



ANIL NAIK TECHNICAL TRAINING CENTRE

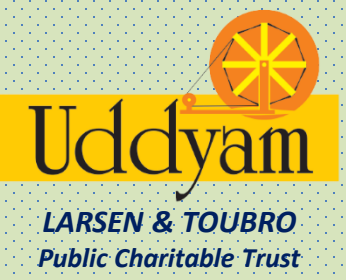
GEETA MULTIPURPOS

અનિલ નાયક ટેકનીકલ ટ્રેનીંગ સેન્ટર  
૬૧ જાહેલ એજ્યુકેશન સોસાયટી,  
અમિતભવન, ગાંધીધામ





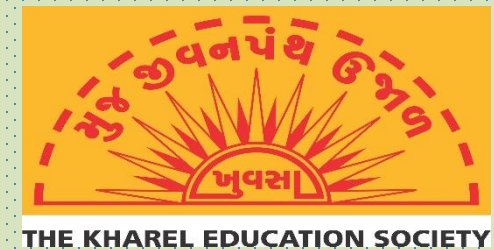
# ANIL NAIK TECHNICAL TRAINING CENTER



## SOLAR PANEL TECHNICIAN

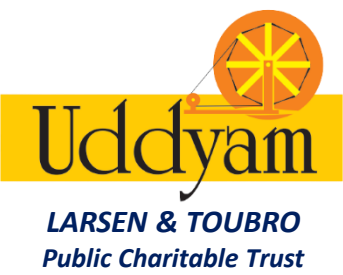


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# INTRODUCTION OF ANTTTC



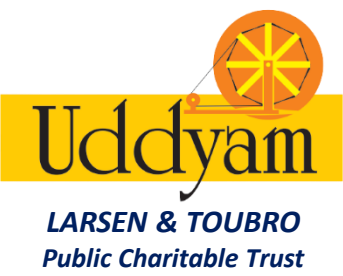
## **(1). INTRODUCTION AND FUNCTION OF INSTITUTE :**

**02 HOURS**

- INTRODUCTION OF VOCATIONAL TRAINING PROGRAMME
- FACILITIES , RULES AND REGULATIONS.
- VISIT OF ANTTTC DISPLAY GALLERY, TRADES WORKSHOP, CLASS ROOM
- STUDY OF LAYOUT FOR TRADE WORKSHOP- CLASS ROOM



# INDEX



## Index

Time :960 Hours

Sr. No.	Topics	Hours
1	INTRODUCTION AND FUNCTION OF INSTITUTE	02
2	EHS (ENVIORNMENT HEALTH & SAFETY), FIRE SAFETY	06
3	WORKSHOP CALCULATION & SCIENCE	24
4	ENGINEERING DRAWING	24
5	TRADE THEORY	248
6	TRADE PRACTICAL	600
7	BASIC COMPUTER TRAINNING AND SOFT SKILL	56
	(Weekly 40 hour x 24 week = 960 hour)	
	TOTAL HOURS -	960



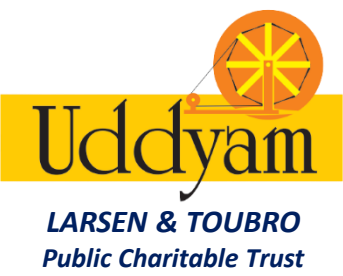
# THEORY INDEX



Sr. No.	Topics	Hours
1	<b>INTRODUCTION &amp; IMPORTANCE OF SOLAR PANEL TECHNICIAN TRADE.</b> -SOURCES OF RENEWABLE ENERGY, ROLE OF SOLAR-PV INSTALLER/TECHNICIAN, SOLAR SCENARIO.	06
2	<b>BASIC ELECTRICAL AND OHM'S LAW</b> -BASIC ELECTRICAL -OHM'S LAW- ELECTRIC CURRENT, VOLTAGE & RESISTANCE. OHM'S LAW FORMULA ,CALCULATIONS OF VOLTAGE,CURRENT RESISTANCE	12
3	<b>INTRODUCTION AND USE OF HAND TOOLS</b> - USE OF HAND TOOLS-BASIC HAND TOOLS FOR ELECTRICAL & SOLAR PANEL INSTALLATION WORK.(INTRODUCTION & USE OF TOOLS)	12
4	<b>STUDY OF BASIC MEASURING UNITS &amp; ELECTRICAL MEASURING INSTRUMENTS</b> - STUDY OF BASIC LENGTH MEASURING UNITS AND ELECTRICAL MEASURING INSTRUMENTS.	10



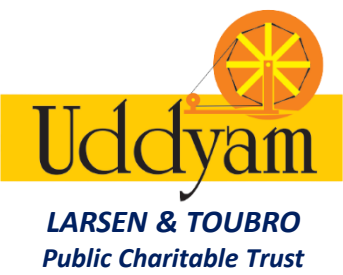
# THEORY INDEX



Sr. No.	Topics	Hours
5	<b>ELECTRICAL POWER BASICS AND EARTHING</b> - ELECTRICAL POWER BASIC & EARTHING- TYPES OF POWER SUPPLY, STUDY OF CURRENT, VOLTAGE, POWER. $P=VI$ FORMULA.	12
6	<b>STUDY OF WIRE AND CABLE</b> - 1). INTRODUCTION, CONSTRUCTION, TYPES OF WIRE AND CABLE 2). CONDUCTOR AND INSULATION MATERIAL	06
7	<b>STUDY OF SOLDERING PROCEDURE AND TECHNIQUES</b> - 1). SOLDERING PROCEDURE & SOLDERING TECHNIQUE 2). BRAZING PROCEDURE & PROPERTIES OF FLUX, SOLDER	12
8	<b>INTRODUCTION AND STUDY OF ELECTRICAL SYMBOLS</b> - INTRODUCTION AND USE OF ELECTRICAL SYMBOLS: MAIN SYMBOLS FOR ELECTRICAL CIRCUITS, LAYOUTS. READING OF NAME PLATE OF EQUIPMENT	12



# THEORY INDEX



Sr. No.	Topics	Hours
9	<b>FUNDAMENTALS OF ELECTRICITY</b> - FUNDAMENTALS OF ELECTRICITY. ELECTRON THEORY. DEFINITION, UNITS & EFFECT OF ELECTRIC CURRENT, VOLTAGE & POWER	12
10	<b>1). BASIC SOLAR PANEL TECHNOLOGY, PHOTOVOLTAIC EFFECT PV-CONSTRUCTION.</b> <b>2). MAIN EQUIPMENTS FOR SOLAR PLANT - BASIC STUDY OF SOLAR PANEL:</b> 1. SOLAR PANEL CONSTRUCTION 2. MAIN EQUIPMENTS OF SOLAR PLANT	12
11	<b>TECHNICAL PARAMETERS AND SPECIFICATIONS OF SOLAR PANEL</b> - (1). TECHNICAL PARAMETERS AND SPECIFICATIONS OF SOLAR PANEL (2). VIDEO TRAINING FOR DIFFERENT TYPES SOLAR PANELS DATA SHEET	12
12	<b>SITE SURVEY FOR SOLAR PLANT INSTALLATION</b> (1). SITE SURVEY OF SOLAR PV INSTALLATION (2). STEP FOR CONDUCTING A LOAD ASSESSMENT (3). STEP FOR CONDUCTING A SITE ASSESSMENT	18



# THEORY INDEX

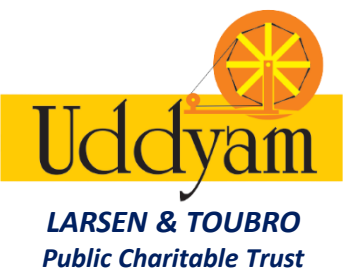


Sr. No.	Topics	Hours
13	<b>SPECIFICATIONS OF SOLAR INVERTER</b> - STUDY OF SPECIFICATIONS OF SOLAR INVERTER	08
14	<b>SOLAR PLANT DESIGN &amp; ESTIMATION WORK</b> - STUDY OF SOLAR PLANT DESIGN AND ESTIMATION WORK	10
15	<b>INSTALLATION OF SOLAR ROOF TOP PLANT</b> - STUDY OF INSTALLATION OF SOLAR ROOF TOP PLANT	12
16	<b>TYPES OF SOLAR PLANT , PLANT CAPACITY DESIGN WORK</b> - STUDY OF TYPES OF SOLAR PLANT , PLANT CAPACITY DESIGN WORK	12
17	<b>SOLAR PANEL INSTALLATION AND INTERNAL CONNECTION WORK</b> - STUDY OF SOLAR PANEL INSTALLATION AND INTERNAL CONNECTION WORK	08





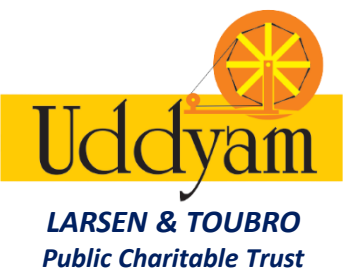
# THEORY INDEX



Sr. No.	Topics	Hours
18	<b>MARKING AND STRUCTURE MOUNTING WORK</b> - STUDY OF MARKING AND STRUCTURE MOUNTING WORK	08
19	<b>ELECTRICAL EQUIPMENTS AND COMPONENTS</b> - STUDY OF ELECTRICAL EQUIPMENTS AND COMPONENTS USED FOR SOLAR PLANT	10
20	<b>WIRING OF D.C. CABLES AND A.C. CABLES</b> - STUDY OF WIRING OF D.C. AND A.C. CABLE , CONDUITING AND CABLE LAYING	10
21	<b>GROUNDING SYSTEM (EARTHING)</b> - STUDY OF GROUNDING SYSTEM (EARTHING) FOR SOLAR PLANT	08
22	<b>INSTALLATION OF ENERGY METERS (SOLAR METER , NET METER)</b> - STUDY OF INSTALLATION OF ENERGY METERS (SOLAR METER , NET METER)	12



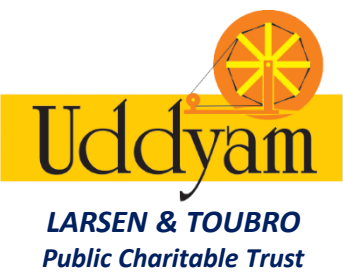
# THEORY INDEX



Sr. No.	Topics	Hours
23	<b>COMMISSIONING OF SOLAR PLANT</b> - STUDY OF COMMISSIONING OF SOLAR PLANT	08
24	<b>MAINTENANCE OF SOLAR PLANT</b> - STUDY OF MAINTENANCE OF SOLAR PLANT	06
	<b>TOTAL</b>	<b>248</b>



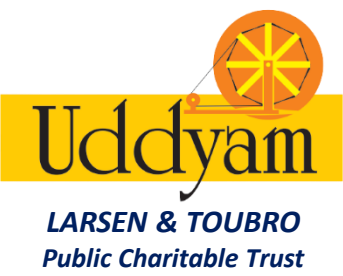
# SAFETY



Sr .No	Topics	Duration Hr.
1	BASIC SAFETY INTRODUCTION. PERSONAL AND OCCUPATIONAL SAFETY.	1
2	BASIC INJURY PREVENTION, BASIC FIRST AID.	1
3	HAZARD IDENTIFICATIONS AND AVOIDANCE.	1/2
4	SAFETY SIGNS FOR DANGER,WARNING,CAUTIONS.	1/2
5	PPES(PERSONAL PROTECTIVE EQUIPMENTS) INTRODUCTION AND USE. SAFETY HELMET, SAFETY SHOES, FULL BODY HARNESS	1
6	STUDY AND USE OF PORTABLE FIRE EXTINGUISHER.	1
7	CONCEPT OF 5'S AWARENESS: 1 SHORT, 2 SET IN ORDER, 3 SHINE, 4 STANDARDIZE, 5 SUSTAIN.	1
	<b>TOTAL</b>	<b>06</b>



# SAFETY



Sr .No	Topics	Duration
1	<b><u>BASIC SAFETY INTRODUCTION</u></b> 1. WHAT IS SAFETY ? 2. WHY SAFETY ? 3. REASON TO BE SAFE 4. WHAT IS HAZARD & RISK? 5. BASIC STEPS FOR TO BE SAFE	01 HR
2	<b><u>HAZARD IDENTIFICATION</u></b> 1. SAFETY SIGNS AND ITS MEANING	30 MIN
3	<b><u>FIRE EXTINGUISHER</u></b> 1. FIRE CHEMISTRY 2. TYPE OF FIRE 3. FIRE EXTINGUISHER 4. TYPE OF FIRE EXTINGUISHER 5. PASS METHOD 6. EMERGENCY PLANNING AND CONTROL	01.15 HRS



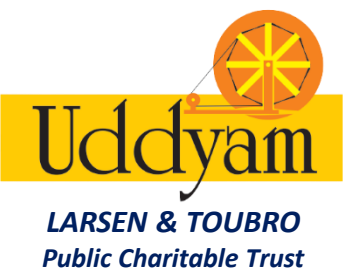
# SAFETY



Sr .No	Topics	Duration
4	FIRST AID WITH CPR	01.15 HR
5	<b>5S</b> 1. BACKGROUND, 2. WHY 5S, 3. MEANING OF 5S, 4. ADVANTAGE OF 5S, 5. BENEFIT OF EACH, 6. EXAMPLE & BRIEF	1 HR
6	<b>TRADE SPECIFIC SAFETY</b> 1.BASIC HAZARD, 2. JOB RELATED INJURY 3.PREVENTIVE ACTION, 4. SAFETY MEASURES IN INDUSTRY 5.PETROL, 6.LIFTING TOOLS, 7. CONFINE AREA 8.BATTERY, 9.PPE, 10. ROAD SAFETY, 11. TOEING OF VEHICLE	01 HR
	<b>TOTAL</b>	<b>06 HR</b>



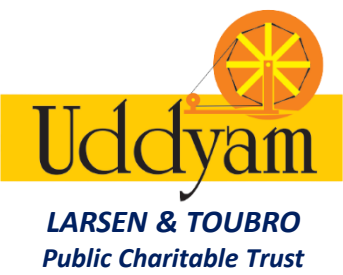
# SAFETY-EHS,CRP, Hazard, Risk, 5'S



- (1) **EHS** STANDS FOR “ENVIRONMENT, HEALTH, AND SAFETY,” AND FOR MANY COMPANIES, A CRUCIAL PART OF THEIR **PROCESSES** IS **EHS** MANAGEMENT, MEANING THE CODIFICATION AND PRACTICE OF PROCEDURES AIMED AT ENSURING THE SAFETY OF WORKERS AND THEIR SURROUNDINGS.
- (2) **CPR** IS AN [EMERGENCY PROCEDURE](#) THAT COMBINES CHEST COMPRESSIONS OFTEN WITH [ARTIFICIAL VENTILATION](#) IN AN EFFORT TO MANUALLY PRESERVE INTACT BRAIN FUNCTION UNTIL FURTHER MEASURES ARE TAKEN TO RESTORE SPONTANEOUS BLOOD CIRCULATION AND BREATHING IN A PERSON WHO IS IN [CARDIAC ARREST](#). CPR INVOLVES CHEST COMPRESSIONS FOR ADULTS BETWEEN 5 CM (2.0 IN) AND 6 CM (2.4 IN) DEEP AND AT A RATE OF AT LEAST 100 TO 120 PER MINUTE
- (3) **HAZARD** : A **HAZARD** IS SOMETHING THAT CAN CAUSE HARM, E.G. ELECTRICITY, CHEMICALS, WORKING UP A LADDER, NOISE, A KEYBOARD, A BULLY AT WORK, STRESS, ETC. A **RISK** IS THE CHANCE, HIGH OR LOW, THAT ANY **HAZARD** WILL ACTUALLY CAUSE SOMEBODY HARM. FOR EXAMPLE, WORKING ALONE AWAY FROM YOUR OFFICE CAN BE A **HAZARD**.
- (4) **RISK** : **RISK** IS THE POTENTIAL FOR UNCONTROLLED LOSS OF SOMETHING OF VALUE. ... **RISK** CAN ALSO BE DEFINED AS THE INTENTIONAL INTERACTION WITH UNCERTAINTY. UNCERTAINTY IS A POTENTIAL, UNPREDICTABLE, AND UNCONTROLLABLE OUTCOME; **RISK** IS AN ASPECT OF ACTION TAKEN IN SPITE OF UNCERTAINTY.
- (4) **5'S** : 5S, SOMETIMES REFERRED TO AS 5S OR FIVE S, REFERS TO FIVE JAPANESE TERMS USED TO DESCRIBE THE STEPS OF THE 5S SYSTEM OF VISUAL MANAGEMENT. EACH TERM STARTS WITH AN **S**. IN JAPANESE, THE FIVE S'S ARE *SEIRI*, *SEITON*, *SEISO*, *SEIKETSU*, AND *SHITSUKE*. IN ENGLISH, THE FIVE S'S ARE TRANSLATED AS SORT, SET IN ORDER, SHINE, STANDARDIZE, AND SUSTAIN.



