

LEARNING OUTCOME BASED VOCATIONAL CURRICULUM

CLASS 11 & 12

**SECTOR:
ELECTRONICS
SUB-SECTOR: SOLAR
ELECTRONICS**

JOB ROLE

SOLAR & LED TECHNICIAN

(Qualification pack: REF. ID.ELE/Q5903 VERSION 1.0)



State Council of Educational Research & Training (SCERT) Kerala

(Department of General Education, Government of Kerala)

Vidhya Bhavan, Poojappura, Thiruvananthapuram



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www.scert.kerala.gov.in

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FOREWORD

A collaborative initiative for developing learning outcome based vocational curriculum and courseware aimed at integrating both vocational and general qualifications has been implemented by the State Council of Educational Research and Training (SCERT) Kerala and the PSSCIVE Bhopal. This is intended to open up pathways of career progression for students and the SCERT Kerala is developing curricula under the project as an integral part of Vocationalisation of Education under Samagra Shiksha, approved by the Government of Kerala. Decisive improvement in the teaching-learning process and working competencies through learning outcomes that have been judiciously embedded in the vocational subject is expected to be the major impact that will be brought about by the learning outcome based vocational curriculum.

It is a matter of great pleasure to introduce this learning outcome based vocational curriculum as part of the vocational training package for the job role of Solar and LED Technician (ELE/Q5903 VERSION 1.0). The curriculum has been developed for the higher secondary students of vocational education and is aligned to the National Occupation Standards (NOSs) of a job role identified and approved under the National Skill Qualification Framework (NSQF).

The key aim of the curriculum will be to provide children with employability and vocational skills that would in turn aid occupational mobility and lifelong learning. A major transformation in the teaching process is also aimed at, which will be brought about through interactive sessions in classrooms, practical activities in laboratories and workshops, projects, field visits, and professional experiences.

The curriculum has been meticulously developed and judiciously reviewed by a group of experts and their much-valued contributions are immensely acknowledged. The imminent utility of the curriculum will without doubt, be adjudged by the qualitative improvement that it brings about in teaching-learning. The feedback and suggestions on the content by the teachers and other stakeholders will be of immense value to us in bringing about further enhancement and augmentation to this document.

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We are extremely thankful to Dr. RVG Menon, Chairperson, High Power Committee for the implementation of NSQF in Kerala, Dr. Sukesh Kumar, Former Principal, Government Engineering College Palakkad and Sri. G S Unnikrishnan Nair, Former Director State Agricultural Management and Extension Training Institute (SAMETI), Thiruvananthapuram for their mentorship in the process of developing this document. The contributions made by Dr. Vinay Swarup Mehrotra, Professor and Head, Curriculum Development and Evaluation Centre (CDEC), PSSCIVE Bhopal in development of the curriculum are duly acknowledged.

We are grateful to the experts for their earnest efforts and contributions in the development of this learning outcome based vocational curriculum. Their names are acknowledged in the list of contributors.

We are grateful to the Vocational Higher Secondary wing of the Directorate of General Education (DGE) Kerala for extending the support to develop this curriculum document on time by providing the service of its teaching staff.

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1. COURSE OVERVIEW

COURSE TITLE: SOLAR AND LED TECHNICIAN

GENERAL OBJECTIVES

Production and distribution of Solar Energy Equipment is a fast-growing sub sector in the Electronics sector in our country. Trained manpower is required for this industry at various levels ranging from researcher, engineer to technician or PV system installers. The role of the technician is mainly in the field of installation and maintenance of Solar and LED lighting system. The main objectives of Solar and LED Technician course are to create skilled manpower to carry out the installation and maintenance of Solar and Solar based LED lighting systems.

On successful completion of this course, the learners are expected to develop skills to;

- understand the integration, Installation and testing of different kinds of solar panels and Solar based street lights
- verify different kinds of site lay-outs and prepare bill of materials
- apply how to carry out break- down and preventive maintenance of solar and LED systems
- handle various tools and testing/measuring instruments
- explain and perform the activities complying with safety protocols

COURSE OUTCOMES

On completion of this course, students should be able to;

- prepare electrical wire joints, carryout soldering and crimping
- construct and test series and parallel circuits
- demonstrate simple wiring
- use instruments for measurement of various electrical parameters
- demonstrate photovoltaic cells and modules, batteries and charge controllers
- demonstrate solar based LED home lighting system and street lighting system
- installation & repair of solar based LED -home lighting system and Street Lighting system
- connect and test Solar panel, charge controller, battery and inverter
- fix PV panels on a roof and no roof structure
- perform various test and measurement pertaining to PV modules and their installation
- perform operation and maintenance of PV system with best practices
- perform routine maintenance and repair

COURSE REQUIREMENTS

The learner should have the basic knowledge of science.

COURSE DURATION: 600 hrs

Class 11	300hrs
Class 12	300hrs
Total	600 hrs

2. SCHEME OF UNITS

The unit-wise distribution of hours and scores for Class 11 is as follows:

CLASS 11			
	Units	No. of Hours for Theory and Practical = 300	Max. scores for Theory and Practical =100
Part A	Employability Skills		
1.	Communication Skills – III	25	10
2.	Self-management Skills – III	25	
3.	Information and Communication Technology Skills – III	20	
4.	Entrepreneurial Skills – III	25	
5.	Green Skills – III	15	
	Total	110	10
Part B	Vocational Skills		
6.	Basic Electrical and Electronics	55	40
7.	Basics of LED	40	
8.	Basics of Solar Electricity	54	
9.	Solar Lighting Systems	16	
	Total	165	40
Part C	Practical Work		
	Practical Examination	06	15
	Written Test	01	10
	Viva Voce	03	10
	Total	10	35
Part D	Project Work/Field Visit/ OJT		
	Practical File/Student Portfolio	10	10
	Viva Voce	05	05
	Total	15	15
	Grand Total	300	100

The unit-wise distribution of hours and scores for Class 12 is as follows:

CLASS 12			
	Units	No. of Hours for Theory and Practical =300	Max. scores for Theory and Practical = 100
Part A	Employability Skills		
1.	Communication Skills – IV	25	10
2.	Self-management Skills – IV	25	
3.	Information and Communication Technology Skills – IV	20	
4.	Entrepreneurial Skills – IV	25	
5.	Green Skills – IV	15	
	Total	110	10
Part B	Vocational Skills		
6.	Pre commission test and measurement pertaining to PV modules and their Installation	55	
7.	AC system with Inverter	30	
8.	Trouble shooting of PV system	40	
9.	Maintenance of PV System	40	
	Total	165	40
Part C	Practical Work		
	Practical Examination	06	15
	Written Test	01	10
	Viva Voce	03	10
	Total	10	35
Part D	Project Work/Field Visit/OJT		
	Practical File/Student Portfolio	10	10
	Viva Voce	05	05
	Total	15	15
	Grand Total	300	100

3. LEARNING OUTCOME BASED ACTIVITIES

Classroom, Laboratory/workshop and field are the key spots where teaching and learning take place. Classroom and laboratory-based teaching and learning facilitate knowledge creation whereas field visits open venues for free interaction with experts and also helps acquaint learners with various tools, materials, equipment procedures and operations in the workplace. While considering these intensified ways of knowledge acquisition, emphasis should also be laid on the occupational safety, health and hygiene of the participants.

