wall should be sufficient and it should not be less than 20 cm. Inter connection of battery should be done as per the voltage and power requirement.
- Install the mounting structure of SPV module depending on the requirement. During installation the wind load data should be considered to withstand wind loads. Usually SPV modules are installed at an angle (facing southwards on northern hemisphere and northwards on southern hemisphere.)
- Interconnect all the components in the SPV System as per the design. (stand alone, grid connected or hybrid system).
- Test the whole installation before commissioning.

PRECAUTIONS

- All the connections should be tight to avoid short circuits and sparks at connecting points.
- Always use PV module of required capacity.
- Enough space should be provided for batteries.
- The inter connection of battery should be done properly and the connection points should be tight.
- Appropriate material should be used for the mounting structure.
- Stain less steel bolts should be used to avoid any rusting.
- Do not install PV Modules of different ratings together.

RESULT

Studied the installation of a SPV System and installed a simple standalone SPV System.

ACTIVITY-4**MAINTENANCE OF SOLAR PV SYSTEM****OBJECTIVE:**

To understand maintenance of SPV System

MATERIALS/TOOLS/INSTRUMENTS REQUIRED:

Cotton waste	- as required
Water & mild detergent	- as required
Hydrometer	- 1No
Cell Tester	- 1 No
Screw driver set	- 1 No
Spanner set	- 1 No
Neon Tester	- 1 No
Multi meter	- 1 No

RELATED THEORY:

Maintenance refers to fixing any sort of mechanical or electrical work so that the equipment or system does not become out of order or broken. Generally there are 2 types of maintenance such as unscheduled maintenance and scheduled maintenance (Periodical maintenance). Unscheduled maintenance involves repair or replacement of components of the system at the time of sudden break down. Scheduled maintenance involves a routine check-up of the system to ensure proper working condition to extends its life.

PROCEDURE:

- Clean the PV modules with the help of a soft cloth/cotton waste.
- If the atmospheric moisture condition is high, clean the SPV module with water & mild detergent to remove the bird droppings.
- Shadows if any on the SPV module should be removed by cutting tree branches nearby.
- Check the connections in the PV module to avoid loose contact or breakage in wires and junction box.
- Perform the maintenance of battery periodically by checking the voltage, sp. Gravity and State of Charge (SoC).
- Compare the measured voltage with manufacturer's data sheet.
- For sealed maintenance free batteries, inspect the casing, terminal connections, wiring, voltage and the venting strategies.
- Check all fuses and circuit breakers.
- Check the junction boxes, distribution boxes and wiring for loose connections/corrosion.
- Check the PV modules and batteries for proper series parallel configurations.
- Check system wires for proper polarity.
- Check the meters installed in the system for proper voltage and current readings.
- Check the continuity of the circuit.
- Finally check the overall functions of solar PV system.

PRECAUTIONS

- Disconnect all loads and connections of Solar PV system during maintenance.
- Always handle the PV modules carefully when they are exposed to sunlight.
- Take necessary precautions to avoid electric shock.
- Positive and negative terminals of the PV modules should be kept away from each other to avoid shorting of terminals.

- Always remember to disconnect the batteries before handling them.
- Keep all safety equipment ready to be used during installation and maintenance.

RESULT

Studied the maintenance of a SPV System

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