



CERTIFICATE COURSE IN SOLAR POWER TECHNICIANS

(6 MONTHS)



**STATE BOARD OF TECHNICAL EDUCATION & TRAINING
SANKETHIKA VIDYA BHAVAN, MASAB TANK
TELANGANA, HYDERABAD**



6MONTHS CERTIFICATE COURSE IN SOLAR POWER TECHNICIANS

ACCOMMODATION REQUIRED:

Class Room	:	300Sqft to be provided
Lab	:	200Sqft to be provided
Principals Room	:	10 x 9 ft
Reception Room	:	12 x 10 ft
Open area Lab for Welding & Other activities	:	38 x 08 ft

FURNITURE REQUIRED:

I. Teachers Tables	:	2nos
II. Teachers Chairs	:	2nos
III. Writing board	:	2nos
IV. Student chairs	:	25nos
V. Working Tables	:	5nos

EQUIPMENT REQUIRED:

i. Solar Panel's	:	3Wp – 2nos, 5Wp – 4nos, 10Wp – 2nos, 35Wp – 2nos.
ii. D C Loads	:	Solar Lantern, DC Fan, CFL light
iii. Batteries	:	90Ah x 4nos, 40Ah x 2nos, 6V 4.5Ah x 10nos
iv. Solar Water Heaters	:	FPC - 1nos & ETC – 1nos
v. Solar Street light Assemblies	:	1nos
vi. Solar Lanterns	:	5nos
vii. Solar Fencing kit(Demo)	:	1nos
viii. Solar Cooker (Box Type)	:	1nos
ix. Oscilloscope	:	1nos
x. Regulated Power Supply	:	2nos
xi. Solder Irons	:	10nos
xii. Temperature controlled Solder Irons	:	10nos
xiii. Solar Inverter	:	2nos
xiv. Welding Machines	:	Arc Welding

STAFF REQUIREMENT:

1) Lecturer	:	3(Three)
2) Lab Assistants	:	2(Two)
3) Welder(Part Time)	:	1(one)



SCHEME OF INSTRUCTION AND EXAMINATION

Sub Code	Name of the Subject	Instruction Period/ Week		Total Periods / Year	Scheme of Examination			
		Theory	Practical		Duration	Sessional	End Exam Marks	Total Marks
THEORY								
SP-101	SOLAR PHOTOVOLTAIC – I	5	--	70	3Hrs.	--	100	100
SP-102	SOLAR PHOTOVOLTAIC - II	4		60	3Hrs.	--	100	100
SP-103	ENTREPRENEURIAL DEVELOPMENT, MARKETING, FINANCIAL ACCOUNTING.	6	--	95	3Hrs.	--	100	100
PRACTICALS								
SP-104	SOLAR PHOTOVOLTAIC	--	5	60	3Hrs.	40	60	100
SP-105	SOLAR THERMAL	--	3	42	3Hrs.	40	60	100
SP-106	INDUSTRIAL TRAINING	--	--	2MONTHS	--			
	T O T A L	15	8	327		80	420	500



SOLAR PHOTOVOLTAIC – I

SUBJECT TITLE : SOLAR PHOTOVOLTAIC – I
SUBJECT CODE : SP-101
PERIODS/WEEKS : 05
PERIODS/YEAR : 70

OBJECTIVE: The student will develop professional competence on Solar Photovoltaic.