Classroom activities

Classroom activities are mainly interactive lecture sessions, followed by discussions and doubt clarifications. Classes are handled by trained vocational teachers and this is considered as an

integral part of the course. The most attractive feature of the class is that the classes are in tune with the outcome-based curriculum. Teaching learning processes are well planned and implemented. Teaching learning materials such as audio-visual materials, colour slides, charts, diagrams, models, exhibits, handouts, on-line teaching materials etc., have been incorporated in accordance with the topic and this may help the teachers to impart the content in an effective manner.

Practical work in Laboratory / Workshop

Practical work is usually performed to enhance the skills of the learners which are indeed essential for them to become specialized technicians. Practical sessions may include hands on training, simulation training, role-play, case-based studies and exercises. Equipment and other appliances are available for use in abundance. Trained personnel teach and exercise specialized techniques. Practical classes involving laboratory/workshop are well planned with tools, equipment, materials and also other skill acquisition activities. Vocational teachers should submit the plan of laboratory/workshop work in advance to the head of the institution and get it sanctioned prior to use.

Field visits/ Educational Tour

Field visit is one of the ways and means of learning outside the classroom. It promotes knowledge acquisition by giving opportunity to learners to interact with renowned experts and to make observations of the activities performed by them. An observation check list may help the students to ensure the collection of required information and its analysis for further use. This may be developed with the help of vocational teachers who are in charge of outdoor learning activities. All the field visits are well planned by taking into consideration of the learning requirements, distance to travel, time, health and hygiene. The Principal and teachers should plan to implement at least three field visits within a year by making all necessary arrangements.

Virtual Field Visits, Expert Interactions and Practical Activities

With the rapid potentials offered by information technology in digital classrooms, the extent of virtual field visits, online expert interactions and online demonstrations cum practical activities can be worked out. It may be helpful amid the current Covid 19 pandemic scenario. A State level cluster of teachers and experts in the concerned subject can be pooled together for the purpose. The guidelines for such activities can be issued by the concerned SCERTs.

Suggested topics for Expert Interaction

1. Scope of Solar Energy and Modern Trends
2. Types of solar module, Testing and Certification standards
3. Components of a DC solar system
4. Solar LED street light

5. Solar PV modules and Arrays
6. Modern Trends in LED lighting
7. I-V characteristics of PV cell and maximum power point tracking
8. Safety measure during work and maintenance
9. Mini project on Solar Energy
10. Site survey and layout
11. Pre-commission test and measurement of PV module installation
12. AC solar system- OFF Grid
13. Trouble shooting of PV system
14. Maintenance of PV system

4. ASSESSMENT AND CERTIFICATION

The National Skill Qualification Framework (NSQF) is based on outcomes rather than inputs referred by the National Occupation Standards (NOSs). Learning outcomes, as per the NSQF level descriptors, include the Process, Professional Knowledge, Professional Skills, Core Skills and Responsibility. Knowledge in the job of a learner shall be the basis of assessment. It would also be considered if the learning program undertaken by the learner has delivered the required output. Certification is based on required standards so that the learner and the employer could come to know about the competency attained in the vocational subject/ course. In order to make the assessment reliable, valid, flexible, convenient, cost effective, fair and transparent standardised assessment tools are to be used. Technology assisted assessment process is in vogue now.

Knowledge Assessment (Theory)

Knowledge Assessment usually includes two components – Internal Assessment and External Assessment. External assessment includes theory examination conducted by the concerned examination Boards. Tools for assessment contain components for testing the application of knowledge. Knowledge testing can be performed by making use of either objective or short answer type paper-based test. Source of the questions should be the content of the curriculum.

Written Test

A group, comprising of academicians, experts from existing vocational subject experts / teachers, subject experts from University/ College or from the industry prepare theory question paper for the vocational subjects. A panel of experts for question paper setting and conducting examination should be formed by the respective central / state boards. Written tests allow the learners to demonstrate that they have acquired the necessary knowledge and skill in the given topics.

The blue print for the question paper may be as follows:

Duration: 3 hrs

Maximum Scores: 50

	Typology of Question	No. of Questions			Scores
		Very Short Answer (1 Score)	Short Answer (2 Scores)	Long Answer (3 Scores)	
1.	Remembering – (Knowledge based simple recall questions, to know specific facts, terms, concepts, principles, or theories; identify, define or recite, information)	3	3	3	18
2.	Understanding – (Comprehension – to be familiar with meaning and to understand conceptually, interpret, compare, contrast, explain, paraphrase, or interpret information)	2	4	3	19
3.	Application – (Use abstract information in concrete situation, to apply knowledge to new situations: Use given content to interpret a situation, provide an example, or solve a problem)	0	2	1	07
4.	High Order Thinking Skills – (Analysis and Synthesis – Classify, compare, contrast, or differentiate between different pieces of information; Organize and/ or integrate unique pieces of information from a variety of sources)	0	2	0	04
5.	Evaluation – (Appraise, judge, and/or justify the value or worth of a decision or outcome, or to predict outcomes based on values)	0	1	0	02
	Total	5x1=5	12x2=24	7x3=21	50 (24 questions)

Skill Assessment (Practical)

Skill assessment should be done by considering the practical demonstration of skills by the candidate. It is assessed by making use of a competency checklist prepared by experts. The competency checklist should be developed as per the National Occupation Standards (NOSs). This should be in tune with the qualification pack for the Job Role to ensure necessary consistency in the quality of assessment across different sectors and institutions. As per the performance criteria defined in the National Occupation Standards, the students have to demonstrate their competencies in front of the examiners. Assessment will indicate whether they are competent or incompetent. The assessors assessing the skills of the students should possess enough industrial experience and should have undergone a rigorous training in assessment principles and practices. The Sector Skill Councils (SSCs) should ensure that the assessors are given the required training on the assessment of competencies.