# FIRE SAFETY



**FIRE SAFETY** IS THE SET OF PRACTICES INTENDED TO REDUCE THE DESTRUCTION CAUSED BY FIRE. FIRE SAFETY MEASURES INCLUDE THOSE THAT ARE INTENDED TO PREVENT IGNITION OF AN UNCONTROLLED FIRE, AND THOSE THAT ARE USED TO LIMIT THE DEVELOPMENT AND EFFECTS OF A FIRE AFTER IT STARTS.

## THERE ARE FOUR CLASSES OF FIRES:

**CLASS A:** ORDINARY SOLID COMBUSTIBLES SUCH AS PAPER, WOOD, CLOTH AND SOME PLASTICS.

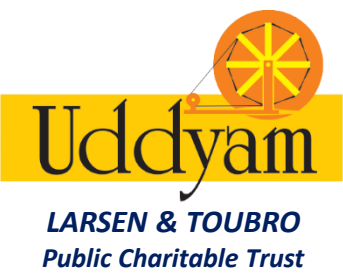
**CLASS B:** FLAMMABLE LIQUIDS SUCH AS ALCOHOL, ETHER, OIL, GASOLINE AND GREASE, WHICH ARE BEST EXTINGUISHED BY SMOTHERING.

**CLASS C:** ELECTRICAL EQUIPMENT, APPLIANCES AND WIRING IN WHICH THE USE OF A NONCONDUCTIVE EXTINGUISHING AGENT PREVENTS INJURY FROM ELECTRICAL SHOCK. DON'T USE WATER.

**CLASS D:** CERTAIN FLAMMABLE METALLIC SUBSTANCES SUCH AS SODIUM AND POTASSIUM.



# FIRE EXTINGUISHER



- ❖ THE **WATER** AND **FOAM EXTINGUISHER** ELIMINATES A **FIRE** BY ALLOWING **WATER** TO TAKE AWAY THE HEAT COMPONENT OF A **FIRE** WHILE **FOAM** SEPARATES OXYGEN FROM THE **FIRE**. A **WATER EXTINGUISHER** SHOULD ONLY BE **USED** ON CLASS A **FIRES** (COMBUSTIBLES SUCH AS WOOD, PAPER, CLOTH, TRASH, AND PLASTICS)
- ❖ **DRY CHEMICAL** :- A **DRY** FREE-FLOWING **CHEMICAL FIRE EXTINGUISHING COMPOSITION** IN THE FORM OF A FINELY DIVIDED MIXTURE OF PARTICLES AND CONSISTING ESSENTIALLY OF ABOUT 79.35% MONOAMMONIUM PHOSPHATE, ABOUT 5% OF TRICALCIUM PHOSPHATE, ABOUT 12% OF BARIUM SULFATE, ABOUT 2.50% OF AMMONIUM TARTRATE, ABOUT 0.45% OF SILICA AND ABOUT 0.70% OF AMONIUM
- ❖ **CO2 TYPE** :-CO2 FIRE EXTINGUISHERS CONTAIN PURE **CARBON** DIOXIDE WHICH IS A CLEAN EXTINGUISHER, LEAVING NO RESIDUE. SUITABLE FOR CLASS B FLAMMABLE LIQUID FIRES (PETROL, OIL, SOLVENTS), AND RECOMMENDED FOR USE ON LIVE **ELECTRICAL** EQUIPMENT. OUR EXTINGUISHERS ARE BAFE APPROVED, FULLY CHARGED AND SUPPLIED WITH A WALL BRACKET.
- ❖ **WET CHEMICAL** :- (POTASSIUM ACETATE, POTASSIUM CARBONATE, OR POTASSIUM CITRATE) EXTINGUISHES THE **FIRE** BY FORMING AN AIR-EXCLUDING SOAPY FOAM BLANKET OVER THE BURNING OIL THROUGH THE **CHEMICAL** PROCESS OF SAPONIFICATION



## Using The Correct Fire Extinguisher

Water	Dry Powder	Foam	CO2	Wet Chemical
<p><b>For use on</b></p> <ul style="list-style-type: none"> <li>CLASS A Wood, Paper, Textiles etc</li> </ul> <p><b>Do not use on</b></p> <ul style="list-style-type: none"> <li>CLASS B Flammable liquid</li> <li>Live electrical equipment</li> </ul>	<p><b>For use on</b></p> <ul style="list-style-type: none"> <li>CLASS A Wood, Paper, Textiles etc</li> <li>CLASS B Flammable liquids</li> <li>CLASS C Gaseous fires</li> </ul> <p><b>Do not use on</b></p> <ul style="list-style-type: none"> <li>Live electrical equipment</li> </ul>	<p><b>For use on</b></p> <ul style="list-style-type: none"> <li>CLASS A Wood, Paper, Textiles etc</li> <li>CLASS B Flammable liquids</li> </ul> <p><b>Do not use on</b></p> <ul style="list-style-type: none"> <li>Live electrical equipment</li> </ul>	<p><b>For use on</b></p> <ul style="list-style-type: none"> <li>CLASS B Flammable liquids</li> <li>Live electrical equipment</li> </ul> <p><b>Do not use on</b></p> <ul style="list-style-type: none"> <li>CLASS A Wood, paper and textiles</li> <li>CLASS D Flammable metal fires</li> </ul> <p>Do not use in a confined space</p>	<p><b>For use on</b></p> <ul style="list-style-type: none"> <li>CLASS F Cooking oil fires</li> <li>CLASS A Wood, Paper, Textiles etc.</li> </ul> <p>Discharge entire contents on to fire from at least 1 metre distance</p>

### Fire Extinguisher Chart





Extinguisher	Type	Type of Fire			
		Solids (paper)	Flammable Liquids	Flammable Gas	Electrical Equipment
	WATER	✓ Yes	✗ No	✗ No	✗ No
	FOAM	✓ Yes	✓ Yes	✗ No	✗ No
	Dry Powder	✓ Yes	✓ Yes	✓ Yes	✓ Yes
	Carbon Dioxide (CO <sub>2</sub> )	✗ No	✓ Yes	✗ No	✓ Yes

SafetyBanners.ORG



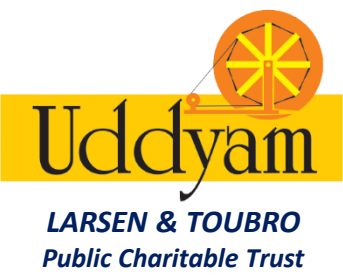
# ENGINEERING DRAWING SOLAR TRADE

## TYPES OF LINE

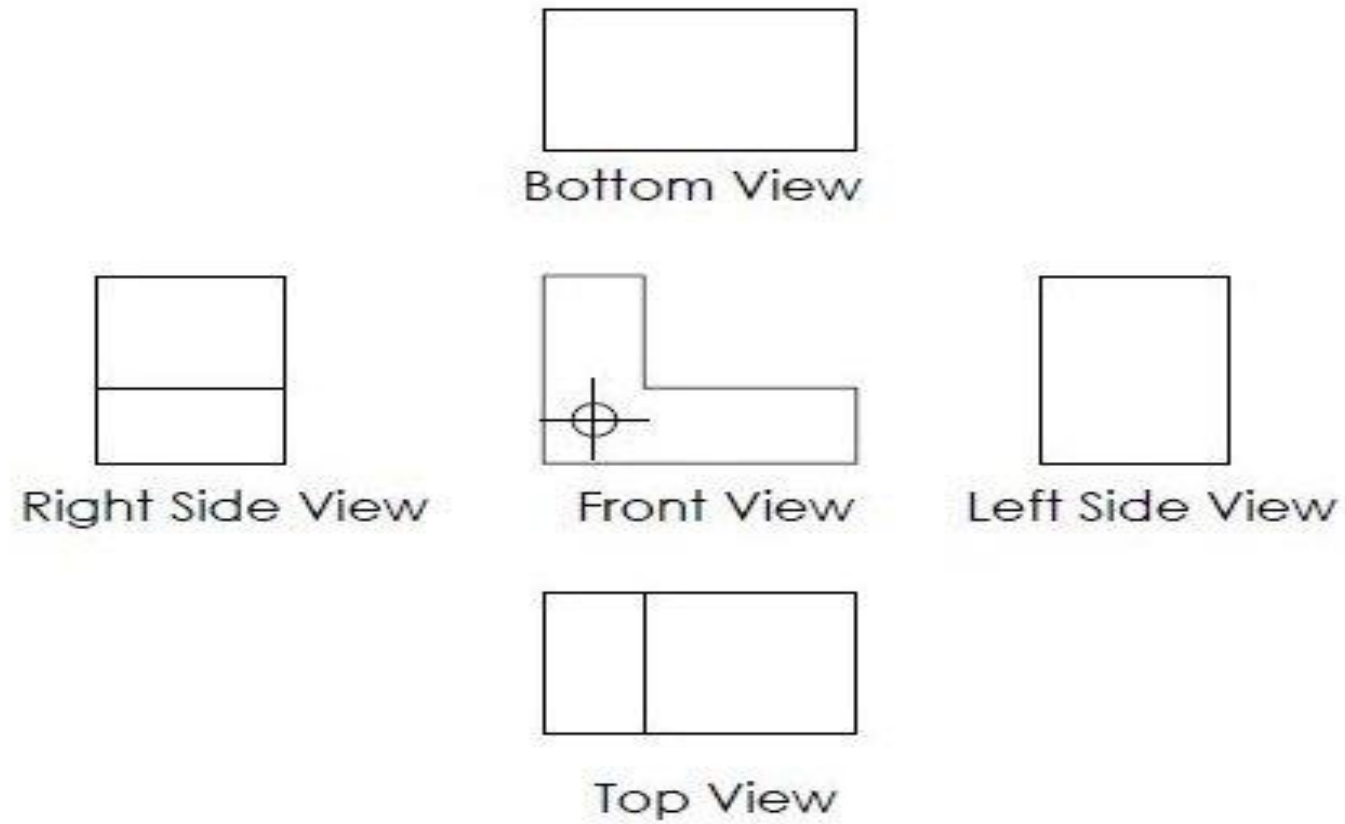
	<b>SAMPLE</b>	<b>DESCRIPTION</b>	<b>APPLICATION / USE</b>
1)		Continuous thick	Layout Drawing line ,Visible outlines
2)		Continuous thin	Circuit Diagram line, projection lines
3)		Dotted thin / thick	Neutral line ,Hidden outlines
4)		Chain thin	Earth line ,Centre lines



# ENGINEERING DRAWING SOLAR TRADE



## FIRST ANGLE PROJECTION DRAWING





# ENGINEERING DRAWING SOLAR TRADE



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## THIRD ANGLE PROJECTION DRAWING