Sl. No.	TOPIC	No. of Periods	Weightage of marks	No. of Short Questions	No. of Essay Questions
1	Ohms Law, Kichof's Laws & Explanation, Einstein's Photoelectric Equation	11	15	1	1
2	Basics of Photovoltaic, Arrays & SPV Systems.	10	25	1	1
3	Introduction to Solar Energy	5	20	1	1
4	Basics of Inverter	10	20	1	1
5	Diodes in Photovoltaic system.	6	5	1	1
6	Energy Enhancement Methods.	7	5	1	1
7	DC Motors & Pump sets.	10	5	1	1
8	Basics of Electronics.	12	5	1	1
TOTAL		70	100	8	8

OBJECTIVES:

1.0 Explanation of Ohms Law, Kichof's Law, Einstein's Photo Electric Equation

2.0 Basics of Photovoltaics, Arrays & SPV Systems

- 2.1 Introduction of Solar Cells
- 2.2 Principals of Electricity Generation.
- 2.3 Photovoltaic Module
- 2.4 Cell, Module, Panel & Array.
- 2.5 Electrical Parameters of P V Module.
- 2.6 Factors that Influence the output of a PV Module.
- 2.7 Key Benefits of SPV Systems.
- 2.8 Differences between SPV & Conventional Power.
- 2.9 Substantial Voltage Drop in SPV System.
- 2.10 Connecting / Disconnecting of Components / Modules.

3.0 - Introduction to Solar Energy

- 3.1 Energy Types & Classifications.
- 3.2 Energy Sources & Energy Reserves.
- 3.3 Energy Utilization & Current Scenario.
- 3.4 Electrical Power Generation & Consumption.
- 3.5 Need for Renewable Energy Sources.
- 3.6 Global Warming.
- 3.7 Solar Energy – An alternative source.
- 3.8 Solar Energy Availability on Earth.
- 3.9 Solar Energy Applications.



4.0 Diodes in Photovoltaic system.

- 4.1 Shading & Bypass Diodes.
- 4.2 Different methods to build high Voltage arrays.
- 4.3 Functions of Blocking Diode.

5.0 Basics of Inverters.

- 5.1 Inverter Types.
- 5.2 Sizing of Inverters.
- 5.3 Effective Load Efficiency.
- 5.4 Inverter Options.
- 5.5 Performance parameters & Selection criteria.

6.0 Energy Enhancement Methods.

- 6.1 Introduction to Energy enhancement methods.
- 6.2 Sun Position Tracking.
- 6.3 To Know Various methods of Tracking.

7.0 DC Motors & Pump sets.

- 7.1 Introduction to DC Motors & Pump sets.
- 7.2 Advantages of Solar water pumping.
- 7.3 Battery powered or Direct coupled array.
- 7.4 Types of Motors for PV Pumping systems.
- 7.5 Water Pumping system Installation.
- 7.6 Matching Array to pump.
- 7.7 Maximum Power Tracking.

8.0 Basics of Electronics.

- 8.1 Understanding Electronic Components.
- 8.2 Getting to know there symbols & uses.
- 8.3 Understanding Schematics.
- 8.4 Understanding Measuring equipment.
- 8.5 To know about Opto Electrical Devices.
- 8.6 General precautions to be observed.

COURSE CONTENTS :

Basics of Photovoltaic, Arrays & SPV Systems.
Hybrid Systems
Diodes in Photovoltaic system.
Basics of Electronics.
Basics of Inverters.
Energy Enhancement Methods.
DC Motors & Pump sets.

BOOKS RECOMENDED:

Book on “SOLAR POWER TECHNOLOGIES”. By : M/s. PLNS Enterprises.
Book on “SOLAR ENERGY UTILISATION” by G.D.RAI



SOLAR PHOTOVOLTAIC – II

SUBJECT TITLE : SOLAR PHOTOVOLTAIC – II
SUBJECT CODE : SP-102
PERIODS/WEEKS : 04
PERIODS/YEAR : 60

OBJECTIVE: The student will develop professional competence on Solar Photovoltaic.

Sl. No.	TOPIC	No. of Periods	Weightage of marks	No. of Short Questions	No. of Essay Questions
1	Batteries.	10	20	2	2
2	Solar Radiation Fundamentals.	5	20	2	1
3	Basic System Sizing, Installation Practices & Wiring	10	20	1	2
4	Inspection Procedures & Safety Aspects	15	20	1	2
5	Troubleshooting, Preventive Maintenance Schedules & Precautionary Measures.	20	20	2	1
TOTAL		60	100	8	8

OBJECTIVES:

1.0 Batteries.

ACIDS & BASES

- 1.1 Explain Arrhenius theory of Acids & Bases and its Limitations
- 1.2 Explain Brownsted - Lowry theory of Acids & Bases and its Limitations
- 1.3 Explain Lewis theory of Acids & Bases and its Limitations
- 1.4 Explain Ionic product of water.