The demonstration of knowledge and skill in performing a task of the learners, is the purpose of the practical examination. This include practical examination where hands on experience will be displayed and a viva voce. A team of two evaluators, one a subject teacher and the other an expert from the relevant industry certified by the relevant Board or SSCs concerned can conduct practical examination as well as viva voce.

Project Work

Project is an efficient strategy to assess the practical skills acquired along a certain timeline. Project is chosen and given to candidates only on the basis of their capabilities, because it needs specific skills. It is performed step by step and the first and foremost step is classroom discussion and selection of the topic for the project. After fixing the topic and objectives, the methodology of the project work should be decided during the classroom discussions. Monitoring and evaluation should be done at each stage. Proper feedback shall be provided to the learners for improvement and innovation. Field visits can be organized as part of the project work. The data collected may be used for presentations and report writing. Accuracy of the data is to be ensured. The entire project work is maintained as a practical work file or as student's portfolio.

Student Portfolio

It is a document that supports the candidate claim of competencies acquired as a part of the teaching learning process. The student portfolio is a compilation of project reports, articles, photos of products prepared by the student.

Viva Voce

Viva voce provides chance to each candidate to demonstrate communication skills and content knowledge. It is a way of obtaining feedback on the student's experience, learning, project work

and field visit. Audio visual recording of the whole procedure can be done for future reference and documentation. A Board, including external examiners, is constituted as per the norms which in turn should be suitably adapted to the specific requirement of the vocational subjects.

The central/state examination board for secondary education and the respective Sector Skill Councils can certify the competencies of the learner upon the successful completion of the course.

5. UNIT CONTENTS

CLASS 11

Part A: Employability Skills

Sl.No.	Units	Duration (hrs)
1.	Communication Skills- III	25
2.	Self-management Skills – III	25
3.	Information and Communication Technology Skills - III	20
4.	Entrepreneurial Skills – III	25
5.	Green Skills – III	15
Total		110

Unit 1: Communication Skill– III

Expected Learning Outcomes	Theory (10 hrs)	Practical (15 hrs)	Duration (25 hrs)
1. Demonstrate knowledge of various methods of communication	<ul style="list-style-type: none"> • Methods of communication • Verbal • Non-verbal • Visual 	<ul style="list-style-type: none"> • Writing pros and cons of written, verbal and non-verbal communication • Listing do's and don'ts for avoiding common body language mistakes 	05
2. Identify specific communication styles	<ul style="list-style-type: none"> • Communication styles- assertive, aggressive, passive-aggressive, submissive, etc. 	<ul style="list-style-type: none"> • Observing and sharing communication styles of friends, teachers and family members and adapting the best practices • Role plays on communication styles. 	10
3. Demonstrate basic writing skills	<ul style="list-style-type: none"> • Writing skills to the following: 	<ul style="list-style-type: none"> • Demonstration and practice of 	10

	<ul style="list-style-type: none"> • Sentence • Phrase • Kinds of Sentences • Parts of Sentence • Parts of Speech • Articles • Construction of a Paragraph 	writing sentences and paragraphs on topics related to the subject	
Total			25

Unit 2: Self-Management – III			
Expected Learning Outcomes	Theory (10 hrs)	Practical (15 hrs)	Duration (25 hrs)
1. Demonstrate impressive appearance and grooming	<ul style="list-style-type: none"> • Describe the importance of dressing appropriately, looking decent and positive body language • Describe the term grooming • Prepare a personal grooming checklist • Describe the techniques of self- exploration 	<ul style="list-style-type: none"> • Demonstration of impressive appearance and groomed personality • Demonstration of the ability to self-explore 	10
2. Demonstrate team work skills	<ul style="list-style-type: none"> • Describe the important factors that influence in team building • Describe factors influencing team work 	<ul style="list-style-type: none"> • Group discussion on qualities of a good team • Group discussion on strategies that are adopted for team building and team work 	10
3. Apply time management strategies and techniques	<ul style="list-style-type: none"> • Meaning and importance of time management – setting and prioritizing goals, creating a schedule, making lists of tasks, balancing work and leisure, using different optimization tools to break large tasks into smaller tasks. 	<ul style="list-style-type: none"> • Game on time management • Checklist preparation • To-do-list preparation 	05
Total			25

Unit 3: Information and Communication Technology - III			
Expected Learning Outcomes	Theory (08 hrs)	Practical (12 hrs)	Duration (20 hrs)
1. Create a document on word processor	<ul style="list-style-type: none"> • Introduction to word processing. • Software packages for 	<ul style="list-style-type: none"> ➤ Demonstration and practice of the following: <ul style="list-style-type: none"> • Listing the features 	10

	word processing. <ul style="list-style-type: none"> • Opening and exiting the word processor. • Creating a document 	of word processing <ul style="list-style-type: none"> • Listing the software packages for word processing • Opening and exit the word processor • Creating a document 	
2. Edit, save and print a document in word processor	<ul style="list-style-type: none"> • Editing text • Wrapping and aligning the text • Font size, type and face • Header and Footer • Auto correct • Numbering and bullet • Creating table • Find and replace • Page numbering • Printing document • Saving a document in various formats 	<ul style="list-style-type: none"> • Demonstration and practising the following: • Editing the text • Word wrapping and alignment • Changing font type, size and face • Inserting header and footer • Removing header and footer • Using autocorrect option • Insert page numbers and bullet • Save and print a document 	10
Total			20

Unit 4: Entrepreneurial Skills – III

Expected Learning Outcomes	Theory (10 hrs)	Practical (15 hrs)	Duration (25 hrs)
1. Describe the significance of entrepreneurial values and attitude	<ul style="list-style-type: none"> • Values in general and entrepreneurial values • Entrepreneurial value orientation with respect to innovativeness, independence, outstanding performance and respect for work 	<ul style="list-style-type: none"> • Listing of entrepreneurial values by the students. • Group work on identification of entrepreneurial values and their roles after listing or reading 2-3 stories of successful entrepreneur • Exhibiting entrepreneurial values in Ice breaking, rapport building, group work and home assignments 	10
2. Demonstrate the knowledge of attitudinal changes required to become an entrepreneur	<ul style="list-style-type: none"> • Attitudes in general and entrepreneurial attitudes • Using imagination/intuition • Tendency to take moderate risk 	<ul style="list-style-type: none"> • Preparing a list of factors that influence attitude in general and entrepreneurial attitude • Demonstrating and identifying own entrepreneurial attitudes 	15

