SYLLABUS OF MODULES

FOR THE SECTOR

OF

RENEWABLE ENERGY

UNDER

MODULAR EMPLOYABLE SKILLS (MES)

Redesigned in – 2014

By

Government of India
Directorate General of Employment & Training
Ministry of Labour& Employment (DGET)

Preface

The redesigned modules of **RENEWABLE ENERGY SECTOR** consist of **Three** modules with following details:

Module No. & Code	Module Name	Total Duration Hrs	Existing Modules			Competency as per NCO Code
ML-1 RNE-1	Solar Electric system Installer & service provider	**500 (4-5 Months)**	ML-1 RNE-101	Basics of Solar Electricity	180 hrs	
			ML-7 RNE-207	Solar lighting system	120 hrs	
			ML-9 RNE-209	Solar Electric system Installer & service provider	200 hrs	
				TOTAL	**500 hrs**	
ML-2 RNE-2	Solar Hot water system installer (Domestic system upto 2000L)- including servicing	**500 (4-5 Months)**	ML-2 RNE-102	Solar Hot Water Tank Technician	150 hrs	
			ML-6 RNE-206	Solar Heater & Solar cooker sys	120 hrs	
			ML-10 RNE-210	Solar Hot water system installer (Domestic system upto 2000L)- including servicing	200 hrs	
				TOTAL	**470 hrs**	
ML-3 RNE-3	Manufacturing Assistant – Solar Hot Water System	**500 (4-5 Months)**	ML-3 RNE-103	Grooving & Collar making operator	100 hrs	
			ML-4 RNE-104	Puffing & Tank Cleaner	160 hrs	
			ML-5 RNE-105	Packer (Total Solar Water Heater sys)	100 hrs	
				TOTAL	**360 hrs**	

Module No & Code No.	Module Name	Space Norms	Power Norms	Unit Size	Instructor's Qualification
ML-1 RNE-1	Solar Electric system Installer & service provider	Shadow free terrace or ground size: 20 feet x 20 feet	02 KW	20	As per General Information of each module
ML-2 RNE-2	Solar Hot water system installer (Domestic system upto 2000L)- including servicing	Shadow free terrace size: 20 feet x 20 feet	04 KW	20	As per General Information of each module
ML-3 RNE-3	Manufacturing Assistant – Solar Hot Water System	Work shop	03 KW	20	As per General Information of each module

GENERAL INFORMATION FOR THE MODULE-1

SOLAR ELECTRIC SYSTEM INSTALLER & SERVICE PROVIDER

Name of Sector	**RENEWABLE ENERGY**
Name of Module	**ML-1: Solar Electric system Installer & service provider**
MES Code	**RNE701**
Competency **as per N C O Code**	
Duration of Course	**500 Hrs**
Entry Qualification of Trainee	8^{th} Pass + 18 yrs of age
Unit size (No. Of trainees)	20
Power Norms	2.0 KW
Space Norms (Workshop and Class Room)	Shadow free terrace or ground size: 20 feet x 20 feet
Instructors Qualification	Degree in Electrical Engineering with one year Experience **OR** Diploma in Electrical Engineering with two year Experience **OR** NTC/ NAC in Electrical Trade Group with three years of Experience
Desirable	National Instructor Training Certificate (NITC)

MODULE- 1

1. **Name of the Module:** **Solar Electric System Installer and Service Provider**

2. **Sector:** **Renewable Energy**

3. **Code:** **RNE701**

4. **Entry Qualification:** **Minimum 8th Class Pass**

5. **Age:** **18 Years.**

6. **Terminal Competency:** **After completion of course Trainees may be able to:**
   a. Know the basics of Electricity & Solar Electricity
   b. Operate Solar System & Maintain them
   c. Work in a manufacturing Unit
   d. Plan & Install Solar Electric System
   e. Commission & Service Solar Electric System
   f. Check all equipments, parts & instruments with safety

7. **Duration:** **500 Hours**

8. **Contents:**

Sl. No.	Underpinning Knowledge (Theory)	Practical Competencies
1	a. Introduction to Conventional & Non-conventional sources of energy b. Difference between conventional & Non-conventional energy & their limitations c. Advantages & Disadvantages of Non-conventional energy d. Solar Energy: Reasons for Non-conventional energy being not so popular. Chances for development of Non-conventional energy in India	Demonstration of Conventional & Non-conventional energy sources
2	Basics of Electricity: • Atomic Structure – Proton, Neutron & Electron • Characteristics & Laws of Electricity • Various methods of generation of Electricity • Definitions of Voltage, current, Resistance & their units. • Ohm's Law • Symbols used in Electrical system • Electrical Safety – Hazards & Safety measures. First Aid	Demonstration of various Safety Measures. Demonstration of First Aid. Study & application of various electrical symbols. Demonstration of Ohm's Law

3	Introduction to Electric circuit. AC & DC current. Series & parallel connections. AC Single phase & three phase. Frequency. Electric Power & Energy. Joules Law. Conductors, Resistors & Insulators. Resistance of Wires made of different materials. Types of Wiring. Faults in wiring & their effects. Earthing: Importance & Types	Study & practice various electrical circuits. Measurement of voltage, current, power, Energy & frequency Demonstration of Conductors, Resistors & Insulators. Demonstration of Earthing systems.
4	Introduction to Photo-voltaic Cell. Advantages & dis-advantages of photo-voltaic conversion. Use of solar cell in various instruments. Photo-voltaic array & its connections, arrangements of array according to the voltage. Module & its connections. Faults & their effects in photo-voltaic cell, array & module (connection of cell, connection of array, connection of module)	Prepare wiring using various accessories in solar electricity & perform its testing. Make a series & parallel wiring in solar electricity & pare a table of equations of voltage & current. To study the faults & their remedies in the wiring in solar electricity. Make an array using photo-voltaic cell in solar electricity. Prepare modules of various capacities with the help of array. In solar electricity, make a 2000 capacity power pack, connect with instruments & test it.
5	Introduction to Lead-acid battery: construction, parts & working. Anode, cathode & Electrolyte (sulphuric acid + distilled water). Construction & working of Hydrometer. Working of a battery capacity tester. Connection of battery (series & parallel). Battery cable & lamp. Maintenance & faults in a battery (battery box, negative & positive plates, cell connector, terminal, electrolyte, specific gravity, battery voltage)	In the charging system of solar electricity, perform servicing of lead acid battery (deep discharge battery), measure specific gravity & voltage. Note the capacity of the battery.
6	Solar lighting system: • Description of main parts of solar lighting system: Solar Lantern, street light, home light • Charge controller • Storage battery • Inverter • Luminars • Maintenance of solar lighting system • Major solar lighting manufacturers in India. Comparative study of Conventional lighting system & solar lighting system	-Study solar photovoltaic module. - Charge the battery & trace out fault. - Assemble a solar lighting system - Carryout first hand maintenance - Dismantle every part of solar lantern, study the construction & function of solar parts - Test for fault finding - Dismantle every part of solar home light system, study the construction & function of each part. - List for finding of the faults.
7	Solar Photovoltaic system: Check the functions of different parts upto the performance level expected.	-Identifying all components of a simple DC solar lighting system & solar lantern - Segregating defective parts & labelling them