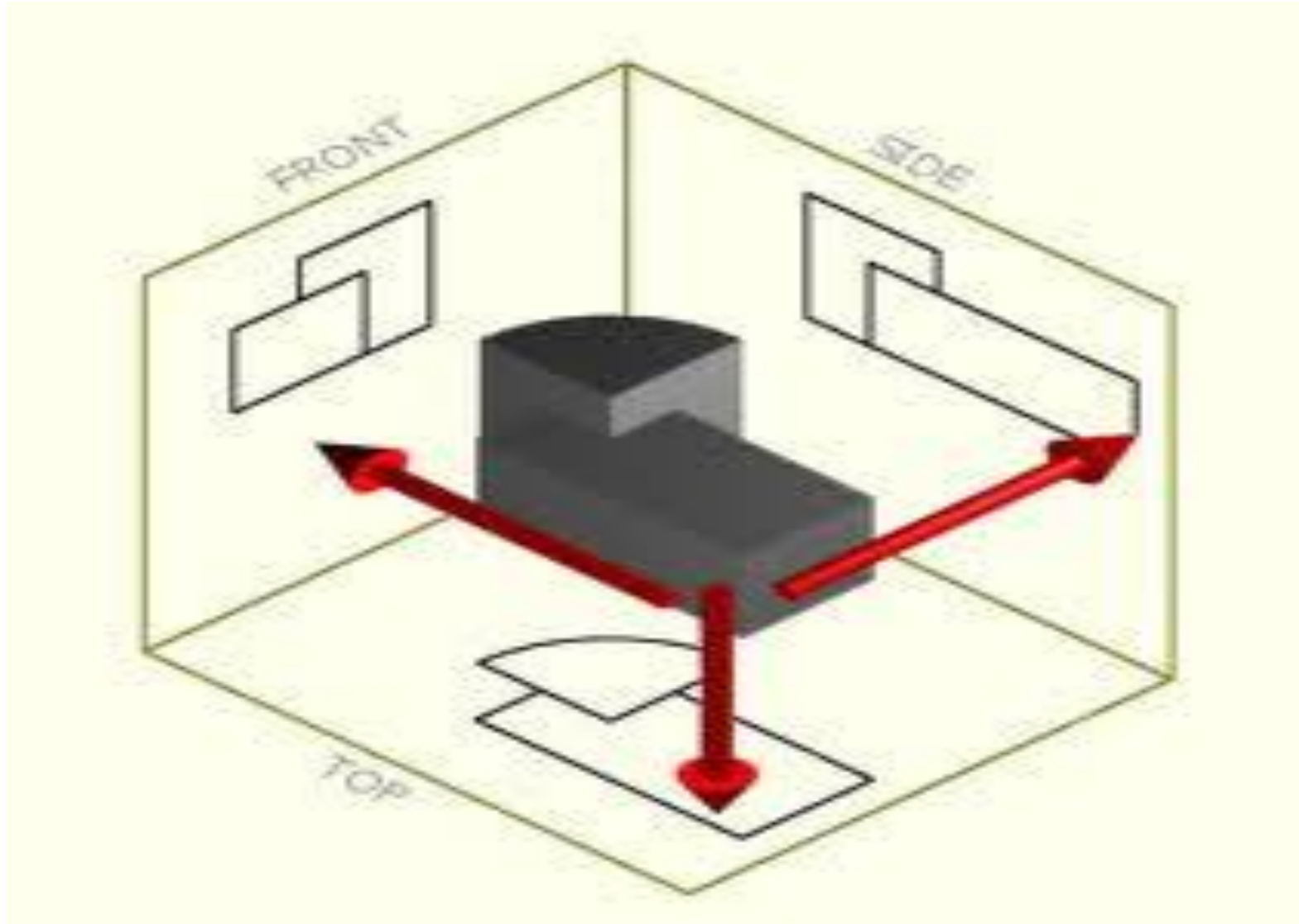
**THIRD ANGLE ORTHOGRAPHIC PROJECTION**

**Plan Elevation**

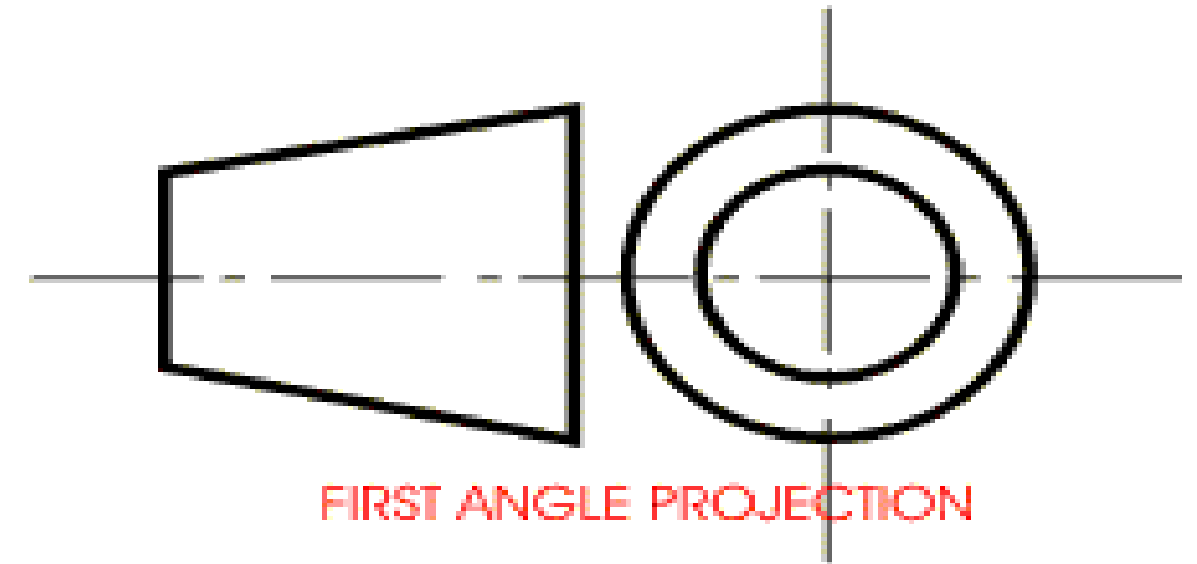
**Side Elevation**

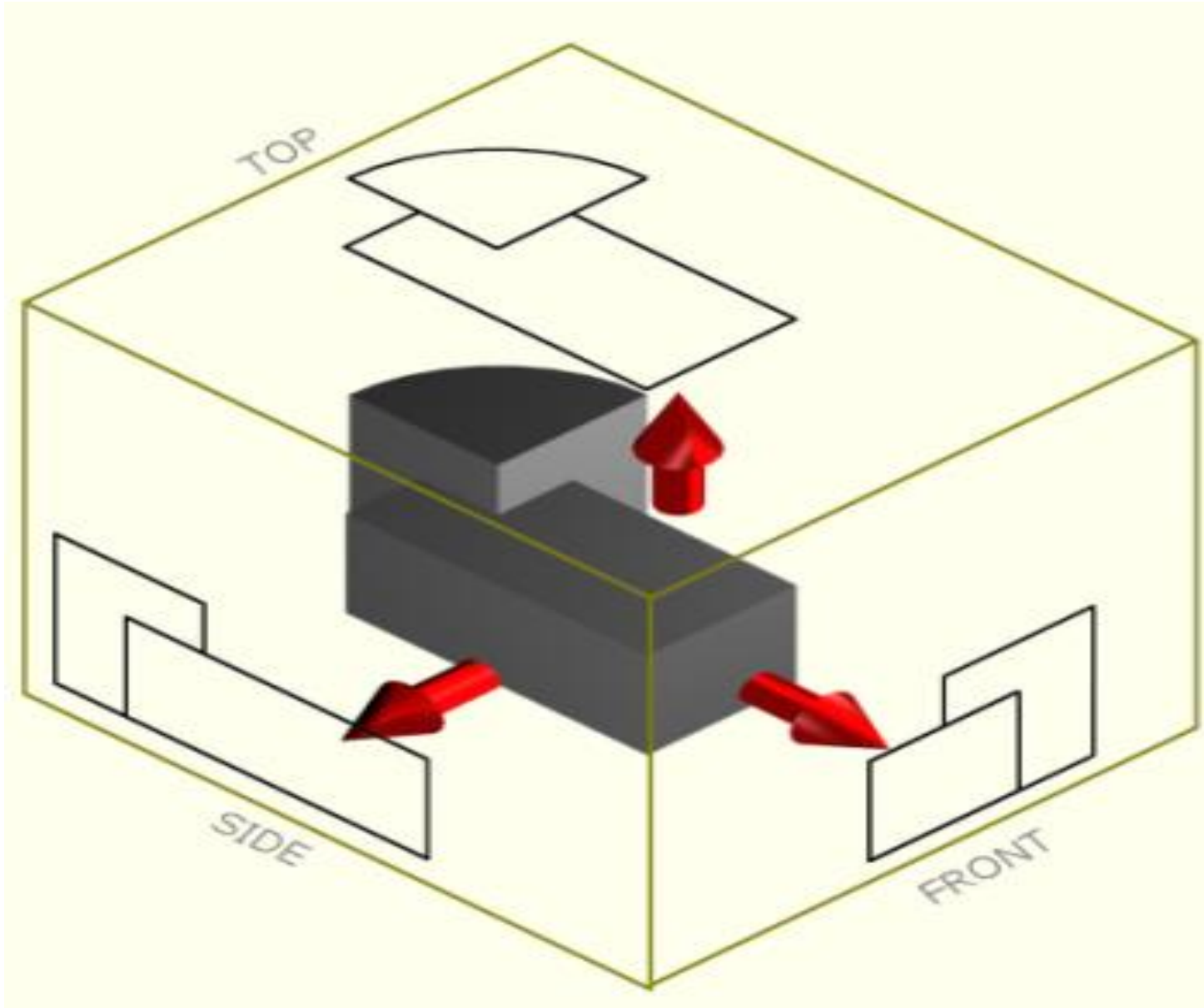
**Front Elevation**



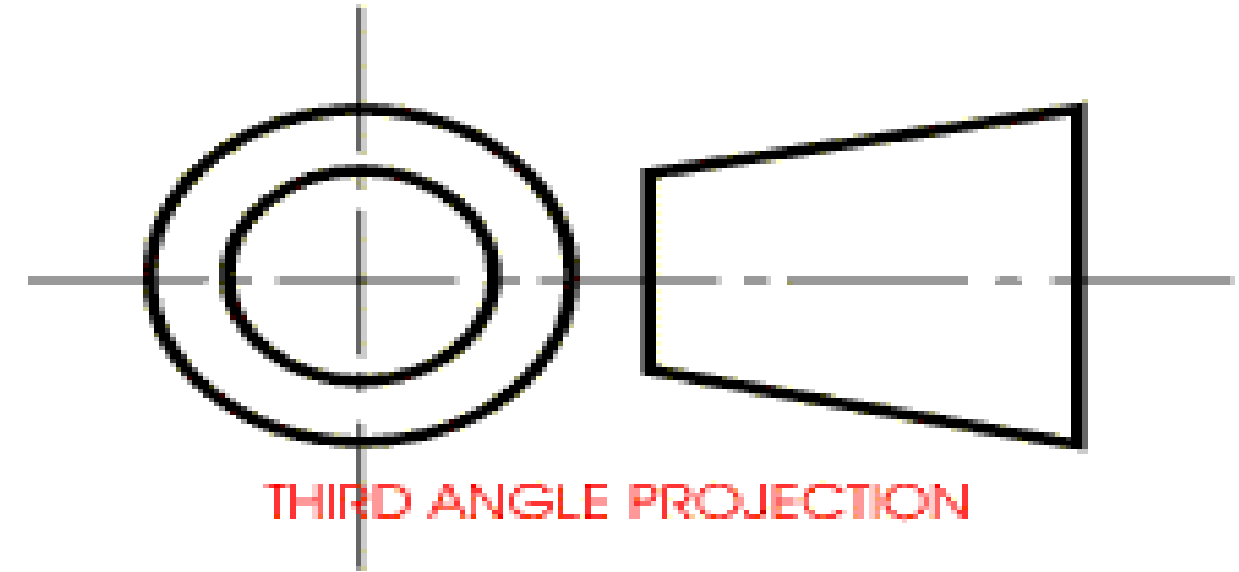


## 1<sup>st</sup> Angle Projection





## 3<sup>rd</sup> Angle Projection

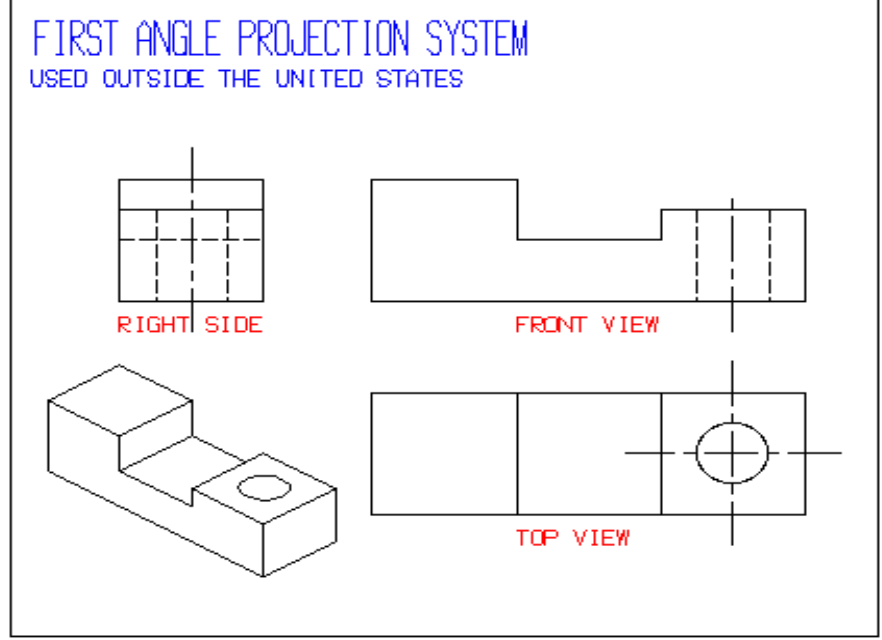
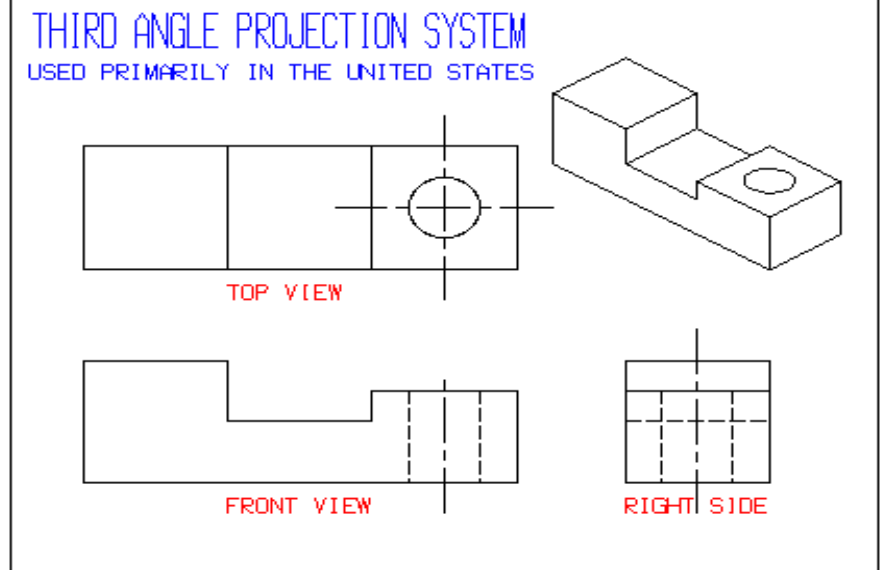
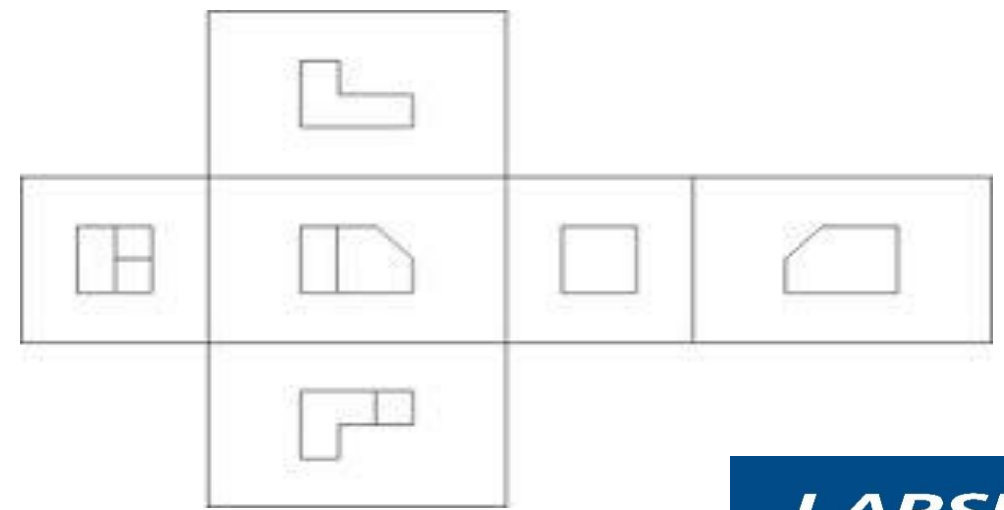
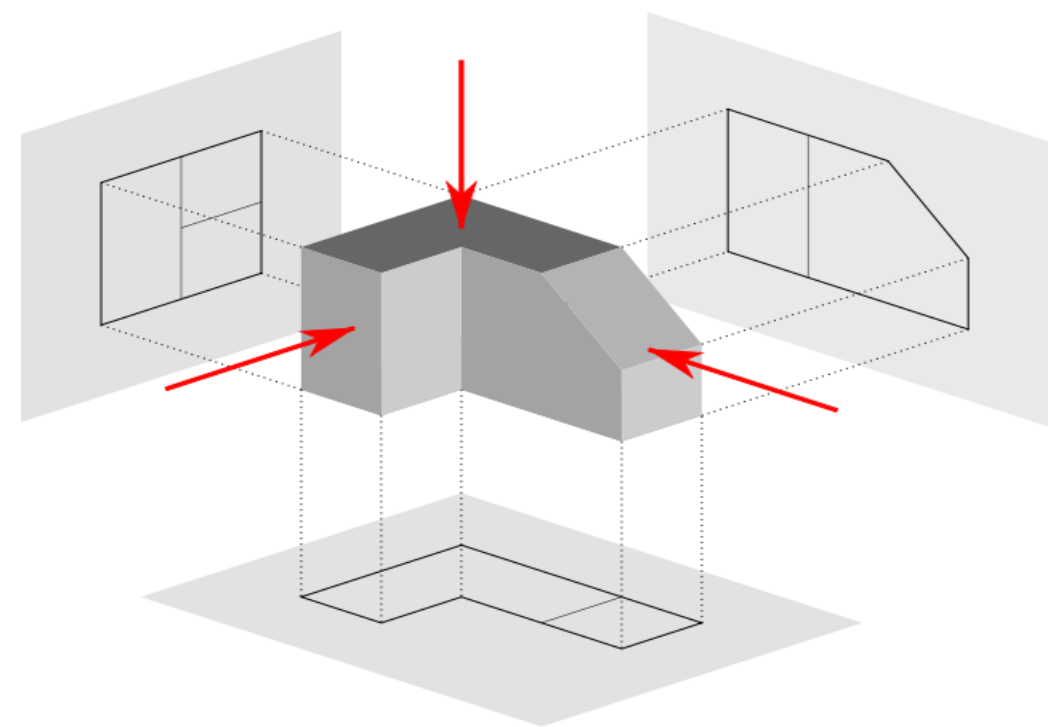