	<ul style="list-style-type: none"> • Enjoying freedom of expression and action • Looking for economic opportunities • Believing that we can change the environment • Analyzing situation and planning action • Involving in activity 	<p>during the following micro lab activities like thematic appreciation test</p> <ul style="list-style-type: none"> • Preparing a short write-up on “who am I” • Take up a product and suggest how its features can be improved • Group activity for suggesting brand names, names of enterprises, etc. 	
Total			25

Unit 5: Green Skills – III			
Expected Learning Outcomes	Theory (07 hrs)	Practical (08 hrs)	Duration (15 hrs)
1. Describe importance of main sector of green economy	<ul style="list-style-type: none"> • Main sectors of green economy- E-waste management, green transportation, renewal energy, green construction, water management • Policy initiatives for greening economy in India 	<ul style="list-style-type: none"> • Preparing a poster on any one of the sectors of green economy • Writing a two-page essay on important initiatives taken in India for promoting green economy 	08
2. Describe the major green Sectors/Areas and the role of various stakeholder in green economy	<ul style="list-style-type: none"> • Stakeholders in green economy • Role of government and private agencies in greening cities, buildings, tourism, industry, transport, renewable energy, waste management, agriculture, water, forests and fisheries 	<ul style="list-style-type: none"> • Preparing posters on green Sectors/Areas: cities, buildings, tourism, industry, transport, renewable energy, waste management, agriculture, water, forests and fisheries 	07
Total			15

PART B: VOCATIONAL SKILLS

Sl.No.	Units	Duration (hrs)
1.	Basic Electrical and Electronics	55
2.	Basics of LED	40
3.	Basics of Solar Electricity	54
4.	Solar Lighting Systems	16
Total		165

Unit 1: Basic Electrical and Electronics			
Expected Learning Outcomes	Theory (25 hrs)	Practical (30 hrs)	Duration (55 hrs)
1. Sensitisation of Terms used in Electrical & Electronics.	<ul style="list-style-type: none"> Voltage, Current (AC & DC), Power, Resistance, Inductance, capacitance and its units Electrical safety while measuring voltage, current, power etc. Proper handling of multimeter 	<ul style="list-style-type: none"> Measurement of voltage, Current & Power with health and safety precautions and Using protective equipment and proper tools. Continuity testing (Wires and cables) 	5
2. Describe the health & safety and list the equipments and materials for safety & security.	<ul style="list-style-type: none"> Meaning of health and safety Safety requirements. Meaning of Risk List of safety equipments Trace out approved action to deal with risk 	<ul style="list-style-type: none"> List out various safety equipments Identify and select equipment for safety 	4
3. Identify tools and measuring instruments	<ul style="list-style-type: none"> Screw Drivers, Spanners, Pliers, Hacksaw, Cutters, Allen Keys, Hand Drill, Drill bit, Box spanner, Crimping tool, Measuring tape, Pulley puller, Neon tester, Wire stripper, Irradiance meter, Digital multimeter, Insulation tester, continuity tester, Soldering iron, Inclinator, Magnetic compass, IV curve analyser, Digital imaging (Thermal) Camera, Torque wrench meter, Resistance Temperature Detector (RTD)-PT100 type, Anemometer, DC fuse (solar rated) g type, Surge protection device, AC side and DC side 	<ul style="list-style-type: none"> Identification of tools, proper handling and use of appropriate tools 	6
4. Identify and explain Passive Electronic Components	<ul style="list-style-type: none"> Resistors, Inductors & Capacitors (Identification, Colour Coding & Testing) Verify the characteristics 	<ul style="list-style-type: none"> Testing of Resistance using multi meter. Practice proper handling of tools 	5

		of series parallel combination of resistor,		
5.	Explain the function of Active Electronic Components	<ul style="list-style-type: none"> • Diodes, Transistors, (Identification, Basic Working & Testing), 	<ul style="list-style-type: none"> • Testing of Diodes using Multi-meter with proper safety precautions and appropriate tools 	5
6.	Describe AC and DC Voltages, Currents and Resistance	<ul style="list-style-type: none"> • Alternating Current, voltage, Frequency, wave forms, RMS value, Average Value, Single Phase, Three Phase, • DC Voltage and current, Resistance 	<ul style="list-style-type: none"> • Measurement of AC and DC voltage and current with proper safety precautions and appropriate tools and equipment. • Practice Oscilloscope (Measurement of voltage, current, frequency, Wave shape)AC and DC. 	8
7.	Identify common Electrical accessories	<ul style="list-style-type: none"> • TPM Switch, Change Over switch. Clip On meter, Contactor, ON/Off Switch, Reversing Switch, Electrical Measuring Instruments (Description and applications), ELCB,MCCB,MCB 	<ul style="list-style-type: none"> • Identification of common Electrical accessories 	8
8.	Demonstrate Electrical wiring	<ul style="list-style-type: none"> • Electrical wiring for ON/OFF switch and reversing switch. • Importance of Earthing in a wiring, Types of earthing 	<ul style="list-style-type: none"> • Practice of electrical wiring for ON/OFF switch, practice electrical wiring for reversing switch(2way) 	8
9.	Explain work, power and Energy	<ul style="list-style-type: none"> • Work, mechanical power, Energy, Units of Energy, Wattage of house hold items 	<ul style="list-style-type: none"> • List the wattage of some house hold items. 	1
10.	Demonstrate manual soldering and crimping	<ul style="list-style-type: none"> • Practice on soldering and crimping of wire joints 	<ul style="list-style-type: none"> • Manual soldering with proper safety precautions and appropriate tools 	3
11	Demonstrate safety equipment	<ul style="list-style-type: none"> • Insulated gloves, Helmet, Industrial shoes, Goggles Safety and its importance, PPEs, Safety Signs, Safety Slogans, Safety Rules, 	<ul style="list-style-type: none"> • Proper use of appropriate equipment 	2
Total				55