8	• Role of an Installer • Description of trade	Planning installation activity
9	-Need for personal safety & safety of others. Dangers associated with working at heights. Methods of safety practices while using different hand tools. - Impact of incorrect lifting of objects, system components (especially battery) while installing at heights & while working. - Personal protective equipments & their usage. - Knowledge of the causes of accident & its remedial actions.	Adopt all safety practices: -Safe use of ladders, safe working in open terraces & other risky & elevated places. - Correct handling of heavy components - Use of personal protective equipments (PPE) like gloves, goggles, safety belts etc - Handling any incidents / accidents
10	Battery: Typical values of battery voltage, module current & voltage. Acid & their properties, current flow in batteries & impact of shorting of terminals. Charging process & precautions to be taken while charging a battery	Safe handling of batteries & maintenance. Checking batteries for their function. Correcting the gravity of acid & charging the battery.
11	Different types of tools & their use	Use of installation tools
12	Sun movement over the day, shadowing effects. Risks involved in Hydrogen released by batteries & the need for ventilation. Charge controller basic functions.	Identifying current location of the solar modules, correct installation practice, correct location for charge controller & batteries & visual indications in charge controller & check for proper functioning.
13	Short circuit length, aesthetics, maximizing the utility (as in the case of lighting max space) & convenience.	Wiring plan & location of loads & charge controllers & modules to avoid loss
14	Commissioning steps	Commissioning the Solar Electric system
15	Overall operation of system, safe use & basic maintenance & trouble shooting	Educating the customer on use
16	I&C format & contents	Documentation
17	Registering complaints, tracing & disposing complaints, customer relations.	Complaint management system

Building:

1. A class room with basic teaching aids – black board, table 6’ x 3’
2. Atleast two AC power outlets
3. A shadow free terrace area of 20 ft x 20 ft / shadow free open flat area on the ground
4. Transparent / white board with temporary marker
5. LCD Projector & Screen.

List of Tools & Equipment for a batch of 20 trainees:

Sl. No.	Name of Tools & Instruments	Quantity (Nos.)
1	Electric tester	20
2	Plier	5
3	Screwdriver (light duty)	5
4	Spanner set	5
5	Crimping tool	5
6	Knife	5
7	Hacksaw	5
8	Hammer, small	5
9	Wire stripper	5
10	Measuring tape	5
11	Magnetic compass	5
12	Ammeter	5
13	Voltmeter	5
14	Multimeter	5
15	Meggar	5
16	Hydrometer	5
17	Solar Insulation meter	5
18	Pyranometer	5
19	Pyrheliometer	5
20	Lux meter	5
21	Sunshine recorder	5
22	Solar cell based sunlight radiation meter	5
	Demo Equipments	
1	Cut models of Photo voltaic cell assembly	2
2	Cut model of Lead acid battery	2
3	An assortment of solar modules-10W, 40W, 75W	2
4	Charge controller 12V/ 10A	2
5	Flooded Lead acid battery, 12V/40 Ah, 75 Ah	2
6	CFL based & LED based lanterns	2
7	Home lighting system with CFL & LED based lamps, DC fans	2
8	Solar cell educating kit	2
9	Cables of varying sizes, 2x2.5 sq.mm & 4 sq.mm	2
10	Ring & fork type terminals	
11	PVC mug, 25 ltr bucket & PVC rod	2
12	A laminate coating the following: Multi crystalline & single crystalline (both circular & square) wafer, processed solar cells, front & back	2
13	A typical module junction box	2
14	Sample fuses	
15	Chart for voltage drop in respect of length & size of wire / cable ie. Wire table	2
16	Complete line diagram with installation procedure of each equipment step by step with connection of wire with equipments.	2

17	Register to record all complaints received :& disposed	2
	Safety & Protective Equipments	
1	Rubber gloves	4
2	Cotton gloves	4
3	Goggles	4
4	Helmet	4
5	Gum boots	4
6	Safety belt	4
7	First Aid kit	4

GENERAL INFORMATION FOR THE MODULE-2

SOLAR COOKER & SOLAR HOT WATER SYSTEM INSTALLER (DOMESTIC SYSTEM UPTO 2000 L) - INCLUDING SERVICING

Name of Sector	**RENEWABLE ENERGY**
Name of Module	**ML-2: SOLAR HOT WATER SYSTEM INSTALLER (DOMESTIC SYSTEM UPTO 2000 L) - INCLUDING SERVICING**
MES Code	**RNE 702**
Competency **as per N C O Code**	
Duration of Course	**500 Hrs**
Entry Qualification of Trainee	8^{th} Pass + 18 yrs of age
Unit size (No. Of trainees)	20
Power Norms	4.0 KW
Space Norms (Workshop and Class Room)	Shadow free terrace size: 20 feet x 20 feet
Instructors Qualification	Degree in Electrical Engineering with one year Experience **OR** Diploma in Electrical Engineering with two year Experience **OR** NTC/ NAC in Electrical Trade Group with three years of Experience
Desirable	National Instructor Training Certificate (NITC)