# SECTIONAL VIEW

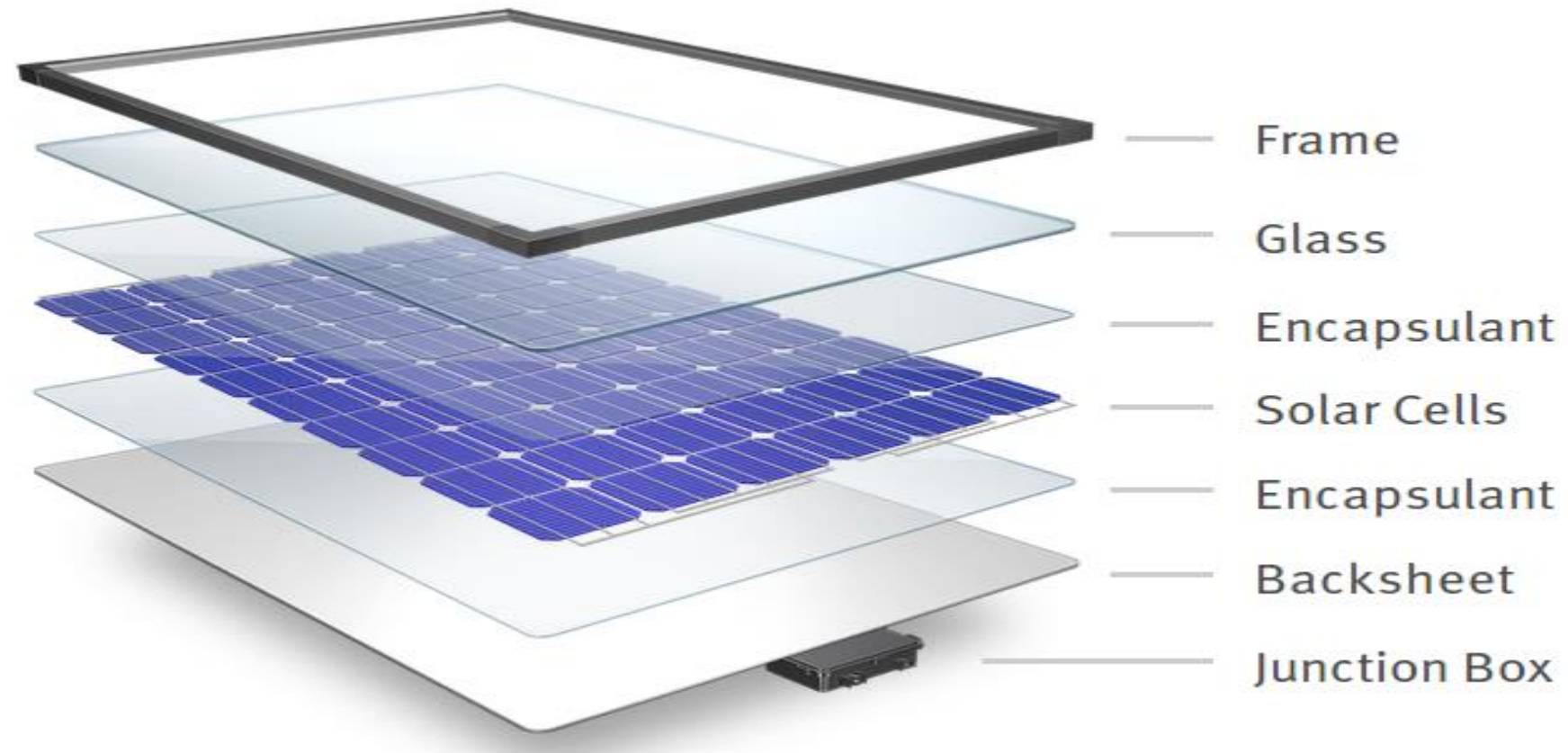


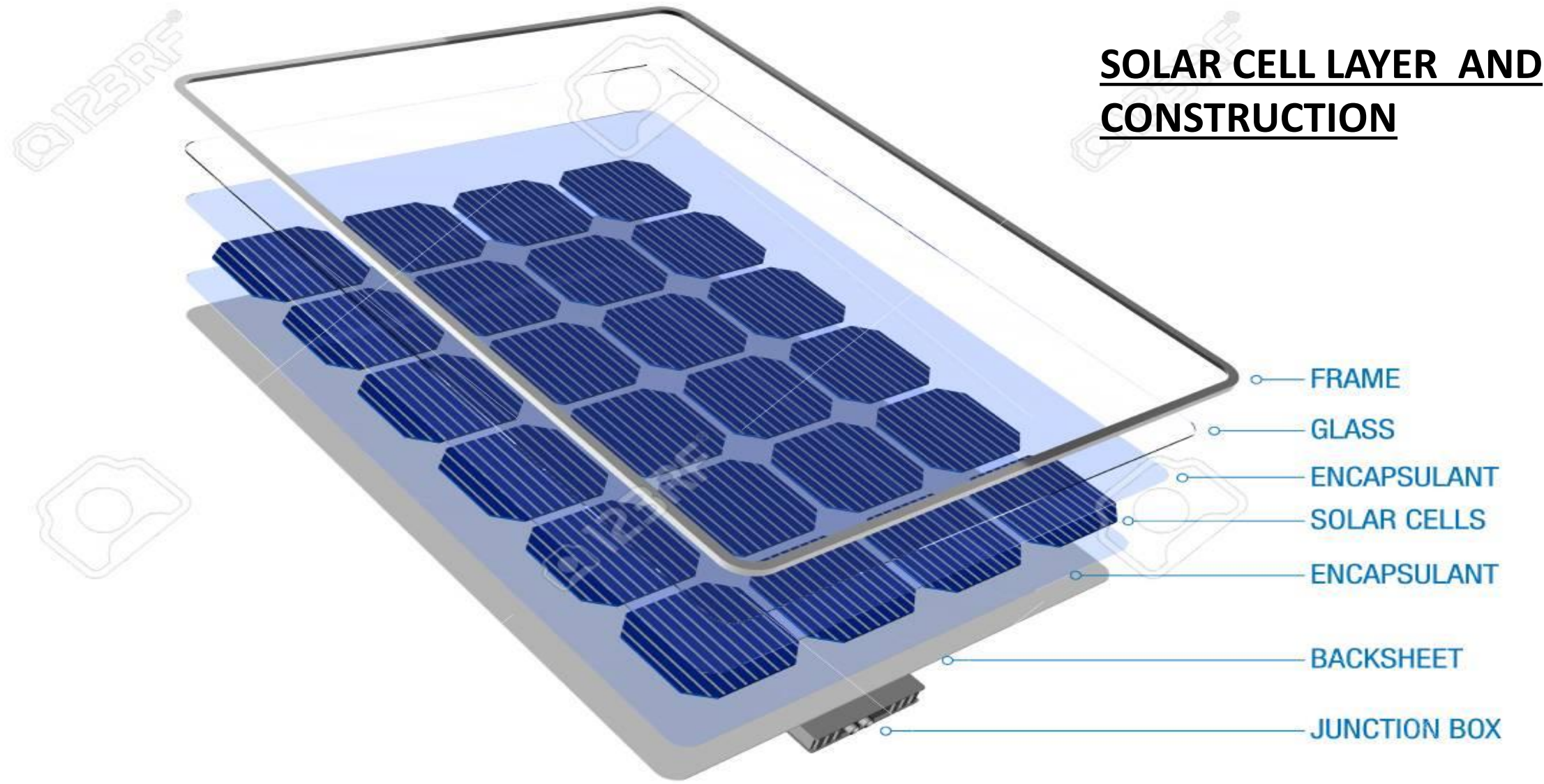
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## BASIC CONSTRUCTION OF SOLAR PANEL : ( 5 LAYERS ,ALUMINIUM FRAME AND JUNCTION BOX )



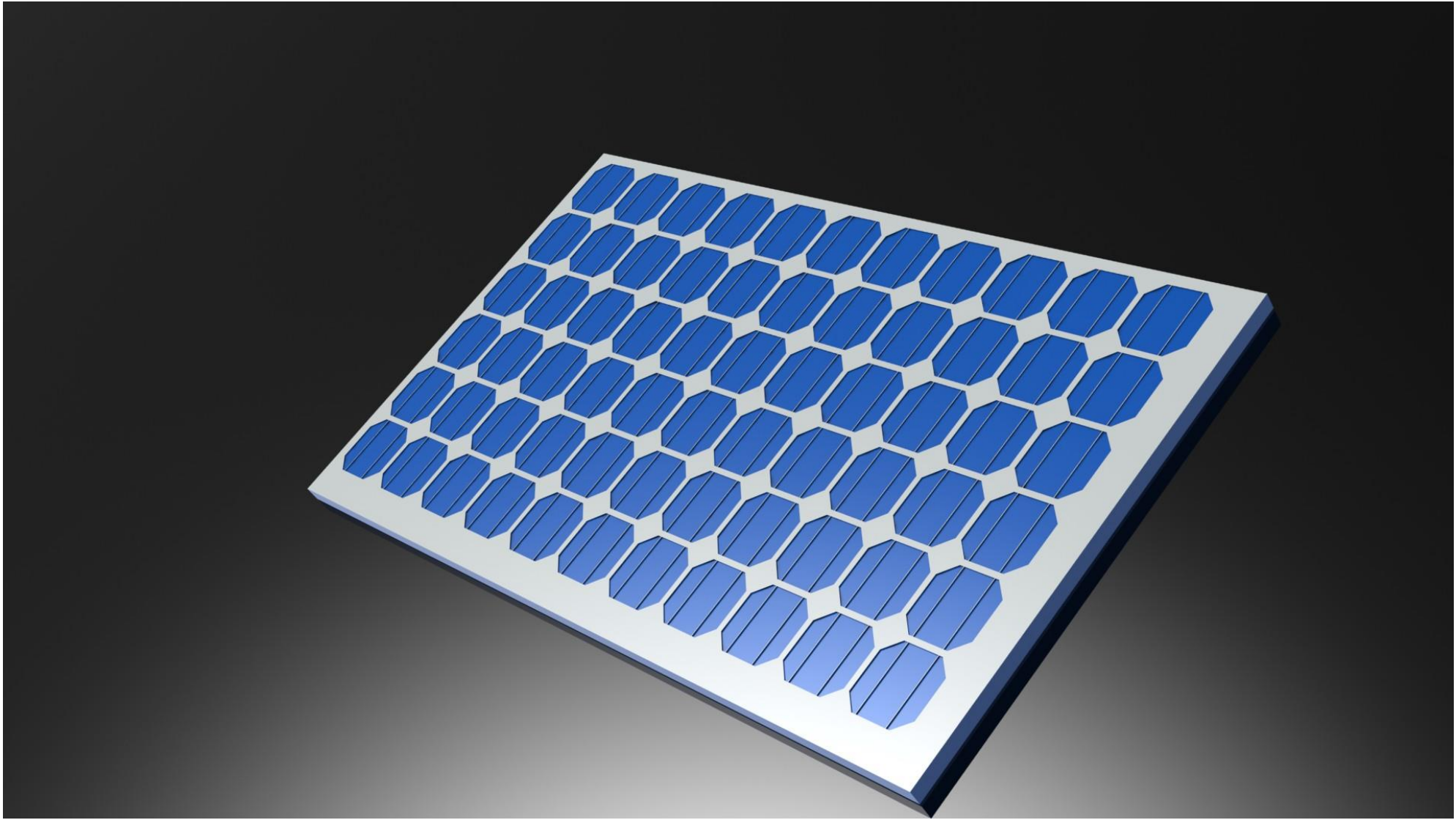




# SOLAR PANEL



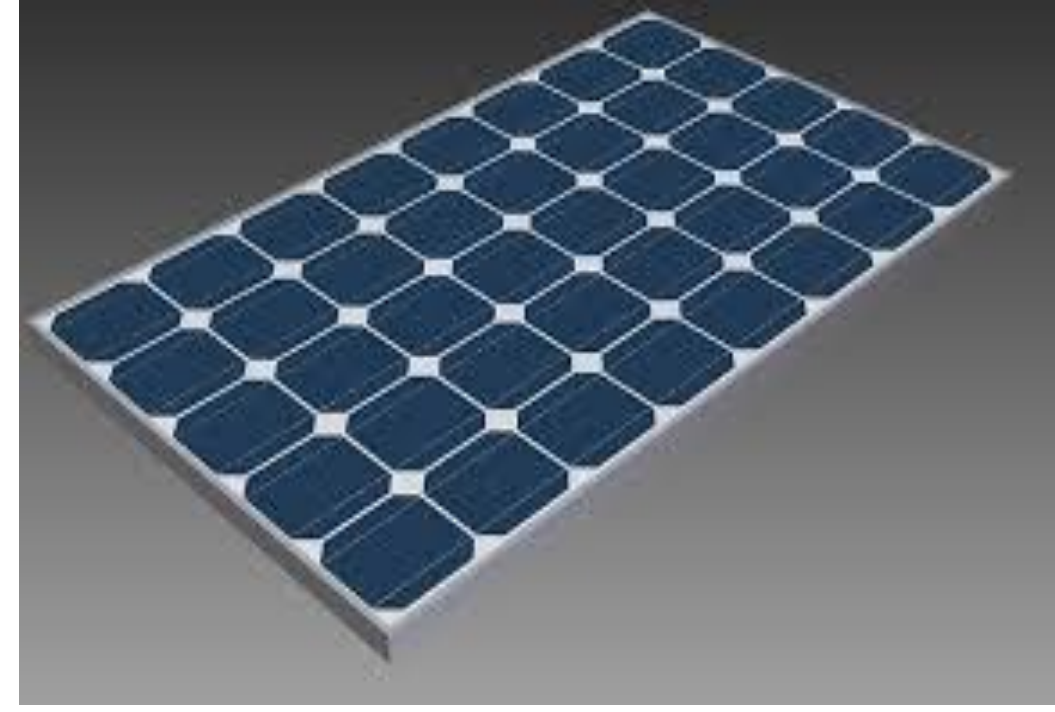
## SOLAR CELL LAYER FOR SOLAR PANEL



## SOLAR PANEL MODULE : MEDIUM, BIG SIZE



## COMPLETE SOLAR PANEL MODULE FOR SOLAR PLANT





# SOLAR PANEL



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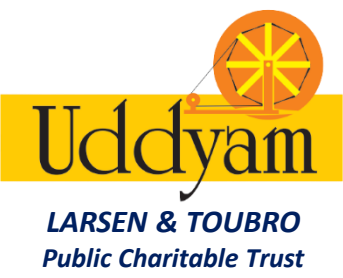


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# SOLAR PANEL



## SOLAR PANELS

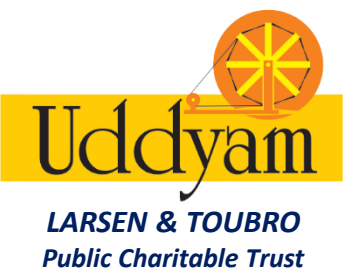


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# SOLAR PANEL



## INSTALLED SOLAR PANELS



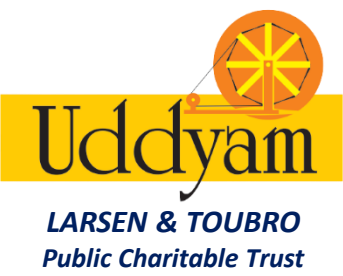




# WORKSHOP CALCULATION & SCIENCE



# MEASUREMENT



## Length

### Matric System

10 mm = 1 cm  
 100 cm = 1 meter  
 1000 meter = 1 km

## Time

60 second = 1 minute  
 60 minute = 1 hour  
 24 hour = 1 day  
 30 day = 1 month  
 12 months = 1 year

## Measurement

### British System

12 inch = 1 feet

## Weight

1000 gram = 1 kg  
 100 kg = 1 Quintal  
 1000kg = 1 met. Ton

### Matric System

1km =  
 1.609 km =  
 1 cm =  
 25.4 mm =  
 2.54 cm =  
 30.8 cm =  
 1 meter =  
 0.453 kg =  
 1 kg =

### British System

0.62 mile  
 1 mile  
 0.39 inch  
 1 inch  
 1 inch  
 1 feet  
 3.281 feet  
 1 pound  
 2.206 pound



# CALCULATION



## Basic Calculation Related Solar Trade :-

- Current
- Voltage
- Power
- Kwhr

## Common Calculation

### • Addition

$$\begin{array}{r} 325 \\ + 86 \\ \hline 411 \end{array}$$

### • Subtraction

$$\begin{array}{r} 787 \\ - 456 \\ \hline 334 \end{array}$$

### Multiplication

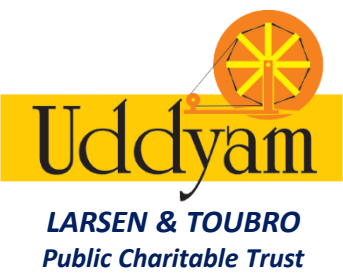
$$\begin{array}{r} 25 \\ \times 16 \\ \hline 250 \\ + 150 \\ \hline 400 \end{array}$$

### Division

$$\begin{array}{r} 9 \\ 5 \overline{)45} \\ \underline{45} \\ 00 \end{array}$$



# CALCULATION



## Current Calculation by using Power Formula :

(1). If one electrical equipment supplied with 240 volt a.c. power supply and the Electrical Power of this equipment is 720 Watt, what will be the current used by the electrical equipment.

$$\text{Power (P)} = V I$$

$$\text{So, } I = P/V$$

$$\begin{aligned} I &= 720/240 \\ &= 72/24 \end{aligned}$$

$$\text{So, } I = 3 \text{ A (Ampere)}$$

$$P = 720 \text{ W (Watt)}$$

$$V = 240 \text{ V (Volt)}$$

$$I = ? \quad (\text{Ampere})$$

Answer : The current used by the electrical equipment is = 3 Ampere



# CALCULATION



## Voltage Calculation by using Power Formula :

(1). If one electrical Heater using current of 4 Ampere and the Electrical Power of this heater is 1000 Watt. what will be the supply voltage for the electric heater.

$$\text{Power (P)} = V I$$

So,  $V = P/I$

$$\begin{aligned} V &= 1000/4 \\ &= 250 \end{aligned}$$

So,  $V = 250 \text{ V (Volt)}$

$$P = 1000 \text{ W (Watt)}$$

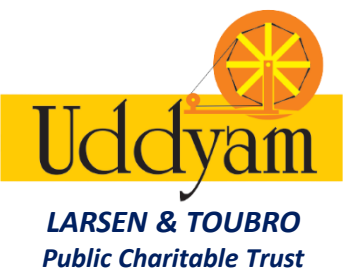
$$I = 4 \text{ A (Ampere)}$$

$$V = ? \text{ v (volt)}$$

Answer : The supply voltage of the electric heater is = 250 Volt



# CALCULATION



## Power Calculation by using Power Formula :

(1). If one electric equipment supplied with 240 volt a.c. power supply and this equipment is using current of 5 A (Ampere). What is electrical power of the electric equipment ?