Unit 2: Basics of LED			
Expected Learning Outcomes	Theory (15hrs)	Practical (25 hrs)	Duration (40 hrs)
1. Explain the basics of LED	<ul style="list-style-type: none"> Basic Construction, Working Principle, Colours Types, Combinations, Applications – (Domestic, Commercial & Industrial) 	<ul style="list-style-type: none"> Different colours & types LED Series Circuit LED Parallel Circuit 	6
2. Differentiate between CCT & CRI	<ul style="list-style-type: none"> CCT and its importance CRI and its significance 	<ul style="list-style-type: none"> Demonstrate Specifications & Data Sheets of CCT & CRI of a LED light 	6
3. Explain LED Power Source and driver	<ul style="list-style-type: none"> LED driver AC / DC Converter & DC / AC converter (working Principle) Identify a LED Driver Circuit Difference between Constant Current Drivers and Constant Voltage Drivers LED Driver selection Criteria 	<ul style="list-style-type: none"> AC-DC Converter Circuit demonstration DC-AC converter Circuit demonstration Demonstration of LED Driver Circuit Specifications of Constant Current & Constant Voltage Drivers 	10
4. Explain the importance of Thermal Management in LED Lights	<ul style="list-style-type: none"> Heat generated in a LED light. Techniques to Control & Dissipate the Heat, Active Thermal Management Systems Passive Thermal Management Systems 	<ul style="list-style-type: none"> Identify Active and Passive Thermal Management Systems 	6
5. Explain about the Optical Management of LED Luminary	<ul style="list-style-type: none"> Optical Elements in a LED light Basic knowledge of Frequency and other Luminescence Parameters, Distribution of Light, Light Distribution Curve(Definition only) Nano Optical Elements and Micro Reflectors 	<ul style="list-style-type: none"> Observe the colour of objects at different colour temperature 	6
6. Explain about LED Luminary Assembly	<ul style="list-style-type: none"> Identify the components of a LED Luminary 	<ul style="list-style-type: none"> Familiarization of LED Home Lights 	6

	Assembly <ul style="list-style-type: none"> • Basic awareness of different luminary assemblies such as LED bulb, LED tube light, LED spot light, LED Display lights etc 	(Bulb Tube Spot Lights) <ul style="list-style-type: none"> • LED Street Light Assembly, LED Signal Lights and LED displays 	
Total			40

Unit 3: Basics of Solar Electricity

Expected Learning Outcomes	Theory (20 hrs)	Practical (34 hrs)	Duration (54hrs)
1. Explain renewable energy	<ul style="list-style-type: none"> • Introduction to Renewable and Non-renewable energy. • Advantages and disadvantages of nonconventional energy 	<ul style="list-style-type: none"> • Prepare a chart on different conventional and nonconventional energy sources 	2
2. Explain solar power generation system	<ul style="list-style-type: none"> • Photovoltaic energy conversion 		1
3. Explain the need of solar power and its application	<ul style="list-style-type: none"> • Advantages and challenges of solar photovoltaic energy conversion • Solar Resource Assessment(SRA) impact on PV out put • SRA assessment on irradiance, Temperature, Orientation, Tilt angle 	<ul style="list-style-type: none"> • Field survey on the effect of PV output with shadow, distance and component location 	3
4. Demonstrate Photovoltaic cell, module and array	<ul style="list-style-type: none"> • Photovoltaic conversion • PV cell • Array 	<ul style="list-style-type: none"> • Measuring output voltage of a solar cell on sufficient light, shade and with tilt • Measuring output voltage of a solar panel on sufficient light, shade and with tilt 	10
5. Explain the parameters of solar panel	<ul style="list-style-type: none"> • PV module testing and Certification standards • Parameters of solar cell • V-I characteristics of PV 	<ul style="list-style-type: none"> • Measurement of Voc and Vsc on sufficient light, shade and with 	10

	<p>cell</p> <ul style="list-style-type: none"> Maximum power point tracking 	<p>tilt</p> <ul style="list-style-type: none"> Measurement of Isc on sufficient light, shade and with tilt Identification of MPP. finding MPP manually by varying resistive load of PV modules 	
6. Demonstrate Solar PV Module Arrays	<ul style="list-style-type: none"> Parallel connected solar panels Series connected solar panels String connected Solar panels I-V and P-V characteristics of solar PV module arrays Identify different solar panels as per specification Study of pipe earthing system and plate earthing system 	<ul style="list-style-type: none"> Connect solar panels in series and measure voltage and current. Repeat with different rated panels Connect solar panels in parallel and measure voltage and current. Repeat with different rated panels. String connect the Solar panels and measure voltage and current I-V and P-V characteristics of solar PV module arrays DC wiring practices Earthing and lightning protection 	8
7. Develop skill in connecting MC4 connectors to a solar panel using crimping tool	<ul style="list-style-type: none"> Solar panel terminal wires and MC-4 connectors. Choice of wires (DC cables) used in the solar PV Electrical system. Array junction box (AJB) or combiner box. 	<ul style="list-style-type: none"> Practice to Connect MC 4 connectors to a solar panel using crimping tool 	8
8. Develop skill in connecting the MPPT controller	<ul style="list-style-type: none"> MPPT charge controller. 	<ul style="list-style-type: none"> Connect the MPPT controller with 	6

with solar panel & solar battery and note input and output current and battery voltage, at different time intervals.		solar panel & solar battery and note input and output current and battery voltage, at different time intervals.	
9. Explain Inverter and its function	<ul style="list-style-type: none"> Inverter: working, front panel controls and back panel controls. Normal and solar inverter Block diagram of Solar Photo voltaic electrical system. - Stand alone or off-grid inverter 	<ul style="list-style-type: none"> Connect and test a 12V DC/230V AC normal inverter and solar inverter 	6
Total			54

Unit 4: Solar Lighting Systems			
Expected Learning Outcomes	Theory (4 hrs)	Practical (12 hrs)	Duration (16 hrs)
1. Demonstrate Elements of solar lighting system	<ul style="list-style-type: none"> LED lighting system using solar panel and its components-Solar panel, charge controller, storage battery. Solar street lighting system and its Elements Solar home lighting system and its elements 	<ul style="list-style-type: none"> Connect the charge controller (12V, 10A) with Solar battery (12V, 100Ah), Solar panel (75W)and DC load (12V such as LED light 3W & 5W, DCFan) Test the charge controller working with the above circuit and study the performance Construct home lighting system using solar panel charge controller, battery and inverter. 	8
2. Demonstrate Solar DC appliances.	<ul style="list-style-type: none"> Solar DC industrial application: Solar street light, Solar home lighting system 	<ul style="list-style-type: none"> Construct a Solar Street light using dusk to dawn charge controller (12V, 10 A), Solar battery (12V, 100 Ah), Solar panel (75 W) and 4X LED light (12V DC, 5W). 	8
Total			16