MODULE- 2

1. **Name of the Module:** **Solar Hot water System Installer (Domestic System Upto 2000 L) - including servicing**
2. **Sector:** **Renewable Energy**
3. **Code:** **RNE702**
4. **Entry Qualification:** **Minimum 8th Class Pass**
5. **Age:** **18 Years.**
6. **Terminal Competency:** **After completion of course Trainees may be able to:**
   - **a. Fabricate the sheets as per dimensions & different settings on solar tank**
   - **b. Operate different types of machines**
   - **c. Manufacture solar hot water tank**
   - **d. Use & operate Solar water heater & Solar cooker**
   - **e. Carryout first hand maintenance**
   - **f. Plan & Install Solar hot water system & Solar cooker**
   - **g. Work in manufacturing unit**
   - **h. Check all equipments, parts & instruments with safety**
7. **Duration:** **500 Hours**
8. **Contents:**

Sl. No.	Underpinning Knowledge (Theory)	Practical Competencies
1	Knowledge about dimensions & quality of steel sheets used for making hot tank outer & inner	Checking dimensions & thickness of the sheets with the standard for the size of the tank to be produced.
2	Knowledge of parts & functions of a shearing machine. Importance & practices of marking dimensions on sheet as per the tank size. Safe disposal of scraps without damaging self or the surroundings.	Practice on sheet cutting by shearing machine. Marking dimensions on sheet as per the tank size. Selecting correct template for cutting as per the size of the water tank. Checking shear edge before operating the machine. Collecting scraps & putting them in proper place for disposal.
3	Knowledge of parts & the functions of a power press & hand press	Checking the number of punches to be made & the pitch. Checking the number of tubes to be inserted. Checking the dimensions of punch hole required. Checking the stopper setting before starting operation. Punching the required number of holes & at the spacing as needed.

		Collecting the scraps & putting in the drum for disposal
4	Knowledge of parts & functions of a bending machine.	Checking settings of the bending machine before handling. Safe handling of bending machine. Bending sheets at the edges & forming the cylindrical tube shape.
5	Knowledge of parts & functions of a Linear welding machine. Knowledge of parts & functions of gas welding machine.	Adjusting current, voltage in the welding machine, setting temperature (current level) according to the thickness of sheets. Checking the settings of the machine before welding the sheets. Checking the quality of welding after cooling.
6	Knowledge of parts & functions of a Nipple welding machine.	Practice Tube welding.
7	Knowledge of capacity of gas cylinders. Method of knowing the availability of gas in the cylinders.	Replacing the Gas cylinders
8	Safety precautions while handling inflammable gas cylinders, replacing the pipes & regulators. Environmental impacts of gas leakage.	Checking gas pipes for leakage before starting
9	Safety precautions to be taken while operating a shearing machine, power press, bending machine, linear welding & nipple welding machines.	Practice on use of Eye protecting glass, gloves, shoes Inserting the shirts & folding the sleeves in case of full arm shirts.
10	Importance of team work & mutual cooperation.	Practice on working in a team for bringing material, setting the machine, loading & unloading, removing the scraps, cutting, punching, bending, grooving, collar making & welding.
11	Solar cooker: -Basic working principle - Designs available in the market -Information on solar cookers manufacturers in India -Introduction to solar cookers for house hold & community applications - Operation & maintenance. - Serving schedule. - Disadvantages & Limitations.	Solar cooker: -Study solar cookers designs / components - Assemble solar cookers - General maintenance schedule for solar cooker components - Fault finding & trouble shooting.
12	Solar Water Heaters (SWH): - Basic working principle of solar hot water system – copper flat plate & Evacuated tube collectors (ETC) - Parts of a SWH & criticality. - Types of system – Thermo Siphon / systems operating under pressure / no pressure / heat exchangers. -Importance of insulation & insulation	Solar Water Heaters (SWH): -Able to distinguish between copper based flat plate collector & Evacuated tube collectors (ETC) - Flow diagrams – reading & understanding various systems / drawings / animated representation. - System installation (erection) ensuring leak proof joints. - Safe transportation, erection & commissioning. - Connecting electrical back-up heaters.

	materials. - Equipment handling, moving to location & erection (sequentially). - Basic Electrical knowledge. - Basic plumbing knowledge / pipe sizes.	
13	-Role of an Installer. - Description of trade.	Planning installation activity of Solar hot water system
14	-Need for personal safety & safety of others. Dangers associated with working at heights, methods of safety practices while using different hand tools. - Impact of incorrect lifting of objects, system components (tank, ETC tubes) & while installing at heights. -Importance of using Personal Protective Equipments (PPE) & their usage. - Installation in the presence of end users. - Handling hot parts. - Knowledge of the cause & remedial actions.	- Adopt all safety practices. - Safe use of ladders, safe working in open terraces & other risky & elevated places. - Correct handling of heavy components. - Use of personal protective equipments (PPE) like gloves, goggles, safety belts etc. - Handling any incidents / accidents. - Precautions against heat.
15	Collector components, cover glass / ETC tubes	Safe handling of collectors
16	Different types of tools & its operation	Use of installation tools
17	Use of Thermometer & standard measuring devices.	Measurement of temperature, volume & dimensions.
18	-Sun movement over the day, shadowing effects - Carrying out site survey to identify suitability & location - Water quality – hard /soft, remedies. - Availability of other support system (overhead water tank / plumbing arrangement / electrical access). - Recommending correct size & type of system.	Identifying correct location of the solar collectors / system capacity / water quality
19	Heat loss & piping length, aesthetics, maximizing the utility & convenience..	Plumbing on the inlet & outlet side & integrating to the water line. Location of water outlets.
20	-Overall operation of system, safe use & basic maintenance & trouble shooting - Communication skills - Explaining system features / dos & don'ts - Explaining warranty features - Common problems of SWH &	- Educating the customer on use - Interaction with customers - Trouble shooting of existing systems - Servicing & Maintenance / AMC

	solutions	
21	I&C format & contents	Documentation.

Building:

1 A class room with basic teaching aids – black board, table 6' x 3'
2. Atleast two AC power outlets
3. A shadow free terrace area of 20 ft x 20 ft with overhead storage tank.
4. Transparent / white board with temporary marker.
5. LCD Projector & Screen.