ELECTROCHEMISTRY

- 1.5 Define Conductor, Insulator, Electrolyte & Non – Electrolyte
- 1.6 Explain Arrhenius theory of electrolytic dissociation
- 1.7 Define & explain electrolysis by taking example of fused NaCl
- 1.8 Explain Faraday's laws of electrolysis
- 1.9 Define chemical equivalent and electrochemical equivalent
- 1.10 Define Galvanic cell & Explain its construction
- 1.11 Distinguish between Galvanic cell & electrolytic cell
- 1.12 Understanding standard electrode potential
- 1.13 Understanding electrochemical series & its significance
- 1.14 Understanding EMF of cell
- 1.15 Introduction to Batteries.
- 1.16 Primary Functions.
- 1.17 Basic Terminology.



- 1.18 Comparison between various storage batteries.
- 1.19 Advantages & Disadvantages of different types of batteries.
- 1.20 Battery Charging.
- 1.21 Effect of Maintenance on battery life.
- 1.22 Features of typical batteries for PV applications.
- 1.23 Special requirements.
- 1.24 Battery Installation Procedure.
- 1.25 Safety aspects.

2.0 – Solar Radiation Fundamentals.

- 2.1 Introduction to Sun
- 2.2 Solar Constant & Radiation Spectrum.
- 2.3 Extraterrestrial Solar Irradiance.
- 2.4 Terrestrial Solar Irradiance.
- 2.5 Atmospheric Effects
- 2.6 Beam & Diffused Radiation.
- 2.7 Solar Radiation Measurement Techniques
- 2.8 Radiation Measuring Equipment.
- 2.9 Solar Radiation in India.

3.0 Basic System Sizing.

- 3.1 Introduction to Basic System Sizing.
- 3.2 Array & Battery Sizing principles.
- 3.3 Sizing process: Step by Step Procedure.
- 3.4 Additional Details on Sizing.

3.1 Installation Practices

- 3.1.1 Introduction to Installation Practices.
- 3.1.2 Different stages of planning in the process of installation
- 3.1.3 Transportation plan
- 3.1.4 Human needs plan
- 3.1.5 Selection of Tools
- 3.1.6 General Considerations
- 3.1.7 Site Location for array
- 3.1.8 Foundation plan
- 3.1.9 Array mounting
- 3.1.10 Array assembly
- 3.1.11 Pre assembly/wiring
- 3.1.12 Field wiring
- 3.1.13 Battery installation
- 3.1.14 Wiring of Control Centre / Equipment
- 3.1.15 Commissioning and testing of the system
- 3.1.16 Documentation preparation
- 3.1.17 To understand Different stages of Planning in the process of Installation.

4.0 Inspection Procedures.

- 4.1 Understanding Various Inspection Procedures.
- 4.2 Preparation of Inspection worksheet.



- 4.3 Inspection procedure of loads
- 4.4 Inspection procedure of arrays
- 4.5 Inspection procedure of batteries
- 4.6 Inspection procedure of Charge controller
- 4.7 Inspection procedure of wiring
- 4.8 Inspection procedure of electrical switches, inverter, etc

4.1.0 Safety Aspects.

- 4.1.1 Understanding the importance of Safety aspects that need to be taken care of while handling
 - PV Systems
 - Batteries
 - Designing & Installation of PV systems
 - Electrical Equipment