CLASS 12

Part A: Employability Skills

Sl.No.	Units	Duration (hrs)
1.	Communication Skills- IV	25
2.	Self-management Skills - IV	25
3.	Information and Communication Technology Skills - IV	20
4.	Entrepreneurial Skills - IV	25
5.	Green Skills - IV	15
	Total	110

Unit 1: Communication Skills - IV			
Expected Learning Outcomes	Theory (10 hrs)	Practical (15 hrs)	Duration (25 hrs)
1. Describe the steps to active listening skills	<ul style="list-style-type: none"> Importance of active listening at workplace Steps to active listening 	<ul style="list-style-type: none"> Demonstration of the key aspects of becoming active listener Preparing posters of steps for active listening 	10
2. Demonstrate basic writing skills	<ul style="list-style-type: none"> ➤ Writing skills to the following: <ul style="list-style-type: none"> Sentence Phrase Kinds of Sentences Parts of Sentence Parts of Speech Articles Construction of a Paragraph 	<ul style="list-style-type: none"> Demonstration and practice of writing sentences and paragraphs on topics related to the subject 	15
	Total		25

Unit 2: Self-Management Skills – IV			
Expected Learning Outcomes	Theory (10 hrs)	Practical (15 hrs)	Duration (25 hrs)
1. Describe the various factors influencing self-motivation	<ul style="list-style-type: none"> Finding and listing motives (needs and desires); Finding sources of motivation and inspiration (music, books, activities); expansive thoughts; living fully in the present moment; dreaming big 	<ul style="list-style-type: none"> Group discussion on identifying needs and desire Discussion on sources of motivation and inspiration 	10
2. Describe the basic personality traits, types and disorders	<ul style="list-style-type: none"> Describe the meaning of personality Describe how personality influence others 	<ul style="list-style-type: none"> Demonstrate the knowledge of different personality types 	15

	<ul style="list-style-type: none"> • Describe basic personality traits • Describe common personality disorders- paranoid, antisocial, schizoid, borderline, narcissistic, avoidant, dependent and obsessive 		
Total			25

Unit 3: Information and Communication Technology Skills - IV			
Expected Learning Outcomes	Theory (06 hrs)	Practical (14 hrs)	Duration (20hrs)
1. Perform tabulation using spreadsheet application	<ul style="list-style-type: none"> • Introduction to spreadsheet application • Spreadsheet applications • Creating a new worksheet • Opening workbook and entering text • Resizing fonts and styles • Copying and moving • Filter and sorting • Formulas and functions • Password protection. • Printing a spreadsheet. • Saving a spreadsheet in various formats. 	<ul style="list-style-type: none"> • Demonstration and practice on the following: • Introduction to the spreadsheet application • Listing the spreadsheet applications • Creating a new worksheet • Opening the workbook and enter text • Resizing fonts and styles • Copying and move the cell data • Sorting and Filter the data • Applying elementary formulas and functions • Protecting the spreadsheet with password • Printing a spreadsheet • Saving the spreadsheet in various formats. 	10
2. Prepare presentation using presentation application	<ul style="list-style-type: none"> • Introduction to presentation • Software packages for presentation • Creating a new presentation • Adding a slide • Deleting a slide • Entering and editing text • Formatting text • Inserting clipart and 	<ul style="list-style-type: none"> • Demonstration and practice on the following: • Listing the software packages for presentation • Explaining the features of presentation • Creating a new presentation • Adding a slide to presentation. • Deleting a slide 	10

	<ul style="list-style-type: none"> images Slide layout Saving a presentation Printing a presentation document. 	<ul style="list-style-type: none"> Entering and edit text Formatting text Inserting clipart and images Sliding layout Saving a presentation Printing a presentation document 	
Total			20

Unit 4: Entrepreneurial Skills - IV			
Expected Learning Outcomes	Theory (10 hrs)	Practical (15 hrs)	Duration (25 hrs)
1. Identify the general and entrepreneurial behavioural competencies	<ul style="list-style-type: none"> Barriers to becoming entrepreneur Behavioural and entrepreneurial competencies – adaptability/decisiveness, initiative/perseverance, interpersonal skills, organizational skills, stress management, valuing service and diversity 	<ul style="list-style-type: none"> Administering self-rating questionnaire and score responses on each of the competencies Collect small story/ anecdote of prominent successful entrepreneurs Identify entrepreneurial competencies reflected in each story and connect it to the definition of behavioural competencies Preparation of competencies profile of students 	10
2. Demonstrate the knowledge of self-assessment of behavioural competencies	<ul style="list-style-type: none"> Entrepreneurial competencies in particular: self-confidence, initiative, seeing and acting on opportunities, concern for quality, goal setting and risk taking, problem solving and creativity, systematic planning and efficiency, information seeking, persistence, influencing and negotiating, team building 	<ul style="list-style-type: none"> Games and exercises on changing entrepreneurial behaviour and development of competencies for enhancing self-confidence, problem solving, goal setting, information seeking, team building and creativity 	15
Total			25

Unit 5: Green Skills - IV			
Expected Learning Outcomes	Theory (05 hrs)	Practical (10 hrs)	Duration (15 hrs)
Identify the role and importance of green jobs in different sectors	Role of green jobs in toxin-free homes, Green organic gardening, public transport and energy conservation, Green jobs in water conservation Green jobs in solar and wind power, waste reduction, reuse and recycling of wastes, Green jobs in green tourism Green jobs in building and construction Green jobs in appropriate technology Role of green jobs in Improving energy and raw materials use Role of green jobs in limiting greenhouse gas emissions Role of green jobs minimizing waste and pollution Role of green jobs in protecting and restoring ecosystems Role of green jobs in support adaptation to the effects of climate change	Listing of green jobs and preparation of posters on green job profiles Prepare posters on green jobs.	15
Total			15

Part B–Vocational Skills

Sl.No.	Units	Duration (hrs)
1.	Pre commission test and measurement pertaining to PV modules and their Installation	55
2.	AC system with Inverter	30
3.	Trouble shooting of PV system	40
4.	Maintenance of PV System	40
	Total	165