List of Tools & Equipment for a batch of 20 trainees:

Sl. No.	Name of Tools & Instruments	Quantity (No.)
1	Tool kit	As required
2	Electric tester	As required
3	Portable drilling machine	2
4	Set of spanners	As required
5	Set of Screw drivers	As required
6	Pipe wrench	As required
7	Knife	As required
8	Hacksaw	As required
9	Hammer	As required
10	Screw gauge	1 set
11	Template of different sizes	1 set
12	Die for threading of pipes	1 set
13	Plumbing instrument / equipment for hot & cold water pipe line – oxiac	1 set
14	Radiation measurement devices	1
15	Digital temperature meter	1
16	Magnetic compass	As required
17	Bucket 20 L	As required
18	Measuring tape	As required
19	Punching tools power press	1 set
20	Shearing machine	1
21	Power press	1
22	Bending machine	1
23	Linear welding machine	1
24	Nipple welding machine (Tig Welding)	1
25	Air compressor for leak testing	1
26	Resistance welding machine (Electric)	1
27	Gas welding equipments	1
28	Puff insulator & its machine	1
29	Painting machine (powder coated / spray painting)	1
	Demo Equipments	
1	Different types of Solar cookers	

2	One 100 lpd hot water system each with with flat plate collector & evacuated tube collector	
3	Various types of valves – Gate valve, NRV, Pressure release valve	
4	Hose pipe & flanges / sealing rings / dust rings / washers	
5	Teflon tape / cotton thread	
6	Heater coils / Insulation tape	
7	Sacrificial anode	
8	T joints, L bends, union & other plumbing joints	
9	Water mixer taps	
10	Model storage tank showing the cross section –m SS tank, insulation & cladding, heater coil & sacrificial anode.	
	Safety & Protective Equipments	
1	Rubber gloves	As required
2	Cotton gloves	As required
3	Goggles	As required
4	Helmet	As required
5	Gum boots	As required
6	Safety belt	As required
7	First Aid kit	As required

GENERAL INFORMATION FOR THE MODULE-3

MANUFACTURING ASSISTANT - SOLAR HOT WATER SYSTEM

Name of Sector	**RENEWABLE ENERGY**
Name of Module	**ML-3: Manufacturing Assistant – Solar Hot water System**
MES Code	**RNE704**
Competency **as per N C O Code**	
Duration of Course	**500 Hrs**
Entry Qualification of Trainee	7^{th} Pass + 14 yrs of age
Unit size (No. Of trainees)	20
Power Norms	3.0 KW
Space Norms (Workshop and Class Room)	Work shop
Instructors Qualification	Degree in Electrical Engineering with one year Experience **OR** Diploma in Electrical Engineering with two year Experience **OR** NTC/ NAC in Electrical Trade Group with three years of Experience
Desirable	National Instructor Training Certificate (NITC)

MODULE- 3

1. **Name of the Module:** **Manufacturing Assistant - Solar Hot water System**

2. **Sector:** **Renewable Energy**

3. **Code:** **RNE704**

4. **Entry Qualification:** **Minimum 7th Class Pass**

5. **Age:** **14 Years.**

6. **Terminal Competency:** **After completion of course Trainees may be able to:**
   a. Form tube from sheets
   b. Make groove cutting on tube
   c. Fix the collar in appropriate place
   d. Handle different types of machines
   e. Handle different packing materials
   f. Make the packaging box as per solar heater
   g. Arrange sealing the cartons & packing register
   h. Work in units manufacturing Solar Hot water system

7. **Duration:** **500 Hours**

8. **Contents:**

Sl. No.	Underpinning Knowledge (Theory)	Practical Competencies
1	Knowledge about dimensions & quality of steel sheets used for making hot tank outer & inner.	Check dimensions of the sheets, tube with the standards for the size of the tank to be produced.
2	Knowledge of parts & functions of a spinning lathe.	Keeping the sheet in tube form to be grooved on the spinning lathe. Selecting the depth of groove as per the size of the water tank.
3	Knowledge of importance of collar. Knowledge of sizes of collar.	Check dimensions of the collar to be made. Bending sheet to the shape of the collar. Check the dimensions of the collar after preparation
4	Knowledge of fixing the collar	Practice on fixing the collar securely.
5	Knowledge of dimensions of end dish. Knowledge of importance of end dish.	Practice on fixing the end dish.
6	Safety precautions to be taken while operating a lathe & fixing the end dish.	Practice / working in a team for bringing material, setting the machine, loading, unloading & removing the scraps.
7	Specifications of different tank dimensions	Identifying the tank dimensions & marking pair of inner & outer tank as per the design.
8	Use of stand for inserting the inner into outer.	Adjusting the stand length depending on size of the tank
9	Importance of properties of polyurethane foam in insulating the	Putting the correct inner tank inside the outer tank as per the paring done.

	hot water tanks.	
10	Importance of maintaining uniformity of mixing.	Aligning the hole positions of inner tank & outer tank.
11	Chemicals used for preparing the foam.	Applying a mixture of oil & grease on the outside of outer tank in the hole positions to make the cleaning easy after installation.
12	Precautions to be taken while puffing.	Mixing chemicals in steel bucket or bowl. Maintain mixing ratio of Isocynate to Elastoper at 1:1.2
13	Precautions to be taken from chemical hazards.	Pour mixed chemical in between the tank space. Allow it to foam & settle for 30 minutes. Fix the end cap on the open side. Observe for one day
14	Importance of reaction time while puffing.	Sending the cleaned tank for cleaning
15	Precautions to be taken while sending the finished tank for packing.	Practice working in a team for bringing material, setting the machine, loading, unloading & removing the scrapes.
16	Precautions to be taken while disposing the empty drums of chemical & the possible impact on environment. Knowledge on environmental pollution- their causes, consequences & mitigation related to the module.	Disposing of chemical drums. Practice of safe working habits in view of occupational health & hazards.
17	Knowledge of thinners & the method of using them for removing the puff particles on surface of the tank.	Cleaning surface of the tank using a thinner & soft cloth.
18	Knowledge of using French Chalk powder for polishing tank surface.	Apply powder of Plaster of Paris or French Chalk & rub gently with a soft cotton cloth.
19	Safety precautions taken when handling Plaster of Paris or French Chalk	Handing over the finished tank to packing.
20	Safety precautions to be taken while cleaning a tank	Practicing the use of gloves & shoes. Inserting the shirts & folding the sleeves in case of full arm shirts.
21	Different sizes of cartons for different materials for packing.	Selecting carton as per the size of the tank.
22	Marking on carton, the statutory requirements, the customers requi.rement.	Check markings on the cartons if any.
23	Knowledge of tank size & the serial numbers.	Paste packing information after ensuring the tank model / size & the serial numbers.
24	Precautions while packing.	Putting thermo coal on the sides of the tank as needed.
25	Use of thermo coal as shock absorbers.	Putting accessories as decided in the carton with secure packing.
26	Knowledge of accessories as decided in the carton with secure packing.	Practice to sealing the cartons.
27	Details needed in packing registers	Entering the packing details in the packing register.
28	Accountability of packing person for correctness of the materials packed.	Entering the name of person responsible for inspection before packing.
29	Safety precautions to be taken while	Inserting the shirts & folding the sleeves in case of