$$\text{Power (P)} = V I$$

$$P = ? \text{ W (Watt)}$$

$$V = 240 \text{ V (Volt)}$$

$$\text{So, } P = VI$$

$$I = 5 \text{ A (Ampere)}$$

$$\begin{aligned} P &= 240 \times 5 \\ &= 1200 \end{aligned}$$

$$\text{So, } P = 1200 \text{ W (Watt)}$$

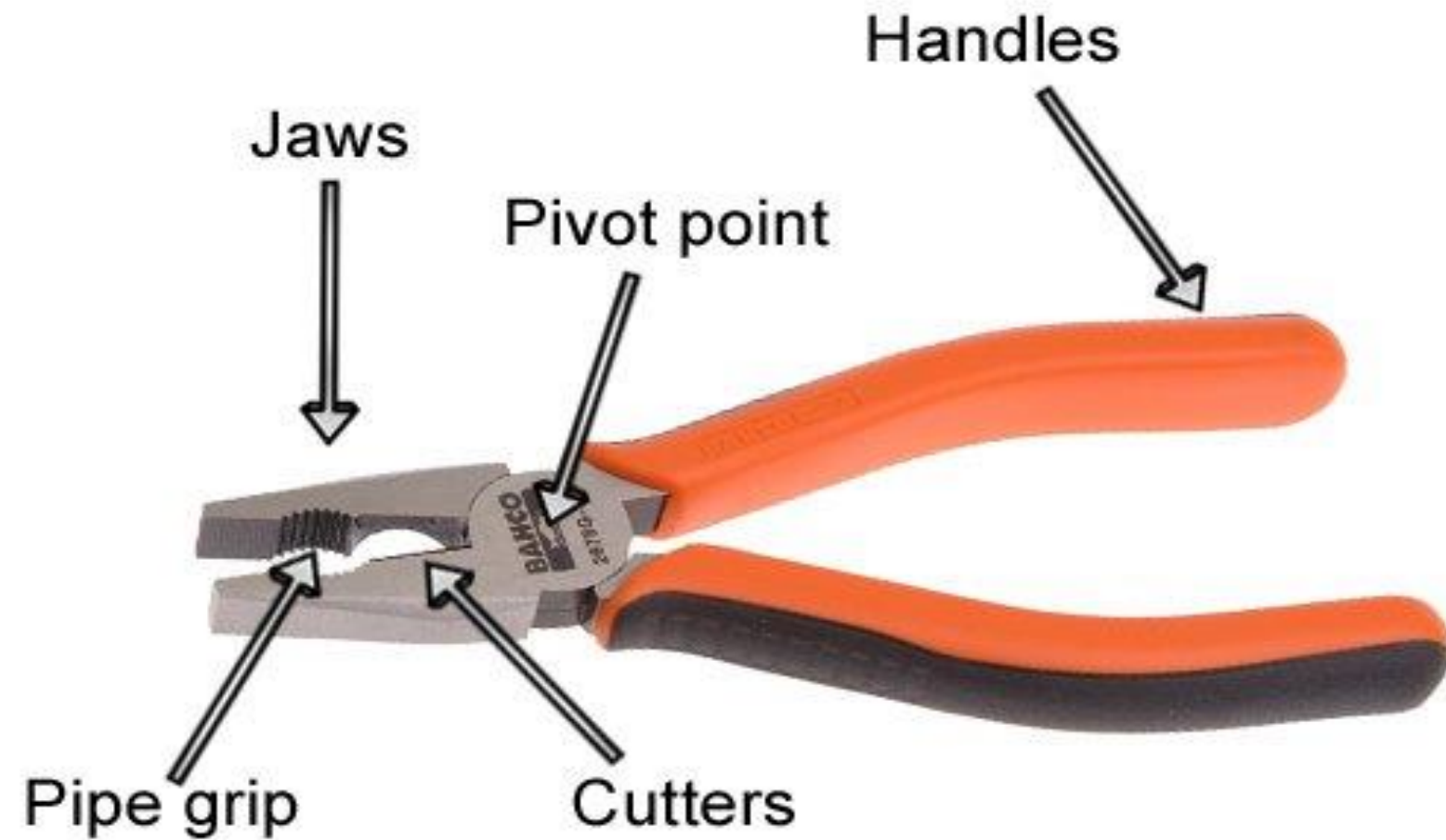
Answer : The Electrical Power of the electric equipment is = 1200 Watt



# SOLAR PANEL TECHNICIAN TOOLS & EQUIPMENT

## COMBINATION PLIER

**Combination Plier-** pliers consist of a pair of metal first-class levers joined at a fulcrum positioned closer to one end of the levers, creating short *jaws* on one side of the fulcrum, and longer *handle* the other side.







# SOLAR PANEL TECHNICIAN TOOLS



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- COMBINATION PLIER
- LONG NOSE PLIER
- CABLE CUTTER



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# SOLAR PANEL TECHNICIAN TOOLS

-SCREW DRIVER, ADJUSTABLE SPANNER, FIX SPANNER, HACKSAW, PLIER, HAMMER

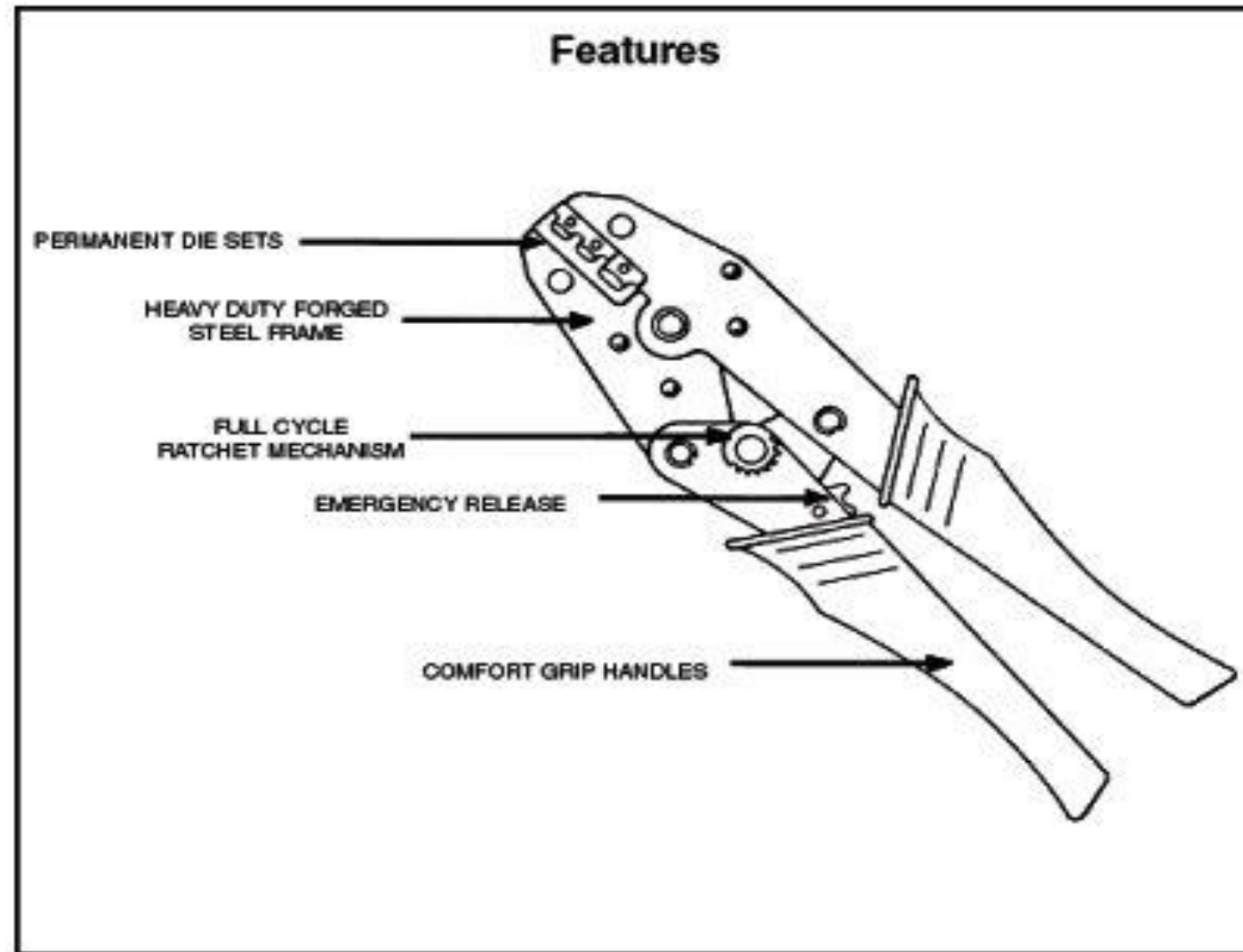




# SOLAR PANEL TECHNICIAN TOOLS

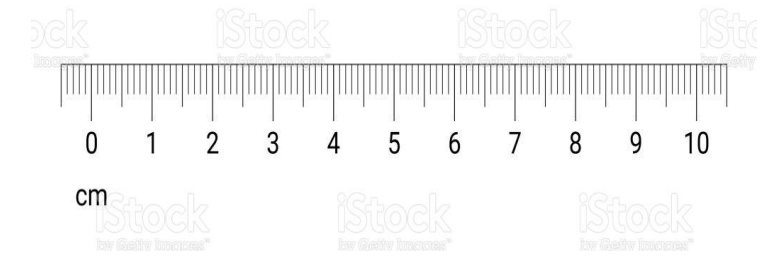


## LUG CRIMPING TOOL



Crimping Tool is used for Lug crimping of End Termination of wire for strong terminal fitting

## - MEASURE TAPE





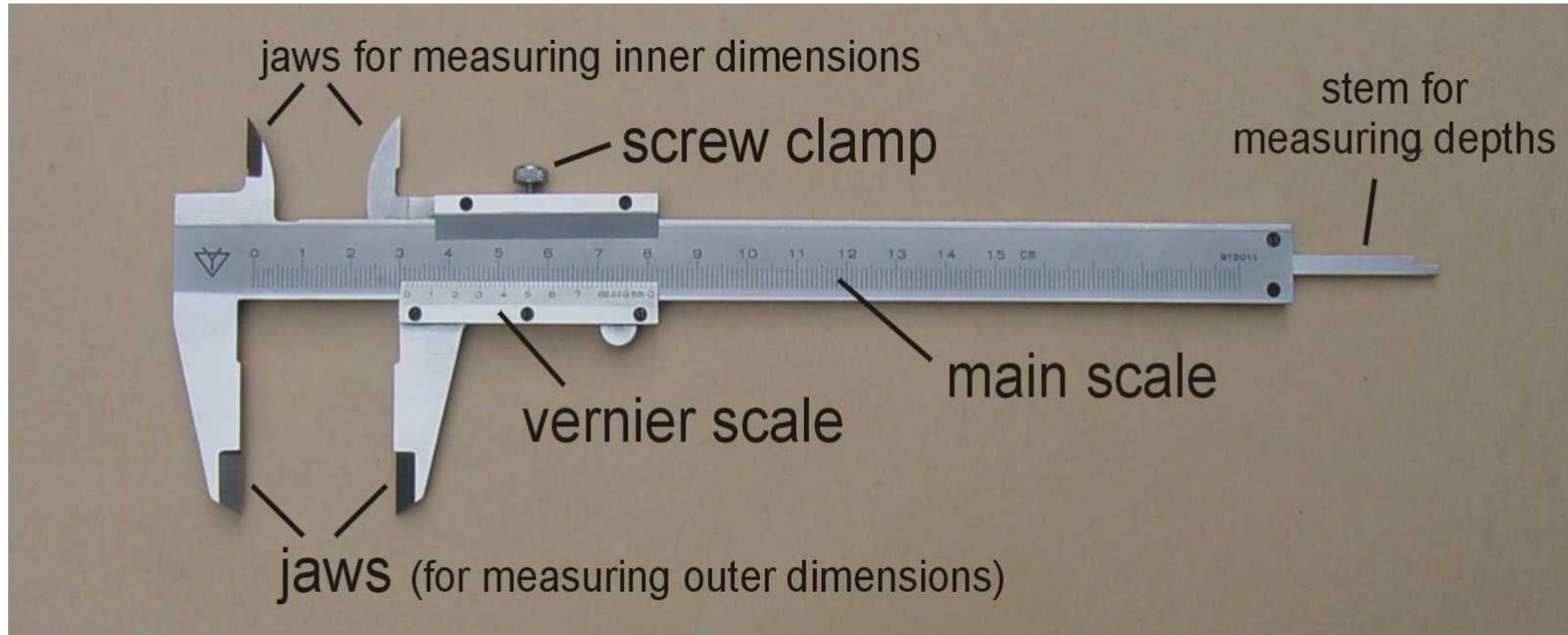
# SOLAR PANEL TECHNICIAN TOOLS



## HACKSAW, HAMMER, SCREW DRIVER, ADJUSTABLE SPANNER, CUTTER

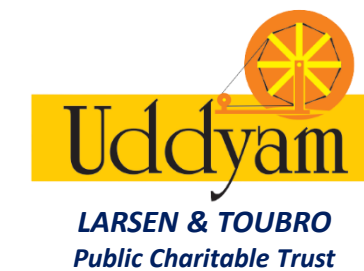


VERNIER CALIPER : For small size length measurement

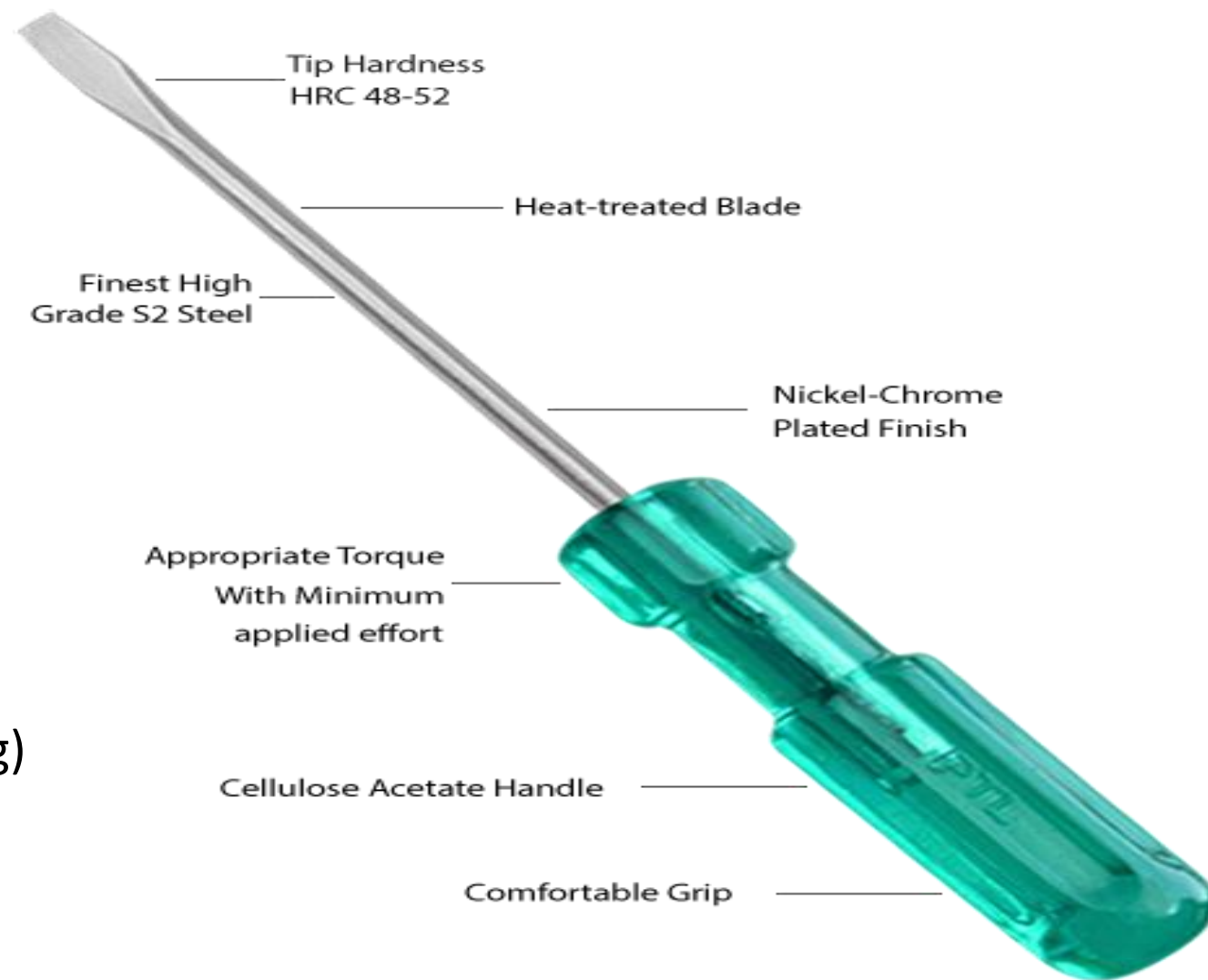




# SOLAR PANEL TECHNICIAN TOOLS



## SCREW DRIVER : Flat tip type



**Screwdriver** is a tool, manual or powered, used for screwing (installing) and unscrewing (removing) screws.

**Wire stripper , Neon Tester ,Screw driver:** Wire stripper used to remove insulation & Cut of small size wires  
Neon tester used to check presence of electricity, screw driver used to fitting and opening of screws.