Unit 1: Pre-commission test and measurement pertaining to PV modules and their Installation			
Expected Learning Outcomes	Theory (20 hrs)	Practical (35 hrs)	Duration (55 hrs)
1. Refer installation drawings, schematic drawing and site layout and prepare As-built drawing	<ul style="list-style-type: none"> • Symbols, legends, specification in the installation and schematic drawings 	<ul style="list-style-type: none"> • Preparation of bill of materials • Prepare changes in the drawing as per site execution • Prepare final bill of materials 	6
2. Explain the personal protective equipment's, health and safety procedures in the work site	<ul style="list-style-type: none"> • Safety gloves, safety helmet, goggles, safety shoes, fire extinguishers, first aid box, Cardio Pulmonary Resuscitation 	<ul style="list-style-type: none"> • Demonstrate the use of safety equipment's • Prepare a poster on managing emergency. • Role play on reporting emergencies • Practice CPR 	5
3. Prepare work site for PV modules	<ul style="list-style-type: none"> • Factors considering while selecting site • Locate magnetic poles • Types of mountings Module • Mounting Structure • Selection of suitable mounting structure • Types of earthing • Lightning Protection System • Safe handling of each component in the site, during transportation and stocking 	<ul style="list-style-type: none"> • Locate magnetic poles (North and South) using magnetic compass. • Demonstrate shadow free area for installation • Prepare site layout • Mark locations for components of solar PV electrical system on site. • Prepare Mounting structure • Fixing of panel on the structure • Set up earthing for panel and mounting • Measure earth resistivity 	5
4. Perform diagnostic electrical performance, thermal irradiance.	<ul style="list-style-type: none"> • Standard test conditions (STC) of a PV module. Terminal box and connectors of a Solar PV module. • Identification of various test standards of PV module. • Measurement of area of the cells and compare with the module area in data sheet. 	<ul style="list-style-type: none"> • Observe shadow effect • Measure intensity of light • Measure tilt angle • Measure ambient temperature • Plot I-V curve 	3

	<ul style="list-style-type: none"> • Identification of faulty PV module. 		
5. Develop skill in connecting panel to MC4 connector	<ul style="list-style-type: none"> • Required IP Standards of Connectors 	<ul style="list-style-type: none"> • Identification and testing of cables • testing of connectors • Prepare rating chart of different types of cables • Practice connections of cable with connector using crimping tool 	5
6. Perform DC wiring of PV modules to Array Junction box	<ul style="list-style-type: none"> • Selection of cables and Connectors • Solar DC cables • Losses in DC cable • General Guidelines For AC/DC Cable Layout and Connections • Surge Protection Device 	<ul style="list-style-type: none"> • Carry out connection of panel to Array junction box • Check continuity for DC cable • Calculate the Voltage drop for a given load, in DC side. 	4
7. Perform electrical connection of Array junction box to charge controller	<ul style="list-style-type: none"> • Rating of charge controller • Blocking diodes • Selection of Circuit breakers and fuses • DC surge arrester 	<ul style="list-style-type: none"> • Identify fuses and circuit breakers • Perform dc wiring of array junction box to charge controller • Practice different wirings 	5
8. Perform electrical connection of charge controller to battery/battery bank	<ul style="list-style-type: none"> • Types of batteries • Lithium-ion batteries • Specification of batteries • Specific gravity & Hydro meter • Series & Parallel connections of Battery • Precautions while handling battery and battery bank • Cut-in and cut-off voltages of charge controller to battery 	<ul style="list-style-type: none"> • Perform DC wiring of charge controller to battery • Connect Batteries in series and measure voltage • Connect Batteries in parallel and measure voltage • Observe Cut-in and cut-off voltages of charge controller to battery 	5
9. Perform electrical connection of dc loads to charge control	<ul style="list-style-type: none"> • Type of dc loads • Solar street light • DC Fan • DC Pump • Rating of dc loads 	<ul style="list-style-type: none"> • Familiarisation of DC loads like Street lights, DC Pump, DC Fan etc... • Connect dc load to charge controller • Measure input and output voltage of charge 	5

		controller at no load and on load	
10. Perform electrical connection of battery to inverter	<ul style="list-style-type: none"> • Specification of Inverter • Battery rating • Precautions while connecting battery to inverter 	<ul style="list-style-type: none"> • Observe the name plate details of Inverter • Observe the indications on Inverter • Measure inverter output voltage • Connect battery to inverter 	3
11. Perform No Load test of PV system	<ul style="list-style-type: none"> • Define no load test 	<ul style="list-style-type: none"> • Measure input and output voltages of Inverter at No load 	3
12. Perform On load test of PV system	<ul style="list-style-type: none"> • Define On load test 	<ul style="list-style-type: none"> • Measure input and output voltages of Inverter at load 	3
13. Perform Over Load test of PV System	<ul style="list-style-type: none"> • Define Over load test 	<ul style="list-style-type: none"> • Check the Indicators of the system at Over load 	3
Total			55

Unit 2: AC System with Inverter			
Expected Learning Outcomes	Theory (10 hrs)	Practical (20 hrs)	Duration (30 hrs)
1. Explain Inverter	Explain; <ul style="list-style-type: none"> • Working of an inverter • Sine waves and Square waves • National/International standards for PV inverters • Performance Requirements of Solar Inverter 	<ul style="list-style-type: none"> • Demonstrate inverter • Familiarise Front panel switches and indicators • Familiarise back panel connectors and terminals 	6
2. Explain different types of solar charge controller technologies	<ul style="list-style-type: none"> • Pulse Width Modulation (PWM) • Maximum Power Point Tracking (MPPT) 	<ul style="list-style-type: none"> • Demonstration of • PWM inverter • MPPT inverter 	6
3. Explain specification of inverter	<ul style="list-style-type: none"> • Performance Requirements of Solar Inverter • Electrical Requirements of a Solar Inverter • Thermal Requirements of a Solar Inverter • Specification of solar inverters 	<ul style="list-style-type: none"> • List out the specification • Plot I-V curves at 25%,50% and 75% of loads 	6
4. Explain solar inverter batteries	<ul style="list-style-type: none"> • Types of solar inverter batteries • Comparison of Solar 	<ul style="list-style-type: none"> • Demonstrate solar inverter batteries 	6

Batteries			
5. Explain specification of solar inverter batteries	<ul style="list-style-type: none"> • Volt • Ampere hour (Ah) • Discharge rate (C-rate) • State of charge (SOC) • Depth of Discharge (DOD) • Efficiency of Batteries • Common defects of Batteries 	<ul style="list-style-type: none"> • Prepare rating chart of different type of batteries • Plot charging and discharging curves 	6
Total			30