5.0 Troubleshooting Methods.

- 5.1 Understanding the breakdown reasons and performing Troubleshooting in a Photovoltaic System.
- 5.2 Troubleshooting of system wiring, switches and fuses
- 5.3 Troubleshooting of loads
- 5.4 Troubleshooting of batteries
- 5.5 Troubleshooting of Inverters
- 5.6 Troubleshooting of arrays
- 5.7 Troubleshooting of charge controllers

5.1 Preventive Maintenance Schedules & Precautionary Measures.

- 5.1.1 Understanding and preparing Preventive Maintenance Schedules & Precautionary Measures.
- 5.1.2 Preventive maintenance procedures
- 5.1.3 Routine Procedures
- 5.1.4 Maintenance schedule
- 5.1.5 Precautionary measures while working with batteries
- 5.1.6 Precautionary measures while working with electrical wiring
- 5.1.7 Precautionary measures while handling fuses and circuit breakers and cables

COURSE CONTENTS :

Batteries.
Charge Controller.
Basic System Sizing, Installation Practices
Inspection Procedures & Safety Aspects.
Troubleshooting, Preventive Maintenance Schedules & Precautionary Measures.

BOOKS RECOMENDED:

Book on “SOLAR POWER TECHNOLOGIES”. By : M/s. PLNS Enterprises.

Book on “SOLAR ENERGY UTILISATION” by G.D.RAI



ENTREPRENEURIAL DEVELOPMENT, MARKETING & FINANCIAL ACCOUNTING

SUBJECT TITLE : **ENTREPRENEURIAL DEVELOPMENT, MARKETING & FINANCIAL ACCOUNTING**

SUBJECT CODE : **SP-103**

PERIODS/WEEKS : **06**

PERIODS/YEAR : **95**

OBJECTIVE: The student should develop the skills of an entrepreneur.

TIME SCHEDULE

Sl. No.	TOPIC	No. of Periods	Weightage of marks	No. of Short Questions	No. of Essay Questions
1	ENTREPRENEURIAL CULTURE AND STRUCTURE	12	20	2	1
2	ENTREPRENEURIAL TRAITS AND TYPE	12	20	1	2
3	STEPS FOR STARTING A SMALL INDUSTRY	12	20	1	2
4	SELECTION OF TYPES OF ORGANISATION	12	20	2	1
5	INSTITUTIONS ASSISTING ENTREPRENEURS	12	20	2	2
TOTAL		60	100	8	8

OBJECTIVES:

1. ENTREPRENEURIAL CULTURE AND STRUCTURE

Meaning of entrepreneurial culture
Stages in the entrepreneurial process
Barriers to entrepreneurship
Socio-economic origins of entrepreneurship
Environmental factors affecting entrepreneurship
Entrepreneurial structures

2. ENTREPRENEURIAL TRAITS AND TYPES

Evolution of the term entrepreneur
Who is an entrepreneur
Entrepreneur and enterprise
Entrepreneurs and managers
Traits of a true entrepreneur
Types of entrepreneur
Functions of an entrepreneur
Behavioral patterns of entrepreneurs



3. STEPS FOR STARTING A SMALL INDUSTRY

Decision to become an entrepreneur,
Steps to be taken, Preparation of project report guidelines,
Procedures and formalities for registration

4. SELECTION OF TYPES OF ORGANISATION

Sole proprietorship,
Partnership,
Joint stock Company,
Factors influencing the choice of organization
Causes for poor decision-making,
Improving managerial decision-making.

5. INSTITUTIONS ASSISTING ENTREPRENEURS

Institutional infrastructure-DICS, SIDO, NSIC, SSIC, SISI, SIDCO, SIPCOT, THIC, IIC, EGB, NAYE, SIETI, NPC, NRDCI, KVIC, TCOS, ITCOT, NIESBUD
Industrial Estates Commercial Banks,
New Entrepreneurial Development Agency

COURSE CONTENTS

ENTREPRENEURIAL CULTURE AND STRUCTURE
COMPETING THEORIES OF ENTREPRENEURSHIP
ENTREPRENEURIAL TRAITS AND TYPE
PROJECT IDENTIFICATION AND CLASSIFICATION
STEPS FOR STARTING A SMALL INDUSTRY
SELECTION OF TYPES OF ORGANISATION
MANAGERIAL DECISION-MAKING
INSTITUTIONS ASSISTING ENTREPRENEURS
INSTITUTIONAL FINANCE TO ENTREPRENEURS
Marketing Research
Sales & After Sales.
Case Studies.
Introduction
Subsidiary Books
Bank reconciliation Statement.