← WIRE STRIPPER

NEON TESTER →



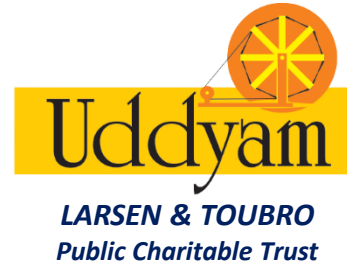
SCREW DRIVER →





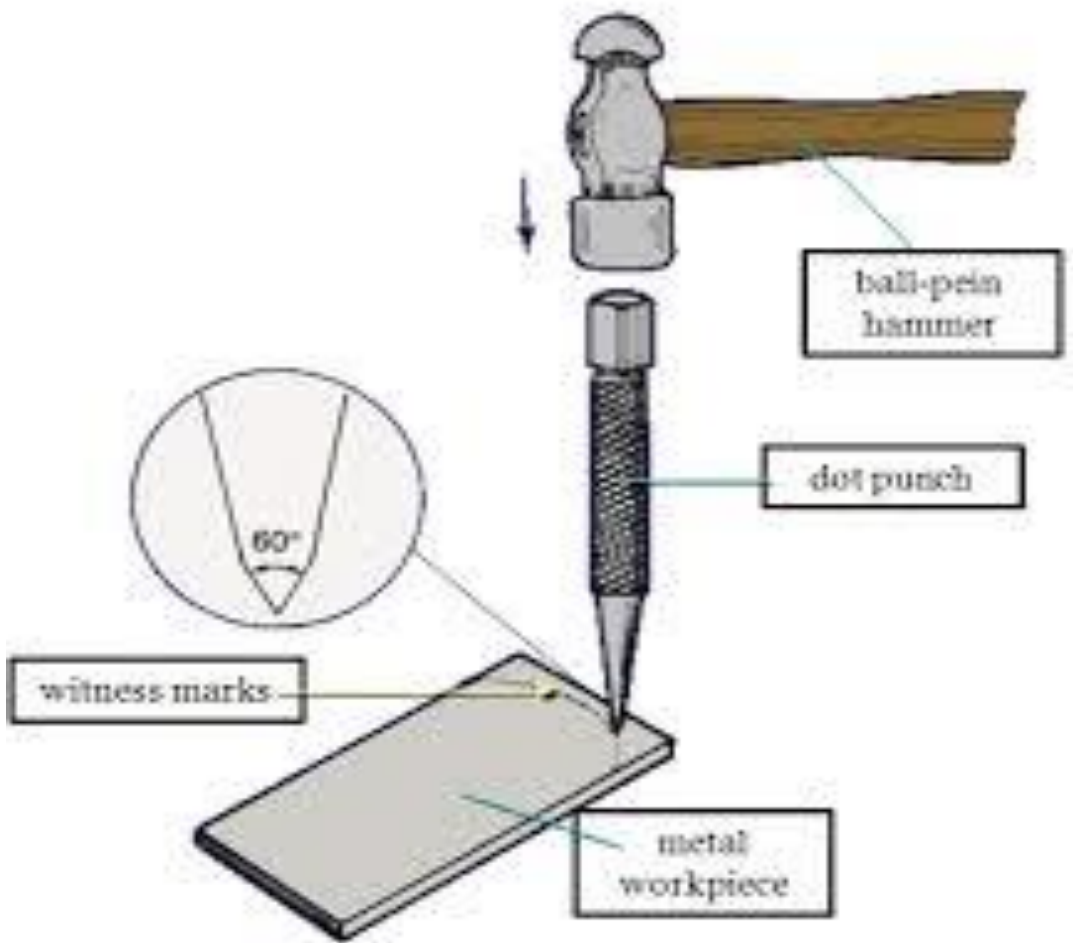


# SOLAR PANEL TECHNICIAN TOOLS



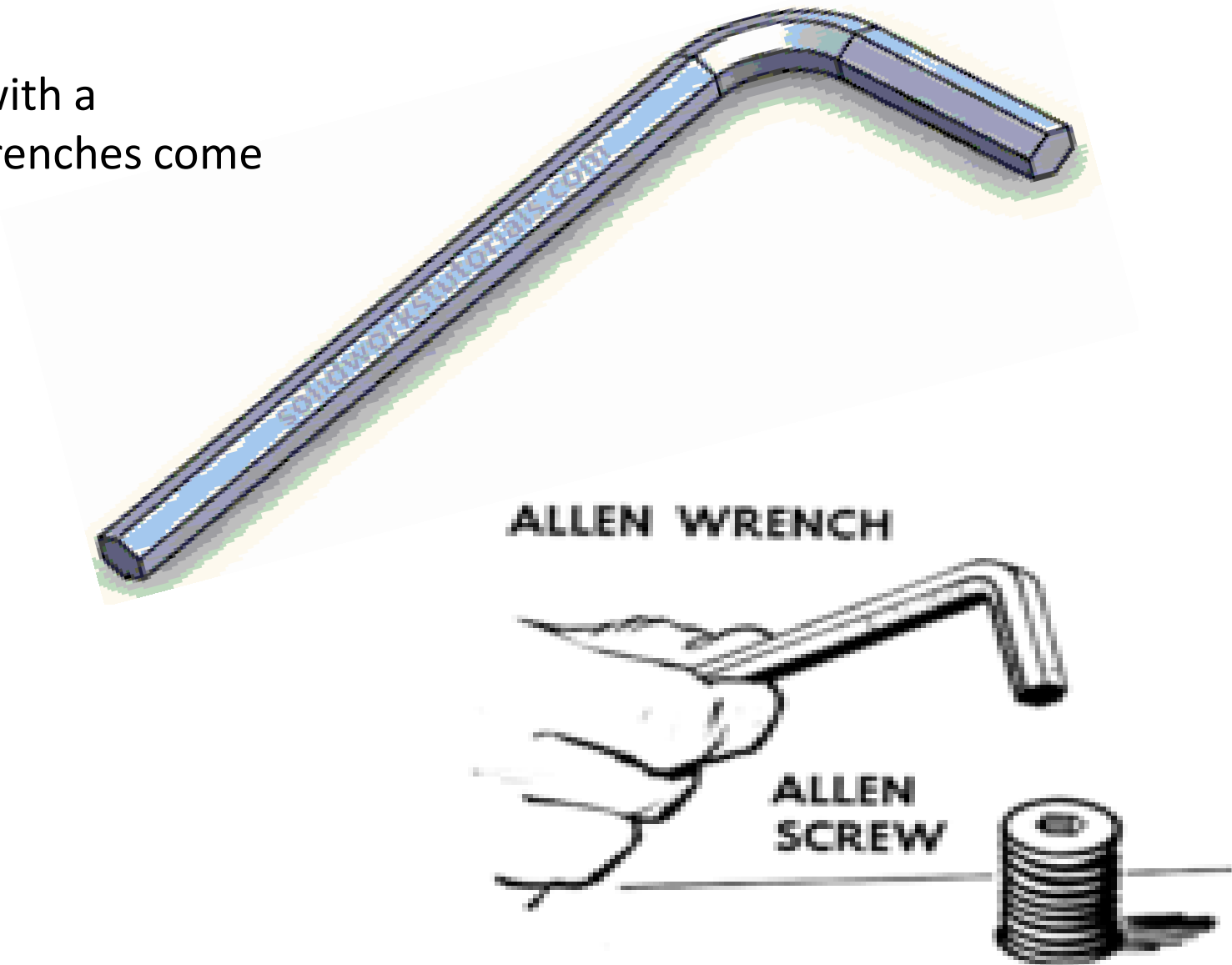
## Centre Punch:

Centre punch is made of high carbon steel, hardened. Centre punch is used to making a hole, or forming an impression of the tip on a work piece.



## Allen key :

Allen Key is used to turn screw or bolt heads designed with a hexagonal socket (recess) to receive the wrench. The wrenches come in two common forms: L-shaped and T-handles type.





# SOLAR PANEL TECHNICIAN TOOLS



**COMPASS:** Compass is an instrument to check Direction as North, South, East & West for True South direction to install Solar plant.



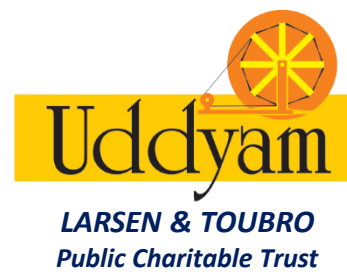


# SOLAR PANEL TECHNICIAN TRADE WORKSHOP TOOLS



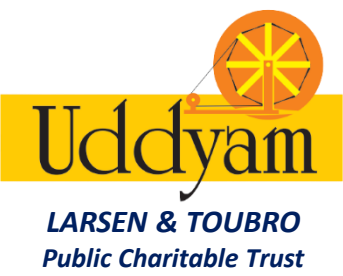


# SOLAR PANEL TECHNICIAN TRADE WORKSHOP EQUIPMENTS





# THEORY SECTION



# THEORY SECTION

# SOLAR PANEL TECHNICIAN



# THEORY LESSON-INDEX



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# THEORY LESSON -INDEX



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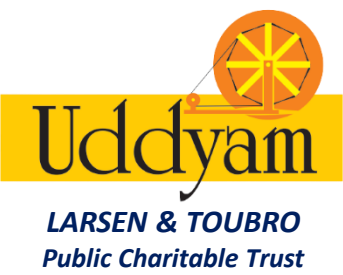
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# THEORY LESSON -1

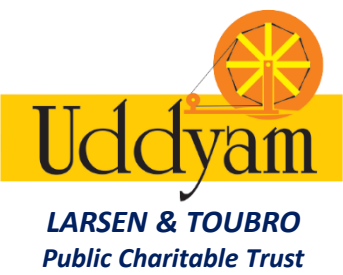


## (1). INTRODUCTION & IMPORTANCE OF SOLAR PANEL TECHNICIAN TRADE :

- SOLAR TECHNOLOGY MAINLY USED AS HEAT ENERGY AND LIGHT ENERGY. BY USING SOLAR LIGHT ELECTRICAL POWER PRODUCED (GENERATE) WITH HELP OF SOLAR PV PANELS BY PHOTO VOLTAIC EFFECT.
- SOLAR ENERGY IS AVAILABLE FREE OF COST REGULAR BY NATURE, INFINITE NATURAL SOURCE,
- PRESENT SOLAR SCENARIO, RENEWABLE Vs. TRADITIONAL SOURCE OF ENERGY.
  
- ADVANTAGES OF SOLAR ENERGY :  
SOLAR SUN LIGHT IS AVAILABLE REGULAR, SUNLIGHT IS AVAILABLE FREE OF COST, INFINITE SOURCE OF NATURAL ENERGY, POLLUTION FREE,
  
- DEMAND OF SOLAR TECHNICIAN  
- INDIA'S TARGET TO PRODUCE 100GW (GIGA WATT)= 10,000 MW SOLAR POWER SINCE 2022.  
INDIA HAVE ABUNDANT SOLAR ENERGY POTENTIAL PROVIDES ATTAINABLE, CLEAN ENERGY TO REPLACE OF THE TRADITIONAL THERMAL POWER .
  
- THE COURSE IS LATEST , HIGH DEMAND OF SKILL SOLAR-TECHNICIAN IN INDIA.



# THEORY LESSON : 2

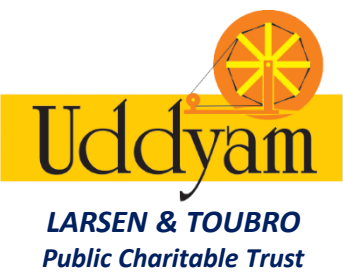


## (2). BASIC ELECTRICAL AND OHM'S LAW:

- STUDY OF ELECTRICAL POWER.
- **DEFINITION OF POWER** : ELECTRIC POWER IS THE RATE, PER UNIT TIME, AT WHICH ELECTRICAL ENERGY IS TRANSFERRED BY AN ELECTRIC CIRCUIT. THE UNIT OF POWER IS THE WATT.
- ELECTRIC POWER IS THE RATE AT WHICH WORK IS DONE OR ENERGY IS TRANSFORMED INTO AN ELECTRICAL CIRCUIT. ELECTRIC POWER IS MEASURED IN WATTS.
  
- TYPES OF POWER SUPPLY: A.C.SUPPLY, D.C. SUPPLY
- **A.C.SUPPLY** : SINGLE PHASE A.C.SUPPLY, THREE PHASE A.C. SUPPLY
- VOLTAGE, CURRENT, POWER AND TYPES OF ELECTRICAL POWER SUPPLY ARE BASICS OF ELECTRICAL.
- DEFINITION OF ELECTRIC CURRENT, VOLTAGE, RESISTANCE.
  
- **OHM'S LAW** : FOR ANY CIRCUIT THE ELECTRIC CURRENT IS DIRECTLY PROPORTIONAL TO THE VOLTAGE AND IS INVERSELY PROPORTIONAL TO THE RESISTANCE.
  
- OHM'S LAW FORMULA : **( $V=IR$ )** ,  $I=V/R$ ,  $R=V/I$  (V= Voltage, I= Current, R= Resistance)
- AND V, I, R CALCULATIONS.
- EXAMPLES CALCULATIONS FOR FINDING VOLTAGE, CURRENT & RESISTANCE.



# THEORY LESSON : 3



## (3). INTRODUCTION AND USE OF HAND TOOLS:

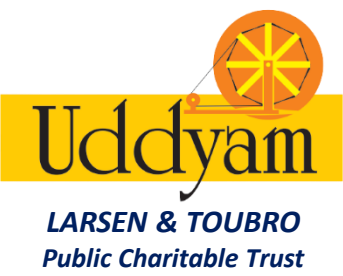
- > STUDY OF BASIC HAND TOOLS REQUIRED FOR SOLAR PANEL INSTALLATION & ELECTRICAL WORK. INTRODUCTION AND USE OF HAND TOOLS. HAND TOOLS ARE USE FOR FITTING, CUTTING AND MEASURING WORK.
- > TOOLS ARE ALSO CLASSIFIED AS PER ITS USAGE(APPLICATION) AND REQUIREMENT & TYPE OF WORK.

### > MAIN TYPES OF TOOLS :

- (1). MEASURING TOOLS
- (2). CUTTING TOOLS
- (3). FITTING TOOLS
- (4). MARKING TOOLS
- (5). SPECIAL PURPOSE TOOLS



# THEORY LESSON : 3



## (3). INTRODUCTION AND USE OF HAND TOOLS:

➤ **LIST OF HAND TOOLS:** HAMMER (BALL PEEN & CROSS PEEN HAMMER), PLIERS ( COMBINATION-PLIER), CUTTING PLIER, NOSE PLIER), WIRE STRIPPER, SPANNERS ( FIX(OPEN)) & RING SPANNER, BOX SPANNER( SOCKET SET), ADJUSTABLE SPANNER, ALLENKY SET, HACKSAW ( REGULAR & MINI ), CHISEL, FLAT ROUGH/SMOOTH FILE, ROUND SMOOTH FILE, SCREW DRIVERS ( SMALL, MEDIUM & HEAVY TYPE), NEON TESTER, LUG CRIMPING TOOL, MEASURE TAPE, RIGHT ANGLE(TRI SQUARE), SPIRIT LEVEL, VERNIER CALIPER, ELECTRIC DRILL MACHINE.(TOOLS INTRODUCTION, DEMONSTRATION AND SAFE USAGE, EXACT USE OF TOOLS, TIPS FOR USE OF TOOLS).

- SKETCH DRAWING FOR MAIN TOOLS.

> ALL TOOLS ARE AVAILABLE WITH DIFFERENT AND SUITABLE SIZE( LENGTH, WEIGHT) AND SELECT TOOLS AS PER REQUIREMENT.



# THEORY LESSON : 4



## (4). STUDY OF BASIC LENGTH MEASURING UNITS AND ELECTRICAL MEASURING INSTRUMENTS :

➤ **LENGTH MEASURING UNITS:** MAIN UNITS FOR LENGTH MEASUREMENT : MM,CM, INCH, FEET, METER. .

10 mm = 1 cm

1 FEET = 12 INCH

1000 mm = 1 meter

100 cm = 1 meter

- LENGTH MEASURING IS BASIC FOR ALL TYPES OF TECHNICAL WORK. FOR SMALL JOB TO BIG MACHINE AND SMALL PARTS TO ROOM, FLOOR, TERRACE MEASUREMENT PURPOSE. ALL TECHNICAL PERSON HAVE TO KNOW LENGTH MEASUREMENT PROCEDURE.

- IT IS NEEDS TO KNOW & UNDERSTAND MAIN LENGTH MEASURING TOOLS AND MEASURING UNITS.

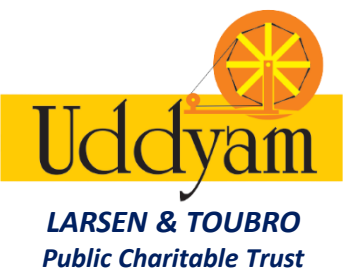
- **MM** : MILIMETER IS THE SMALLEST UNIT FOR SMALL SIZE STEEL SCALE, 1MM IS THE 10<sup>TH</sup> PART OF 1 CM CENTIMETER.

- **CM – CENTIMETER** : CENTIMETER IS THE SECOND BIG UNIT FOR STEEL SCALE AND MEASURE TAPE.

1 CM(CENTIMETER)= 10 MM (MILIMETER). **(1CM=10MM)**



# THEORY LESSON : 4



## (4). STUDY OF BASIC LENGTH MEASURING UNITS AND ELECTRICAL MEASURING INSTRUMENTS :

- **INCH** : INCH IS THE THIRD BIG UNIT FOR STEEL SCALE AND MEASURE TAPE. INCH IS RELATED WITH UNIT CM AND MM. ( **1 INCH= 2.54 CM**), ( **1 INCH= 25 MM**).
- **FEET**: FEET IS THE FOURTH BIG UNIT FOR STEEL SCALE AND MEASURE TAPE. FEET IS RELATED WITH UNIT INCH,CM AND MM. ( **1 FEET= 12 INCH**), ( **1 FEET= 30 CM**) AND ( **1-FEET = 300MM**)
- **METER**: METER IS THE BIG UNIT OF MEASURE TAPE. METER IS RELATED WITH UNIT CENTIMETER (CM) AND MM. ( **1 METER = 100 CM**), ( **1 METER = 1000 MM**) AND ( **1-FEET = 300MM**)
- CALCULATIONS OF SMALL TO BIG UNITS ( MM TO METER, CM TO MM).  
ex.: 8 cm= 80 mm, 120 mm= 12 cm, 900 cm= 9 meter, 5000 mm= 5 meter , 84 inch= 7 feet.