Unit 3: Troubleshooting of PV system			
Expected Learning Outcomes	Theory (10 hrs)	Practical (30 hrs)	Duration (40 hrs)
1. Explain trouble shooting of panels	<ul style="list-style-type: none"> • Factors affecting PV output • various tests carried out in a Solar PV module, as per the IS 14286-2010 standards. 	<ul style="list-style-type: none"> • Visual inspection • Maximum Power Determination • Insulation Test 	8
2. Explain trouble shooting DC wiring	<ul style="list-style-type: none"> • String combiner box • System voltage selection criteria • Common faults in DC side 	<ul style="list-style-type: none"> • Visual inspection • Check wires and connectors • Continuity test of DC cables/SPD • Check DC fuse • Insulation test 	7
3. Explain trouble shooting of charge controller	<ul style="list-style-type: none"> • DC input voltage • Battery charging voltage • DC load voltage 	<ul style="list-style-type: none"> • Visual inspection of wiring • Check switches and breakers • Check input and output voltages 	6
4. Explain trouble shooting of battery	<ul style="list-style-type: none"> • Low voltage • Over charging of Battery • Over discharging of Battery 	<ul style="list-style-type: none"> • Measure battery voltage • Checking level of Electrolyte • Check battery terminals • Charge a Battery externally • Load test of Battery 	11
5. Explain trouble shooting of inverter	<ul style="list-style-type: none"> • No output • Low output 	<ul style="list-style-type: none"> • Check switch • Fuse • Measure DC input voltage, Replacement of damaged SPD, Isolator • Measure AC output voltage 	8
Total			40

Unit 4: Maintenance of PV System			
Expected Learning Outcomes	Theory (10 hrs)	Practical (30 hrs)	Duration (40hrs)
1. Explain types of maintenance	Explain ; <ul style="list-style-type: none"> • Routine maintenance • Preventive maintenance • Break down maintenance 	<ul style="list-style-type: none"> • Demonstrate Routine, Preventive and Break down maintenance of PV system 	8
2. Perform maintenance of Solar panel	<ul style="list-style-type: none"> • Panel cleaning • Precaution while cleaning • DC array inspection 	<ul style="list-style-type: none"> • Perform panel cleaning • Visual inspection of panel assembly • Measure Module/Array voltage 	8
3. Perform electrical maintenance	Electrical maintenance of ; <ul style="list-style-type: none"> • Cables and connectors • String combine box • Switches and Circuit breakers • Surge protection devices • Earthing of panels, structure and equipment's • Charge controller • Lightening protection system • Inverter 	<ul style="list-style-type: none"> • Visual inspection of wiring • Test switches and breakers 	8
4. Perform maintenance of battery	<ul style="list-style-type: none"> • Topping up Battery water • Terminal greasing • Battery storage precautions 	<ul style="list-style-type: none"> • Demonstration of Battery Maintenance. • Measure battery voltage • Checking level of Electrolyte • Measure Specific gravity of electrolyte. • Check and clean Battery Terminals. 	5
5. Perform maintenance of Charge controller	<ul style="list-style-type: none"> • Alarms and indicators of charge controller • Precautions while handling charge controller 	<ul style="list-style-type: none"> • Check connections • Measure input and output voltages 	4
6. Perform maintenance of Inverter	<ul style="list-style-type: none"> • Alarms and indicators of inverter • Precautions while handling inverters 	<ul style="list-style-type: none"> • Check DC and AC connections • Measure input and output voltages 	4

7. Perform maintenance of mounting structure	<ul style="list-style-type: none"> • Foundation • Inclination • Earthing of Panel structures 	<ul style="list-style-type: none"> • Visual inspection of mounting structure 	3
Total			40

6. ORGANISATION OF FIELD VISITS/ON-THE-JOB TRAINING

In a year, at least 3 field visits/educational tours should be organised for the students to expose them to the activities in the workplace

Visit Industries manufacturing solar panel, solar lantern, LED lights, Solar street light, Solar power Plant Etc. During the visit, students should obtain the following information-

- Solar cell
- Solar module
- Electro luminance test
- Vacuum Lamination
- STC of solar panel
- LED driver manufacturing
- LED Street light manufacturing and assembling
- Solar panel mounting and arrays
- Wiring of solar Plant
- Battery bank
- Inverter wiring
- Charge controller
- Lightening Arrester
- Earthing

On-the-job training of at least 80 hours is to be organised by the institution to provide hands-on training to the students.

7. LIST OF EQUIPMENT AND MATERIALS

The list given below is suggestive and an exhaustive list should be prepared by the vocational teacher. Only basic tools, equipment and accessories should be procured by the Institution so that the routine tasks can be performed by the students regularly for practice and acquiring adequate practical experience

PART A: EQUIPMENT

1. Multimeter
2. DC Power Supply
3. LUX Meter

4. Clamp Meter,
5. Light Meter
6. Digital True RMS AC DC Multi Meter
7. Average Type AC DC Clamp Meter
8. Average Type Digital Clamp Meter
9. Electrical Tester
10. Non-Contact AC Voltage Detector
11. Laser Distance Meter
12. Thermo Meter
13. Battery Tester
14. Insulation Resistance Tester
15. Earth Resistance Tester
16. Solar Irradiance Meter

PART B: TOOLS and ACCESSORIES

1. Soldering Iron
2. Combination Plier
3. Wire cutter
4. Screwdriver set
5. Screw Spanner
6. DE Spanner
7. Nose Player
8. Safety Eye wear
9. Safety Caps
10. Rubber Glove
11. Cutting Plier
12. Wire Stripper
13. SPST
14. SPDT
15. Batten Holder Angle
16. Batten Holder Steady
17. MCB
18. ELCB/RCCB
19. PVC Copper wire (Red and Black colour)

PART C: CONSUMABLES

1. Resistors

2. potentiometer
3. Capacitor
4. Diode
5. Voltage Regulator
6. Rheostat
7. Solder
8. Flux
9. LEDs

PART D:OTHER ITEMS

1. Solar Panel
2. Battery
3. Solar Charge Controller
4. Inverter
5. Inverter with Charge controller
6. DC Wire
7. Connectors
8. MC4 series
9. LED Driver
10. LED Street Light with Clamp & Accessories

8. LIST OF CONTRIBUTORS

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