	packing.	full arm shirts.
30	Importance of team work & mutual cooperation.	Practice working in a team for bringing material, setting the machine, loading, uploading & removing of scraps.
31	Environ impacts of the scrapped packing materials.	Disposing the scrap packing materials.

Building:

1. A class room with basic teaching aids – black board, table 6' x 3'
2. Atleast two AC power outlets
3. Work shop
4. Transparent / white board with temporary marker.
5. LCD Projector & Screen.

List of Tools & Equipment for a batch of 20 trainees:

S. No.	Name of Tools & Instruments	Quantity (No.)
1	Spinning lathe	1
2	Grooving machine	1
3	Safety gadgets – shoes, gloves	20 sets
4	Stand for insertion of tank	1
5	Isocynate	1 drum
6	Elastoper	1 drum
7	Buckets for mixing	2
8	Bowls for mixing	2
9	Facility for washing hands & face	1
10	Thinner	10 Litres
11	French Chalk	5 Kgs.
12	Cartons	As required
13	Sealing tapes	As required
14	Safety gadgets – shoes, gloves	20 sets.

LIST OF TRADE COMMITTEE MEMBERS

List of members attended the Trade Committee Meeting for designing the course curriculum under **Skill Development Initiative Skill (SDIS)** based on **Modular Skills (MES)** in Renewable Energy Sector held at L & T Ltd. IFCI Tower, 61 Nehru Place, New Delhi on 13.02.2015

Sl. No.	Name & Designation Sh/Mr/Ms.	Organization	Contact no. & E-Mail Id	Designation
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GENERAL INFORMATION FOR THE MODULE- 4

Asst. Solar PV Technician

Name Of Sector	**RENEWABLE ENERGY**
Name of Module	**Asst. Solar PV Technician**
MES Code	RNE 704
Competency as per N C O Code	
Duration of Course	**600 hrs**
Entry Qualification of Trainee	Min. 8th Pass+ 18 yrs of age
Unit Size (No of trainees)	20
Power Norms	10kW
Space Norms (Workshop and Class Room)	Ground size:1200 Sqmtr Work Shop: 360 Sqmtr Class Room: 40 Sqmtr
Instructors Qualification	1. Degree in Electrical Engineering with one year experience in Solar PV Project **OR** 2. Diploma in Electrical Engineering with Two years Solar PV project **OR** 3. NTC/NAC in Electrician trade with 5 year Experience as Solar PV Technician

MODULE- 4

1. Name of the Module : Asst. Solar PV Technician
2. Sector : Renewable Energy
3. Code : RNE 704
4. Entry Qualification : Minimum 8th Pass
5. Age : 18 Years and above
6. Terminal Competency : After completion of Course Trainees may be able to:

a. Know the basics of Electricity & solar Electricity
b. Operate Solar System & Maintain them
c. Work in an execution project

7. Duration : 600 hrs
8. Contents :

Sl. No.	Underpinning Knowledge (Theory)	Practical Competencies
1	a. Electrical Safety Electrical safety Rules, Simple First Aid , General safety of tools and equipment PPEs , Fire extinguishers, Type of fire extinguishers b. Electricity Basics	Introduction of Institute, Display Room Visit, solar training yard visit, Demonstration of energy sources Tools Introduction & type of tools:- 1. Safety tools 2. Fire extinguisher 3. Marking tools 4. Working tools 5. Measuring tools 6. Testing tools 7. Heavy tools
2	a. Fundamental of Earthing system b. PV module, Fundamental types of modules and its applications, PV components and configuration etc. c. System components & inspection d. Site layout & marking	Study of solar photovoltaic cell & solar photovoltaic module, type of photovoltaic cell & type and size of solar PV module 1.Solar photovoltaic system 2. Types of solar photovoltaic system a. Grid connected solar photovoltaic system b. Grid connected with battery backup solar photovoltaic system c. Off Grid connected solar photovoltaic system d. Standalone solar photovoltaic system

3	Foundation & Structure Reinforcement and basic related theory a. Erection of structure , handling & installation of solar module b. Cable trenching & cable laying c. Introduction to bar bending trade glossary, tools , components& equipment and its uses d. Identifying, marking, cutting of rods of required length & straightening bunch & coil e. Tying of rods in position f. Bending stirrups, cranks & chair bar g. Layout, marking cage for column & footing base set into position	Erection of structure& module mounting Cutting/Bending/Tying of re-bar
4	Foundation & Structure Formwork and basic related theory a. Introduction to Formwork trade glossary, tools , components& equipment and its uses b. Making of system straight shutter c. Assembling & dismantling of foundation formwork d. Assembling & dismantling of column formwork e. Assembling & dismantling of beam & slab formwork system	Cutting of timber & plywood and drilling holes making of Form box, staging and supporting arrangement Assembling & dismantling of Doka formwork
5	Foundation & Structure & Masonry & Concreting and basic related theory a. Introduction to Masson trade glossary, tools , components & equipment and its uses & Preparation of cement mortar b. Preparation of Concrete Mix c. Building Stretcher Bond corner wall using English Bond d. Building cubical room using English bond	Preparation of cement mortar Preparation of concrete mix Building stretcher bond corner wall using English bond
6	a. Construction of cable trenches & conduits b. Cable Tray support & Tray Erection c. Requirements & uses of tools & tackles	Cable tray support & tray erection requirement& use of tools & tackles
7	a. Operation & maintenance of solar power plant b. Check list preparation c. Soft && Entrepreneurship Skills d. On job training at Project	Solar PV module cleaning & testing Measurement of earth resistance, Cleaning of inverter, Cleaning of pole mounted CT/PT, Management of weeds and vegetation. On Job training at project premises.