> **STUDY OF ELECTRICAL METERS**: VOLT METER, AMPERE METER, CLAMP METER, MULTIMETER, WATT METER, ENERGY METER (KWHR METER). USE OF METERS.

## (4). STUDY OF BASIC LENGTH MEASURING UNITS AND ELECTRICAL MEASURING INSTRUMENTS :

> **STUDY OF ELECTRICAL METERS:** VOLT METER, AMPERE METER, ENERGY METER.

- VOLT METER



- AMPERE METER (A-METER)

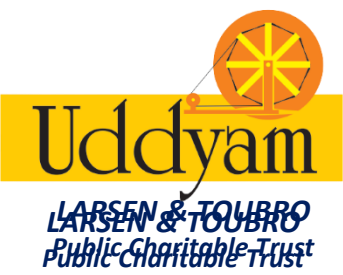


- ENERGY METER





# THEORY LESSON : 5



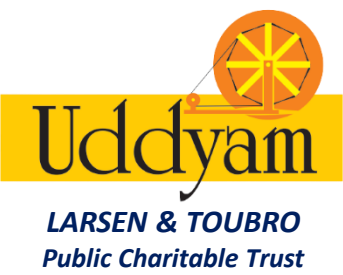
## (5). ELECTRICAL POWER BASICS AND EARTHING :

- ELECTRICAL POWER IS MAIN IMPORTANT THING FOR SOLAR PLANT, AS SOLAR PLANT IS GENERATING ELECTRICAL POWER, BASICALLY POWER IS AN ENERGY, THE VOLTAGE(POTENTIAL DIFFERENCE) AND CURRENT ARE THE COMBINED PARAMETERS FOR ELECTRICAL POWER.
- TO UNDERSTAND THE ELECTRICAL POWER, IT IS NEED TO KNOW **VOLTAGE & CURRENT.**
- **VOLTAGE :** VOLTAGE IS THE PRESSURE FROM AN ELECTRICAL CIRCUIT'S POWER SOURCE THAT PUSHES CHARGED ELECTRONS (CURRENT) THROUGH A CIRCUIT, ENABLING THEM TO DO WORK .  
IN BRIEF, VOLTAGE = PRESSURE, AND IT IS MEASURED IN VOLTS (V).
- **CURRENT :** THE FLOW OF ELECTRIC CHARGE (ELECTRON) IS KNOWN AS ELECTRIC CURRENT.  
ELECTRIC CURRENT IS CARRIED BY MOVING ELECTRONS THROUGH A CONDUCTOR. UNIT OF CURRENT IS AMPERE.
- **POWER :** ELECTRIC POWER IS THE RATE AT WHICH WORK IS DONE OR ENERGY IS TRANSFORMED INTO AN ELECTRICAL CIRCUIT. ELECTRIC POWER IS MEASURED IN WATT. UNIT OF POWER IS WATT (W).





# THEORY LESSON : 5



## (5). ELECTRICAL POWER BASICS AND EARTHING :

- EQUATION OF POWER IS  $P=V \times I$  ( V= Voltage, I= Current, P= Power)

> STUDY OF EARTHING CONCEPT: THE PROCESS OF TRANSFERRING THE IMMEDIATE DISCHARGE OF THE LEAKAGE CURRENT DIRECTLY TO THE EARTH BY THE HELP OF THE LOW RESISTANCE CONDUCTOR.

- EARTHING PROTECT THE ELECTRICAL EQUIPMENT, ELECTRIC CIRCUIT, ELECTRICAL SYSTEM AND A PERSON IN TOUCH WITH THE ELECTRICAL EQUIPMENT OR SYSTEM.

- **TYPES OF EARTHING :** PLATE EARTHING, PIPE EARTHING.

- FOR EARTHING VERY LOW RESISTANCE TYPE PURE CONDUCTING COPPER WIRE, ROD , PIPE AND COPPER PLATE ONLY RECOMMENDED.



# THEORY LESSON : 6

## (6). STUDY OF WIRE AND CABLE :

➤ INTRODUCTION AND DEFINITION OF WIRE AND CABLE. CONSTRUCTION, BASIC DRAWING OF WIRE & CABLE. MATERIAL USED , STUDY OF MAIN TYPES, FUNCTION OF WIRES/CABLES.

> STUDY OF CONDUCTOR , INSULATING MATERIAL , PROTECTION COVER. (PARTS OF WIRE/CABLE).

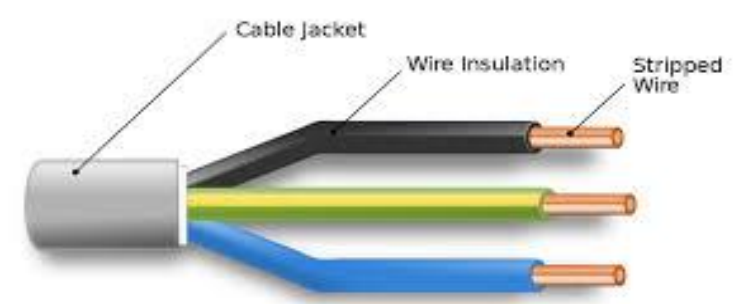
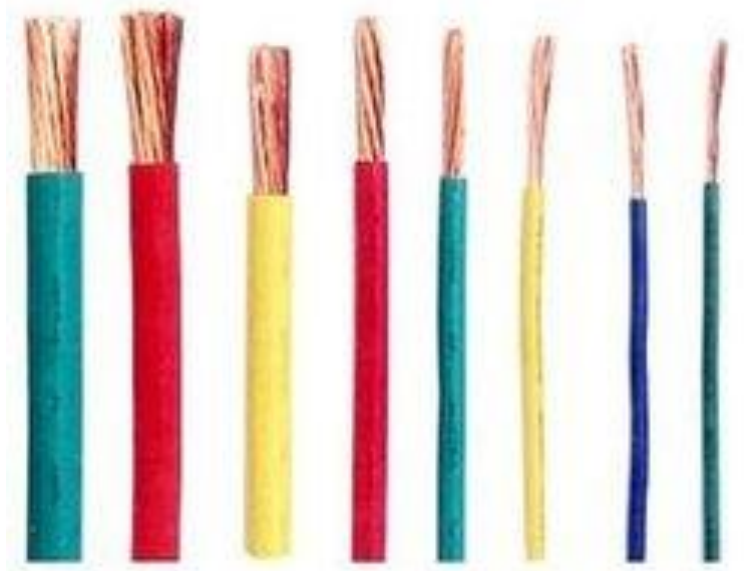
**MAIN TYPES OF CABLES:** POWER & CONTROL CABLES: FLEXIBLE COPPER CABLE, ARMoured CABLE, UNDER GROUND CABLE, COMMUNICATION CABLE, CO-AXIAL CABLE, FIBRE OPTIC CABLE.  
USE AND APPLICATION OF CABLE.

> A.C. CABLE AND D.C. CABLE USED FOR SOLAR PLANT WIRING WORK: ITS PROPERTY AND SPECIALIZATION.

- THE BASIC KEY DIFFERENCE BETWEEN WIRES AND CABLES IS THAT A WIRE IS A SINGLE CONDUCTOR WHEREAS A CABLE IS A GROUP OF CONDUCTORS. BUT, SOME OF THE WIRES ARE COATED WITH THIN PVC LAYER. AND IN CASE OF CABLES, THEY RUN PARALLELLY AND ARE TWISTED OR BONDED TOGETHER TO FORM A SINGLE CASE.

## (6). STUDY OF WIRE AND CABLE :

### FLEXIBLE COPPER WIRE



### ARMoured CABLE





# THEORY LESSON : 7

## (7). STUDY OF SOLDERING PROCEDURE AND TECHNIQUES :

- > DEFINITION OF SOLDERING, REQUIREMENT OF SOLDERING, SOLDERING PROCESS.
- MATERIAL REQUIRED FOR SOLDERING WORK. SOLDERING TECHNIQUE.
- **SOLDERING:** “ TWO OR MORE METAL ITEMS ARE JOINED TOGETHER BY MELTING AND THEN FLOWING A FILLER METAL INTO THE JOINT.”
- SOLDERING IS USED TO FORM A PERMANENT CONNECTION BETWEEN ELECTRICAL WIRES OR ELECTRONIC COMPONENT.
- SOLDER WIRE IS METAL WIRE (FILLER METAL) WITH A LOW MELTING POINT. SOLDER WIRE IS MIX OF TIN & LEAD .
- TYPES OF SOLDERING: HARD SOLDERING & SOFT SOLDERING.
- TECHNIQUE –KEEP SOLDERING IRON AT 45 DEGREE.



# THEORY LESSON : 8



## (8). INTRODUCTION AND STUDY OF ELECTRICAL SYMBOLS :

### > IMPORTANCE AND USE OF SYMBOLS:

SYMBOLS ARE USED FOR STUDY OF ELECTRICAL CIRCUITS, DRAWINGS, LAYOUTS. SYMBOLS ARE USEFUL FOR UNDERSTAND THE NAME PLATE (RATINGS, SPECIFICATIONS, STANDARD VALUES ) OF EQUIPMENTS AND SYSTEM.

- DRAW SYMBOLS , DESCRIPTION OF SYMBOLS.

- **MAIN SYMBOLS :**

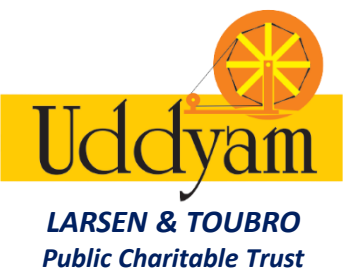
- A.C. SUPPLY, D.C. SUPPLY, EARTHING, POSITIVE, NEGATIVE, PHASE, NEUTRAL, BATTERY, CELL, FUSE, RESISTANCE, VOLT METER, AMPERE(A) METER, MULTIMETER, ENERGY METER, SOLAR CELL, SOLAR PANEL, SOLAR INVERTER, MEGGER, SWITCH, NEUTRAL LINE.

- SYMBOLS ARE USEFUL FOR PREPARATION OF LAYOUT DRAWINGS, ELECTRICAL DRAWING, CIRCUITS. ALSO USED FOR DISPLAY RATINGS ON NAME PLATE OF EQUIPMENT, INSTRUMENTS, DEVICES, SYSTEMS, MACHINE.

- SYMBOLS ARE STANDARD PICTOGRAM (SMALL SIZE FIGURE) ,WHICH REPRESENT (SHOW) ,INDICATES EXACT FUNCTION (MEANING) AND PARAMETER, RATINGS OF THE COMPONENT, DEVICE, SYSTEM.



# THEORY LESSON : 9



## **(9). FUNDAMENTALS OF ELECTRICITY:**

> ELECTRICITY IS THE PRESENCE AND FLOW OF (ELECTRIC CHARGE) ELECTRON IN ONE DIRECTION.

- ELECTRICITY IS A TYPE OF ENERGY THAT WE USE TO MAKE LIGHT, HEAT AND POWER TO RUN VARIOUS MACHINES.

- CURRENT = FLOW OF ELECTRON IN A CONDUCTOR . UNIT OF CURRENT IS AMPERE(A),

- VOLTAGE = ELECTRICAL PRESSURE TO FLOW OF ELECTRON . UNIT OF VOLTAGE IS VOLT(V).

- ELECTRICAL POWER (P) = VOLTAGE x CURRENT =  $V \times I$  (P = VI)

### **> TYPES OF ELECTRICAL POWER SUPPLY :**

- A.C. SUPPLY

- D.C. SUPPLY

> STUDY OF PROPERTY OF CONDUCTOR AND INSULATOR: DEFINITION AND EXAMPLES OF CONDUCTOR AND INSULATOR.





# THEORY LESSON : 10

## (10). BASIC STUDY OF SOLAR PANEL :

(1). STUDY OF SOLAR PANEL CONSTRUCTION : SOLAR PANELS MADE BY SERIES CONNECTIONS OF MANY SOLAR CELLS , STUDY OF SOLAR CELL PROPERTY, (SOLAR CELL MADE FROM SILICON WAFERS). FUNCTION OF CELLS , SIZE AND WEIGHT OF SOLAR PANEL, STUDY OF PHOTOVOLTAIC EFFECT. SOLAR CELL VOLTAGE= 0.5V D.C.

- SOLAR PANEL CONSTRUCTION: SOLAR PANEL MADE BY FIVE TYPES OF LAYERS & ALLUMINIUM FRAME.

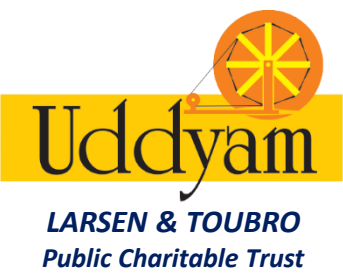
- (1). GLASS LAYER (HIGH TRANSMISSION TEMPERED GLASS).
- (2). E.V,A LAYER ( ETHYLENE VINYLE ACETATE).
- (3). SOLAR CELL LAYER
- (4). E.V.A LAYER ( ETHYLENE VINYLE ACETATE).
- (5). TADDLER LAYER.

- PURPOSE AND FUNCTION OF ALL FIVE(5) LAYERS.

- SOLAR PANEL FUNCTION- ELECTRICAL POWER GENERATION BY USING PHOTONS OF SUN LIGHT.



# THEORY LESSON : 10



## (10). BASIC STUDY OF SOLAR PANEL :

### (2). (MAIN EQUIPMENTS FOR SOLAR PLANT) :MECHANICAL EQUIPMENTS, ELECTRICAL EQUIPMENTS.

> MECHANICAL EQUIPMENTS: STRUCTURE FOR SOLAR PLANT. SUPPORT AND BASE FOUNDATION.

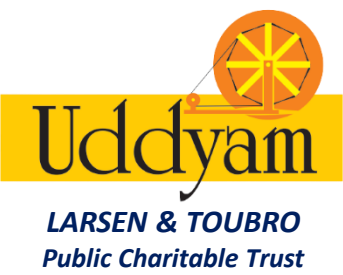
> ELECTRICAL EQUIPMENTS: SOLAR PANEL, D.C. BOX, SOLAR INVERTER, A.C. BOX, ENERGY METERS (SOLAR METER, BI DIRECTIONAL METER). EARTHING SYSTEM, LIGHTENING ARRESTER.

> ACCESSORIES & HARDWARE: MC4 CONNECTOR , D.C. CABLE, A.C. CABLE. MCB, MCCB, FUSE, ISOLATOR SWITCH. HDPE P.V.C. PIPES, COPPER STRIP, HARDWARE( STAINLESS STEEL NUT, BOLT, WASHER), CLAMPS.





# THEORY LESSON : 11



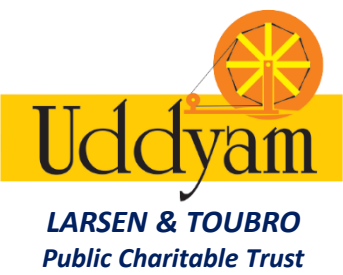
## **(11). TECHNICAL PARAMETERS AND SPECIFICATIONS OF SOLAR PANEL:**

### **(STUDY OF MAIN SPECIFICATIONS AND PARAMETERS OF SOLAR PANEL)**

- > DEFINITION OF SPECIFICATION, USE AND IMPORTANCE OF SOLAR PANEL'S SPECIFICATION
- SPECIFICATIONS ARE USED TO STUDY EXACT ,IMPORTANT TECHNICAL INFORMATION ABOUT SOLAR PANEL:
  
- POWER CAPACITY, VOLTAGE AT MAXIMUM POWER POINT, CURRENT AT MAXIMUM POWER POINT, OPEN CIRCUIT VOLTAGE, MAXIMUM SYSTEM VOLTAGE, MAXIMUM SERIES FUSE RATING, DIMENSION, OPERATING TEMPRATURE, WEIGHT, FRAME, CELLS, GLASS TYPE, TERMINAL BOX,
  
- > VIDEO TRAINNING FOR STUDY OF DIFFERENT TYPES OF SOLAR PANEL'S DATA SHEET.  
STUDY OF PARAMETERS , SPECIFICATIONS FOR VARIOUS TYPES OF SOLAR PANEL AVAILABLE.