Books Recommended:

Entrepreneurial Development
Entrepreneurial Development
Entrepreneurial Development
Marketing management
Marketing management
Accountancy

by C B Gupta / N P Srinivasan
by Vasanth Desai
by S S Kanka
Philip Kotler/Kevin Lane Keller
Karunakaran
Intermediate 1st Year Book published by Telugu
Academy.



SOLAR PHOTO VOLTAIC (PRACTICALS)

SUBJECT TITLE	:	SOLAR PHOTOVOLTAIC
SUBJECT CODE	:	SP-104
PERIODS/WEEKS	:	05
PERIODS/YEAR	:	60

OBJECTIVES:

Enhancing skills level of students in order to achieve employability in the field of Solar Photovoltaic.

Practical:

1. Open Circuit Voltage of the Modules
2. Short Circuit Current of the Modules
3. Series Configuration of the Modules
4. Parallel Configuration of the Modules
5. I-V Curves of the Modules
6. Calculation of the Fill Factor
7. Power Loss due to the Shading of the Modules
8. Identification of the Resistors with Color Coding
9. Testing of the Battery Condition
10. Stripping and Tinning of the Conductors from Wire
11. Soldering of a Basic Circuit
12. Building the Charge Controller
13. Electrical Wiring
14. Analyzing the Schematic of Solar Lantern
15. Analyzing the Schematic of the Street lighting



SOLAR THERMAL (PRACTICALS)

SUBJECT TITLE : **SOLAR THERMAL**
SUBJECT CODE : **SP-105**
PERIODS/WEEKS : **03**
PERIODS/YEAR : **42**

OBJECTIVES:

Enhancing skills level of students in order to achieve employability in the field of Solar Thermal.

Practical:

1. Maximum Temperature attained in Solar Cooker
2. Cooking of Food in the Solar Cooker
3. Understanding of solar dryer.
4. Installation of the Solar Water Heater (Evacuated Tube Collector)
5. Disassembling and Assembling of the Solar Cooker
6. Plumbing
7. Preparing Site Inspection sheet



INDUSTRIAL TRAINING

SUBJECT TITLE : **INDUSTRIAL TRAINING**
SUBJECT CODE : **SP-106**
DURATION : **2MONTHS**

A candidate shall be assessed at the end of the fourth month, before he/she completes the industrial training. The assessment shall be earned out by a committee comprising of a **representative of the industry** where the candidate is undergoing training, **a staff member of the concerned section** of the institute.

OBJECTIVES

On completion of the Industrial Training the Solar Power Technicians establishment and / or in a unit of an allied industry the student will be able to

1.0 Know the organizational structure of the unit

- 1.1 State the ownership and the group of chain to which the unit belongs.
- 1.2 Draw the unit level organizational structure.
- 1.3 Name the various departments in the enterprise that you underwent training.
- 1.4 State the activities of each department that the student has trained in.

2.0 Understand the basic layout/facilities/design of installation department and stores sections.

- 2.1 Draw the layout of the site which has been inspected for installation and planning the installation process along with its logistics.
- 2.2 Explain the routine activities in the sections trained.

3.0 Understand the preliminary tasks to be completed before commencement of training everyday.

- 3.1 List the basic jobs given.
- 3.2 How to do the store pick up
- 3.3 Other activities of the section

NOTE: For the purpose of training report students are advised to note down only those features that are available for training experience in their respective units of training.