Infrastructure:

1. A Class room with basic teaching aids- white board, table 6'x3' and sitting arrangement.
2. A shadow free ground flat area, practical area 1200 SqMtr, workshop 360 SqMtr
3. Different type of PV facility for training like Fixed, Seasonal Tilt, Horizontal axis Tracker & Dual axis Tracker
4. Various type of Module like Thin Film, Crystalline and Bifacial. Total 10 kW.
5. LCD Projector& Screen.

List of Tools & Equipment for a batch of 20 trainees

Sl. No.	Name of Tools & Instruments	Quantity (Nos.)
1	Tool kit	As per requirement
2	Double ended flat spanner	2 set
3	Double ended ring spanner	2 set
4	Combination pliers	4
5	Side cutting pliers	4
6	Nose pliers	4
7	Wire stripper	4
8	Electrician knife	10
9	Hack saw frame with blade	4
10	Hand crimping tools	2
11	Cable cutter	1
12	Screw driver	4
13	Water level	5
14	Measuring tape	1
15	Centre punch	1
16	Standard wire gauge	1
17	Vanier calliper	1
18	Line dori	2
19	Chisel	1
20	Drill m/c	2
21	Plumb bob	2
22	Sprit level	2
23	Flat file	2
24	Round file	2
25	Triangle file	2
26	Hand saw	2
27	Pvc mallet	2
28	Ball pin hammer	4
29	Fuse puller	1
30	Safety helmet	As per requirement
31	Safety souse	4
32	Safety belt	As per requirement
33	Nose mask	5
34	Safety goggles	As per requirement
35	Ear plug	2
36	Pvc hand glove	10

37	Cotton hand glove	10
38	Reflective jacket	5
39	Tong tester AC/DC	2
40	MULTIMETER	2
41	Megger	2
42	Earth resistance tester	2
43	water testing instruments (TDS Meter)	1
44	Earthing Rod	1
45	Soldering Iron & Flux	5
46	Phase Sequence meter	2

Demo Equipment

Sl. No.	Name of Tools & Instruments	Quantity (Nos.)
1	Tool kit	1
2	Double ended flat spanner	1
3	Double ended ring spanner	1
4	Combination pliers	1
5	Side cutting pliers	1
6	Nose pliers	1
7	Wire stripper	1
8	Electrician knife	1
9	Hack saw frame with blade	1
10	Hand crimping tools	1
11	Cable cutter	1
12	Screw driver	1
13	Water level	1
14	Measuring tape	1
15	Centre punch	1
16	Standard wire gauge	1
17	Vanier calipash	1
18	Line dori	1
19	Chisel	1
20	Drill m/c	1
21	Plumb bob	1
22	Sprit level	1
23	Flat file	1
24	Round file	1
25	Triangle file	1
26	Hand saw	1
27	Pvc mallet	1
28	Ball pin hammer	1
29	Fuse puller	1
30	Safety helmet	1
31	Safety souse	1
32	Safety belt	1
33	Nose mask	1
34	Safety goggles	1

35	Ear plug	1
36	Pvc hand glove	1
37	Cotton hand glove	1
38	Reflective jacket	1
39	Tong tester AC/DC	1
40	MULTIMETER	1
41	Megger	1
42	Erath tester	1
43	End termination of power cable	2
44	Cable tray Erection	1
45	Structure with module mounting	1

Safety & Protective Equipment

Sl. No.	Name of Tools & Instruments	Quantity (Nos.)
1	Safety helmet	As per requirement
2	Safety souse	As per requirement
3	Safety belt	As per requirement
4	Nose mask	As per requirement
5	Safety goggles	As per requirement
6	Ear plug	As per requirement
7	PVC hand glove	As per requirement
8	Cotton hand glove	As per requirement
9	Reflective jacket	As per requirement
10	First aid kit	As per requirement
11	Gum boots	As per requirement

Assistant Solar PV Technician (8th Pass)								
Sl. No	**Date**		**Theory (No. of Days)**	**Course Module**	**Module Number**	**Practical (No. of Days)**	**Period Hours**	
	From	**To**					**Theory**	**Practical**
1			3	Electrical Safety Electrical safety Rules, Simple First Aid , General safety of tools and equipment PPEs , Fire extinguishers, Type of fire extinguishers	SL-1	3	1	7
2			3	Electricity Basics	SL-2	3	1	7
3			2	Fundamental of Earthing system	SL-3	2	1	7
4			2	Brief introduction of Solar Photovoltaic, Solar cells, PV module Fundamentals types of modules and its applications , PV components and configuration etc.	SL-4	2	1	7
5			2	System components & inspection	SL-5	2	1	7
6			2	Requirements & uses of tools & tackles.	SL-6	2	1	7
7			1	Site Layout & Marking	SL-7	1	1	7
8			2	Erection of Structure, Handling & Installation of Solar Modules	SL-8	2	1	7
9			1	Cable trenching & cable laying	SL-9	1	1	7
				Foundation & Structure Reinforcement				
10			2	Introduction to Bar Bending trade glossary, tools, components & equipment and its uses	SL-10	2	1	7
11			1	Identifying, marking, cutting of rods of required length & straightening bunch & coil	SL-11	1	1	7
12			1	Tying of rods in position	SL-12	1	1	7
13			1	Bending stirrups, cranks & chair bar	SL-13	1	1	7
14			1	Layout, marking cage for column & footing base set into position	SL-14	1	1	7
				Foundation & Structure Formwork				
15			2	Introduction to Formwork, trade glossary, tools, components & equipment and its uses Cutting timber & plywood and drilling holes	SL-15	2	1	7
16			1	Making of system straight shutter	SL-16	1	1	7
17			1	Assembling & dismantling of foundation	SL-17	1	1	7

				formwork				
18			1	Assembling & dismantling of column formwork	SL-18	1	1	7
19			1	Assembling & dismantling of beam & slab formwork system	SL-19	1	1	7
				Foundation & Structure Masonry & Concreting				
20			2	Introduction to Masson trade glossary, tools, components & equipment and its uses Preparation of cement mortar	SL-20	2	1	7
21			1	Preparation of Concrete Mix	SL-21	1	1	7
22			2	Building Stretcher Bond corner wall using English Bond	SL-22	2	1	7
23			1	Building cubical room using English bond	SL-23	1	1	7
24			1	Construction of Cable Trenches & Conduits	SL-24	1	1	7
25			1	Cable Tray support & Tray Erection	SL-25	1	1	7
26			1	Operation & Maintenance of Solar Plants	SL-26	1	1	7
27			1	Check list preparation	SL-27	1	1	7
28			14	Soft & Entrepreneurship Skills	SL-28	14	1	7
29			21	On job training at Project	SL-29	21	1	7

GENERAL INFORMATION FOR THE MODULE-5

Solar PV Installer& Service Provider (ITI Candidate)

Name Of Sector	**RENEWABLE ENERGY**
Name of Module	**Solar PV Technician**
MES Code	RNE 805
Competency as per N C O Code	
Duration of Course	**600 hrs**
Entry Qualification of Trainee	Min. 10th Pass + ITI in Electrician, Electronics Mechanic, Fitter, Turner, Machinist, sheet metal or welder.
Unit Size (No of trainees)	20
Power Norms	10kW
Space Norms (Workshop and Class Room)	Ground size:1200 Sqmtr Work Shop: 360 Sqmtr Class Room: 40 Sqmtr

Instructors Qualification	1. Degree in Electrical Engineering with one year experience in Solar PV Project **OR** 2. Diploma in Electrical Engineering with Two years Solar PV project **OR** 3. NTC/NAC in Electrician trade with 5 year Experience as Solar PV Technician

MODULE-5

1. Name of the Module : Solar PV Technician
2. Sector : Renewable Energy
3. Code : RNE 805
4. Entry Qualification : 10^{th} + ITI in Electrician, Electronics Mechanic, Fitter, Turner, Machinist, sheet metal or welder.
5. Age : 18 Years and above
6. Terminal Competency : After completion of Course Trainees may be able to:

d. Know the basics of Electricity & solar Electricity
e. Operate Solar System & Maintain them
f. Work for execution project
g. Plan & Install Solar PV Electrical System
h. Testing and Commissioning of Solar plant
i. Check all equipment and part with safety

7. Duration : 600 hrs
8. Contents:

Sl. No.	Underpinning Knowledge (Theory)	Practical Competencies

1	a. Electrical Safety Electrical safety Rules, Simple First Aid , General safety of tools and equipment PPEs , Fire extinguishers, Type of fire extinguishers b. Electricity Basics c. Introduction to Conventional & Non-conventional source of energy	Introduction of Institute, Display Room Visit, solar training yard visit, Demonstration of energy sources Tools Introduction & type of tools:- 1. Safety tools 2. Marking tools, 3. Measuring tools, 4.Testing tools 5. Working tools,
2	a. Fundamental of Earthing system b. PV module, Fundamental types of modules and its applications, PV components and configuration etc. c. System components & inspection d. Site selection , suitability & Planning e. Basic understanding of protection system such as fuse, circuit breaker, relay etc. f. Basic understanding of CT, PT, LA, Switchgear, isolator, ABT meter etc.	Study of Solar photovoltaic cell & solar photovoltaic module, type and size 1. Solar Photovoltaic system 2. Types of solar photovoltaic system, 3. Grid connected Solar PV system, 4. Grid connected with battery back-up solar PV, 5. Off Grid connected Solar PV system and 6. Standalone Solar PV
3	a. Handling and Storage of DC components	Safe handling practices
4	Reading of drawing and Specifications for the followings a. Civil Foundation or Ramming b. Structure Erection and Module Mounting c. Cabling from Module to Inverter Room d. Inverter and Transformer Installation and Connection e. Reading of Single Line Diagram (SLD)	Structure member, cable, cable laying, Types of cable laying-: 1. Open area cable laying 2. Underground cable laying a. Direct laying b. Laying in pipe c. Solid method Installation of inverter, LT panel Transformer, types of Transformer a. Power Transformer b. Distribution Transformer c. Auto Transformer d. Instrumentation transformer PV module Series & parallel connection & testing
5	a. Basic knowledge about Tools & Tackles required for PV plant installation b. Performance analysis and troubleshooting monitoring of generation per string incoming & outgoing power at junction box & Inverter level. c. Requirement & Uses of Tools & Tackles. Basic knowledge of Ammeter Voltmeter, clamp on-meter, tong tester, Irradiance sensor, temperature sensors.	Use of tools and tackles and safe application practises a. Voltmeter b. Amp meter c. MultiMate d. Tong tester AC/DC side testing

6	Preparation of work statement & documents for the followings: a. Foundation- P&M, Tools & Tackles b. Structure Erection- P&M, Tools & Tackles c. Module Mounting- Module Sorting, Tools & Tackles d. Cable Trenching & Conduit Laying- P&M, Tools & Tackles f. Cable Laying & Termination- Tools & Tackles, Pre Requisite g. Cable tray & cable laying h. SCADA & Control System I. End termination of power cable (LT/ HT) j. Junction box Installation- Basic knowledge k. Inverter Erection- Tools & Tackles l. Battery installation& maintenance m. Installation of AC Equipment	Dismantle of Module mounting structure and fixing of the same. Proper alignment and tightening. Fixing of module and its connection. Installation of balance equipment and End termination Power cable. Cable Gland- Types of Cable Gland a. Single compression Cable Gland b. Double compression Cable Gland Installation of Junction String testing DC Side box.
7	Inspection, Testing & Commissioning Purpose for Inspection & testing Tools / Instruments Required Procedure and Work Method	Installation of electrical substation Pole Erection, Types of pole Grid Fundamental AC & DC Working AC Side Testing DC Side Testing Cable tray , types of cable tray & Cable tray Erection Battery, types of battery, Installation of battery Installation of HT & LT Control panels,
8	Study of work method & document for the followings a. String Testing- Pre-checks b. Short Circuit Test- Work Method c. Inverter Testing- Work Method d. Check list preparation e. Pre -requirement of installation of sub-station equipment f. Basics and erection of transformers, pole erection and stringing	Fundamental of earthing system, types of earthing, Installation of earthing & earthing testing
9	Quality: Introduction, quality Management systems requirement	Site selection, suitability & planning, Fundament of site survey direction shadow effect.
10	Operation & Maintenance a. Introduction and Over view of PV System b. Equipment's under AC Side & DC Side and regular maintenance c. General Safety Guidelines for O&M d. Soft & Entrepreneurship skills	Solar PV module cleaning & testing Inverter testing , Battery testing, Cell voltage testing, HT&LT Panel testing, Earthing testing Cable testing, Transformer condition monitoring.

Infrastructure:

6. A Class room with basic teaching aids- white board, table 6'x3' and sitting arrangement.
7. A shadow free ground flat area, practical area 1200 sqmtr, workshop 360 sqmtr
8. Different type of PV facility for training like Fixed, Seasonal Tilt, Horizontal axis Tracker & Dual axis Tracker
9. Various type of Module like Thin Film, Crystalline and Bifacial. Total 10 kW.
10. LCD Projector& Screen.

List of Tools& Equipment for a batch of 20 trainees

Sl. No.	Name of Tools & Instruments	Quantity (Nos.)
1	Tool kit	As per requirements
2	Double ended flat spanner	2 set
3	Double ended ring spanner	2 set
4	Combination pliers	4
5	Side cutting pliers	4
6	Nose pliers	4
7	Wire stripper	4
8	Electrician knife	10
9	Hack saw frame with blade	4
10	Hand crimping tools	2
11	Cable cutter	1
12	Screw driver	4
13	Water level	5
14	Measuring tape	1
15	Centre punch	1
16	Standard wire gauge	1

17	Vanier calliper	1
18	Line dori	2
19	Chisel	1
20	Drill m/c	2
21	Plumb bob	2
22	Sprit level	2
23	Flat file	2
24	Round file	2
25	Triangle file	2
26	Hand saw	2
27	Pvc mallet	2
28	Ball pin hammer	4
29	Fuse puller	1
30	Safety helmet	As per requirement
31	Safety souse	4
32	Safety belt	As per requirement
33	Nose mask	5
34	Safety goggles	As per requirement
35	Ear plug	2
36	PVC hand glove	10
37	Cotton hand glove	10
38	Reflective jacket	5
39	Tong tester AC/DC	2
40	MULTIMETER	2
41	Megger	2
42	Earth tester	2
43	Water testing instrument (TDS meter)	1
44	Earthing Rod	1
45	Soldering Iron & Flux	5
46	Phase Sequence Meter	2

Demo Equipment

Sl. No.	Name of Tools & Instruments	Quantity (Nos.)
1	Tool kit	1
2	Double ended flat spanner	1
3	Double ended ring spanner	1
4	Combination pliers	1
5	Side cutting pliers	1
6	Nose pliers	1
7	Wire stripper	1
8	Electrician knife	1
9	Hack saw frame with blade	1
10	Hand crimping tools	1
11	Cable cutter	1
12	Screw driver	1
13	Water level	1
14	Measuring tape	1

15	Centre punch	1
16	Standard wire gauge	1
17	Vanier calipash	1
18	Line dori	1
19	Chisel	1
20	Drill m/c	1
21	Plumb bob	1
22	Sprit level	1
23	Flat file	1
24	Round file	1
25	Triangle file	1
26	Hand saw	1
27	Pvc mallet	1
28	Ball pin hammer	1
29	Fuse puller	1
30	Safety helmet	1
31	Safety souse	1
32	Safety belt	1
33	Nose mask	1
34	Safety goggles	1
35	Ear plug	1
36	PVC hand glove	1
37	Cotton hand glove	1
38	Reflective jacket	1
39	Tong tester AC/DC	1
40	MULTIMETER	1
41	Megger	1
42	Erath tester	1
43	End termination of power cable	2
44	Cable tray Erection	1
45	Structure with module mounting	1

Safety & Protective Equipment

Sl. No.	Name of Tools & Instruments	Quantity (Nos.)
1	Safety helmet	As per requirement
2	Safety souse	As per requirement
3	Safety belt	As per requirement
4	Nose mask	As per requirement
5	Safety goggles	As per requirement
6	Ear plug	As per requirement
7	PVC hand glove	As per requirement
8	Cotton hand glove	As per requirement
9	Reflective jacket	As per requirement
10	First aid kit	As per requirement
11	Gum boots	As per requirement

Course Module								
Solar PV Technician								
Sl. No	Date		Theory (No. of Days)	Course Module	Module Number	Practical (No. of Days)	Period Hours	
	From	To					Theory	Practical
1			2	Electrical Safety Electrical safety Rules, Simple First Aid , General safety of tools and equipment PPEs , Fire extinguishers, Type of fire extinguishers	S-1	2	1	7
2			3	Electricity Basics	S-2	3	1	7
3			2	Fundamental of Earthing system	S-3	2	1	7

4			5	PV module Fundamentals types of modules and its applications , PV components and configuration etc.	S-4	5	1	7
5			2	Introduction to Solar Photovoltaic , Basic Principle of Photovoltaic & Technology	S-5	2	1	7
6			3	PV System Sizing series & parallel Fundamental, temperature coefficients of current, voltage and power fundamental	S-6	3	1	7
7			3	Performance analysis and troubleshooting monitoring of generation per string incoming & outgoing power at junction box & Inverter level.	S-7	3	1	7
8			3	Requirement & Uses of Tools & Tackles. Basic knowledge of Ammeter Voltmeter, clamp on-meter tong tester Irradiance sensor temperature sensors.	S-8	3	1	7
9			2	Cable tray & cable laying	S-9	2	1	7
10			2	SCADA & Control System	S-10	2	1	7
11			5	End termination of power cable (LT/ HT)	S-11	5	1	7
12			5	Commissioning & testing	S-12	5	1	7
13			4	Structure erection	S-13	4	1	7
14			3	Battery installation& maintenance	S-14	3	1	7
15			2	Check list preparation	S-15	2	1	7
16			2	Pre -requirement of installation of sub-station equipment	S-16	2	1	7
17			5	Basics and erection of transformers, pole erection and stringing	S-17	5	1	7
18			5	Foundation- reinforcement& shutting	S-18	5	1	7
19			5	Operation & Maintenance	S-19	5	1	7
20			12	Soft & Entrepreneurship Skills	S-20	12	1	7