# THEORY LESSON : 11



## (11). TECHNICAL PARAMETERS AND SPECIFICATIONS OF SOLAR PANEL:

### > MAIN SPECIFICATIONS OF SOLAR PANEL.

- |                                  |                                       |
|----------------------------------|---------------------------------------|
| - MAXIMUM POWER                  | - Wp                                  |
| - VOLTAGE AT MAXIMUM POWER POINT | - $V_{MP}$                            |
| - OPEN CIRCUIT VOLTAGE           | - $V_{oc}$                            |
| - SHORT CIRCUIT CURRENT          | - $I_{sc}$                            |
| - MAXIMUM SYSTEM VOLTAGE         | - $V_{DC}$                            |
| - OPERATING TEMPRATURE           | - DEEGREE C                           |
| - WEIGHT                         | - KG                                  |
| - DIMENSION                      | - mm                                  |
| - FRAME                          | - ALUMINIUM                           |
| - CELL TYPE                      | - POLY CRYSTALLINE / MONO CRYSTALLINE |
| - CONNECTOR TYPE                 | - MC4                                 |
| - TERMINAL BOX                   | - IP65                                |
| - GLASS                          | - HIGH TRANSMISSION TEMPERED GLASS    |



# THEORY LESSON : 12

## **(12). SITE SURVEY FOR SOLAR PLANT INSTALLATION :**

### **(STUDY OF SITE SURVEY FOR SOLAR PLANT INSTALLATION )**

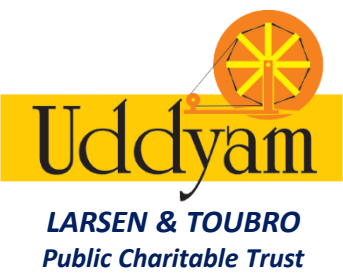
> IMPORTANCE OF SITE SURVEY : SITE SURVEY IS IMPORTANT WORK FOR THE SOLAR PLANT DESIGN WORK. WITH THE HELP OF SITE SURVEY WE CAN DECIDE EXACT POWER CAPACITY OF POWER PLANT .

> FOLLOWING ARE IMPORTANTS STEPS FOR SITE SURVEY :(STEP FOR CONDUCTING LOAD ASSESMENT

- LOAD ASSESMENT(FINDOUT DAILY POWER CONSUMPTION BY STUDY ELECTRIC BILL OF CUSTOMER
- STEP FOR CONDUCTING SITE ASSESMENT.
- SURVEY OF SPACE & LOCATION FOR SOLAR PLANT.
- SHADOW ANALYSIS FOR THE PLACE OF SOLAR PLANT.
- SURVEY FOR LOCATION OF INSTALLATION OF ELECTRICAL EQUIPMENTS.
- SURVEY FOR PLACE OF EARTHING .



# THEORY LESSON : 12



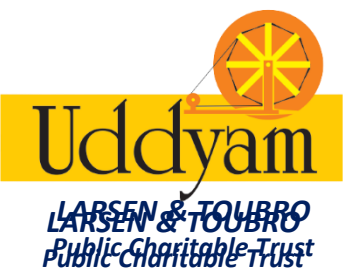
## **(12). SITE SURVEY FOR SOLAR PLANT INSTALLATION :**

**-SITE SURVEY:** SITE SURVEY FOR SOLAR ROOFTOP PLANT IS THE WORK TO ANALYSE / EVALUATE ROOF FOR MAXIMUM SOLAR PLANT'S ENERGY PRODUCTION AT THE SITE WHERE THE PANELS WILL BE EXPOSED TO THE MOST SUNLIGHT. – SHADOW ANALYSIS, ROOFTOP DIMENSION, ROOF DIRECTION, ROOF INCLINATION, CONSTRUCTION TYPE OF ROOF, LOAD ASSESSMENT AND FINANCIAL ANALYSIS. FEASIBILITY, VIABILITY AND USER REQUIREMENT IS IMPORTANT.

**-CONCLUSION:** SITE SURVEY WORK IS VERY IMPORTANT BEFORE SOLAR PLANT INSTALLATION. THIS ENSURE THE SOLAR SYSTEM IS PROPERLY DESIGNED TO SUIT USER REQUIREMENTS.



# THEORY LESSON : 13



## **(13). STUDY OF SPECIFICATIONS OF SOLAR INVERTER :** **(STUDY OF MAIN SPECIFICATIONS AND PARAMETERS OF SOLAR INVERTER.)**

> DEFINITION OF SPECIFICATION, USE AND IMPORTANCE OF SOLAR PANEL'S SPECIFICATION  
- SPECIFICATION OF SOLAR INVERTER MEANS TECHNICAL DETAIL INFORMATION OF A STANDARD, TEST PERFORMANCE, DESIGN (DIMENSION/ SIZE) MATERIAL QUALITY, RATINGS, MEASURED TEST VALUES, CAPACITY ETC.

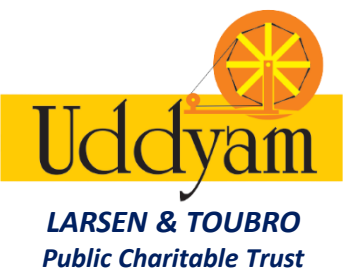
### > MAIN SPECIFICATIONS OF SOLAR INVERTER.

- MAXIMUM A.C. POWER OUT PUT : 8000W( 8KW)
- A.C. VOLTAGE RANGE ( MPP VOLTAGE RANGE) : D.C. 200-900 V
- MAX. INPUT VOLTAGE : D.C. 1000 V
- MAX. INPUT CURRENT : D.C. 15A/ 11A
- RATED GRID VOLTAGE : 3/P/N/E (3/N/PE) \* 380/400V
- RATED GRID FREQUENCY : 50/60 Hz
- MAXIMUM CONTINUOUS OUTPUT CURRENT : A.C 13.3A
- I<sub>sc</sub> PV (SHORT CIRCUIT CURRENT ABSOLUTE MAXIMUM ) : D.C 22.5A/16.5A
- PEAK INVERTER EFFICIENCY : 95.3 %





# THEORY LESSON : 13



## **(13). STUDY OF SPECIFICATIONS OF SOLAR INVERTER :** **(STUDY OF MAIN SPECIFICATIONS AND PARAMETERS OF SOLAR INVERTER.)**

### **MAIN SPECIFICATIONS OF SOLAR INVERTER.**

- GROUNDING : POSITIVE GROUNDING.
- INGRESS PROTECTION (OUT DOOR) : IP 65
- OPERATING TEMPRATURE RANGE : -25 TO 60 \* Degree C.
- PROTECTIVE CLASS : 1
- OVER VOLTAGE CATEGORY : II (PV) , III ( MAINS).

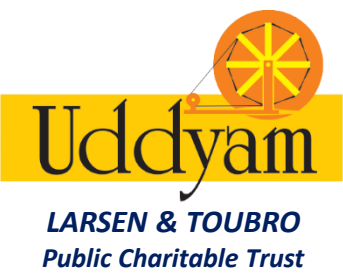
**\*\* SOLAR INVERTER IS A HEART OF SOLAR PLANT, IT CONVERT D.C. ELECTRICAL POWER TO A.C. POWER, SOLAR PLANT'S PANEL STRING DESIGN SHOULD BE AS PER MPP VOLTAGE RANGE. INVERTER SYNCHRONIZE THE GRID (G.E.B) POWER WITH THE SOLAR PLANT'S ELECTRICAL POWER.**

## (13). STUDY OF SPECIFICATIONS OF SOLAR INVERTER :

Technical Data	Sunny Island 6.0H	Sunny Island 8.0H
<b>Operation on the utility grid or generator</b>		
Rated grid voltage / AC voltage range	230 V / 172.5 V to 264.5 V	230 V / 172.5 V to 264.5 V
Rated grid frequency / permitted frequency range	50 Hz / 40 Hz to 70 Hz	50 Hz / 40 Hz to 70 Hz
Maximum AC current for increased self-consumption (grid operation)	20 A	26 A
Maximum AC power for increased self-consumption (grid operation)	4,6 kVA	6 kVA
Maximum AC input current	50 A	50 A
Maximum AC input power	11 500 W	11 500 W
<b>Stand-alone or emergency power operation</b>		
Rated grid voltage / AC voltage range	230 V / 202 V to 253 V	230 V / 202 V to 253 V
Rated frequency / frequency range (adjustable)	50 Hz / 45 Hz to 65 Hz	50 Hz / 45 Hz to 65 Hz
Rated power (at $U_{nom}$ , $I_{nom}$ / 25°C / $\cos \phi = 1$ )	4600 W	6000 W
AC power at 25°C for 30 min / 5 min / 3 sec	6000 W / 6800 W / 11000 W	8000 W / 9100 W / 11000 W
AC power at 45°C permanently	3700 W	5430 W
Rated current / maximum output current (peak)	20 A / 120 A	26 A / 120 A
Total harmonic distortion output voltage / power factor at rated power	< 4 % / -1 to +1	< 4 % / -1 to +1
<b>Battery DC input</b>		
Rated input voltage / DC voltage range	48 V / 41 V to 63 V	48 V / 41 V to 63 V
Maximum battery charging current / rated DC charging current / DC discharging current	110 A / 90 A / 103 A	140 A / 115 A / 130 A
Battery type / battery capacity (range)	LiIon*, FLA, VRLA / 100 Ah to 10000 Ah (lead-acid) 50 Ah to 10000 Ah (LiIon)	LiIon*, FLA, VRLA / 100 Ah to 10000 Ah (lead-acid) 50 Ah to 10000 Ah (LiIon)
Charge control	IUoU charge procedure with automatic full charge and equalization charge	
<b>Efficiency / self-consumption of the device</b>		
Maximum efficiency	95,8 %	95,8 %
No-load consumption / standby	25,8 W / 6,5 W	25,8 W / 6,5 W
<b>Protective devices (inverter)</b>		
AC short-circuit / AC overload	● / ●	● / ●
DC reverse polarity protection / DC fuse	- / -	- / -
Overtemperature / battery deep discharge	● / ●	● / ●
Overvoltage category as per IEC 60664-1	III	III



# THEORY LESSON : 14



## (14). SOLAR PLANT DESIGN AND ESTIMATION WORK :

### (SOLAR PLANT DESIGN WORK )

> SOLAR PLANT DESIGN : SOLAR PLANT DESIGN WORK IS TO FOUND THE REQUIRED PLANT CAPACITY ( HOW MUCH POWER CAPACITY = KW (KILOWATT)) TYPE . SOLAR PLANT POWER CAPACITY IS DECIDE AS PER DAILY POWER COSUMPTION BY STUDY OF ELECTRICITY BILL. 1-KILOWATT CAPACITY SOLAR PLANT GENERATE ABOUT 4 TO 5 UNIT(KWHR)/DAY.

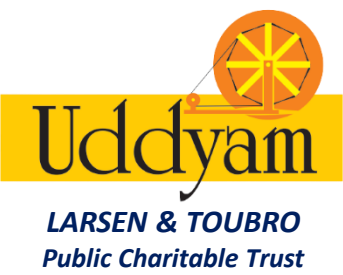
- ACCORDING TO SOLAR PLANT POWER CAPACITY, SITE SURVEY WORK NEED TO PERFORM.
- PREPARE A LAY OUT DRAWING FOR THE SAME PLANT. ALSO MECHANICAL DRAWING NEEDS TO PREPARE FOR STRUCTURE WORK. PREPARE AN ELECTRICAL DRAWING FOR THE WIRING WORK AND INSTALLATION OF ELECTRICAL EQUIPMENTS. MAKE A DRAWING FOR FOUNDATION .







# THEORY LESSON : 14



## (14). SOLAR PLANT DESIGN AND ESTIMATION WORK :

### ( SOLAR PLANT ESTIMATION WORK )

#### > ESTIMATION WORK FOR SOLAR PLANT:

- ESTIMATION WORK TO BE PERFORM AS PER DESIGN OF THE SOLAR PLANT. AS PER SOLAR PLANT POWER CAPACITY – RATING CAPACITY OF THE SOLAR INVERTER, REQUIRED NOS. OF SOLAR PANELS TO BE DECIDE.
- REQUIREMENT OF D.C. CABLE LENGTH, D.C.BOX & ACCESSORIES (D.C. FUSE), A.C. CABLE LENGTH , A.C BOX & M.C.B, ISOLATOR SWITCH , EARTHING ELECTRODE, EARTHING STRIP(EARTH- WIRE) LENGTH TO BE MEASURED AS PER DRAWING AND MAKE A LIST OF REQUIRED MATERIALS LIST WITH NO. OF QUANTITY AND RATINGS WITH SPECIFICATIONS IS CALLED B.O.M(BILL OF MATERIAL).
- ESTIMATION WORK IS NEEDS TO PREPARE REQUIRED-RATED MATERIAL, EQUIPMENT,ACCESSORIES LIST FOR SOLAR PLANT .



# THEORY LESSON : 15

## (15). INSTALLATION OF SOLAR ROOF TOP PLANT :

**- SOLAR PLANT INSTALLATION :** SOLAR PANEL INSTALLATION WORK IS MAIN WORK FOR SOLAR PLANT RELATED WORK. SOLAR PANELS ARE IMPORTANT EQUIPMENT FOR ALL TYPES OF SOLAR PLANTS.

“ SOLAR PANEL INSTALLATION WORK IS DEFINED AS THE WORK TO SETUP, FIXING(FITTING) SOLAR PANELS AS PER SOLAR PALNT DESIGN WITH STRUCTURE FITTING AND SOLAR PANEL’S INTERNAL CONNECTIONS.”

- AFTER COMPLETION OF STRUCURE MOUNTING WORK- SOLAR APNELS ARE FITTED WITH PURLIN OF STRUCTURE BY S.S.(STAIN LESS STEEL HARD WARES- BOLT, NUT, WASHER, SCREW) AS PER DRAWING- SOME PLACE IT IS ONLY ONE PART OF STRUCTURE OR MORE THAN ONE PART.

- SOLAR PANEL INTERNAL CONNECTION IS WORK OF ELECTRICAL CONNECTION OF INSTALLED (FITTED) EACH AND ALL PANELS. FOR HOUSE HOLD (DOMESTIC) TYPE SOLAR PLANTS ARE SMALL POWER (KW) CAPACITY TYPES

- SO ALL THE SOLAR PANELS ARE NEEDS TO CONNECT IN SERIES TYPE ELECTRICAL CONNECTION.

## (15). INSTALLATION OF SOLAR ROOF TOP PLANT :

- STRUCTURE INSTALLATION ( BASE PLATE, LEG, RAFTER, PURLIN, SUPPORT FITTING WORK)



## (15). INSTALLATION OF SOLAR ROOF TOP PLANT :

### - SOLAR PANEL INSTALLATION AND INTERNAL WIRING WORK





# THEORY LESSON : 16



## (16). TYPES OF SOLAR PLANT , PLANT CAPACITY DESIGN WORK :

### > MAIN TYPES OF SOLAR PLANT.

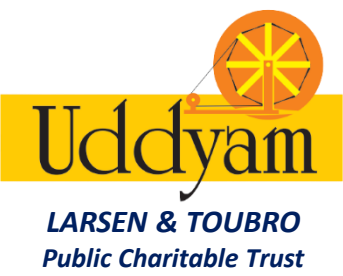
- (1). ON GRID SYSTEM
- (2). OFF GRID SYSTEM
- (3). HYBRID SYSTEM

**(1). ON GRID SYSTEM** : ON GRID SYSTEM OF SOLAR PLANT IS CONNECTED WITH GRID(G.E.B- ELECTRICITY BOARD). ON GRID SOLAR INVERTER IS USED FOR ON GRID SYSTEM. ON GRID SOLAR INVERTER TAKES REFERENCE OF GRID (G.E.B) SUPPLY VOLTAGE, FREQUENCY. ON GRID SOLAR INVERTER-SYNCHRONIZE WITH GRID (G.E.B) POWER SUPPLY. ON GRID SYSTEM IS MOST PREFERABLE SYSTEM.

AS WE (CUSTOMER)CAN USE SOLAR PLANT'S POWER DURING DAY TIME AND CAN USE GRID(G.E.B)POWER SUPPLY DURING NIGHT( WHEN SOLAR PLANT CAN'T GENERATE POWER).



# THEORY LESSON : 16



## **(16). TYPES OF SOLAR PLANT , PLANT CAPACITY DESIGN WORK :**

### **(1). ON GRID SYSTEM :**

#### **> ADVANTAGES OF ON GRID SYSTEM:**

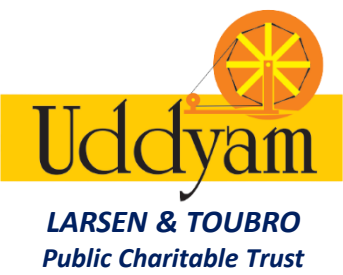
- WE (CUSTOMER) CAN USE GRID(G.E.B) POWER , WHEN EVER REQUIRED.
- EXCESS POWER CAN EXPORT TO GRID(G.E.B) AND CAN IMPORT POWER FROM GRID(G.E.B).
- ON GRID SYSTEM IS CHEAPER THAN OTHER SYSTEM.
- ON GRID SYSTEM'S ROUTINE & BREAKDOWN MAINTENANCE IS VERY LESS.

### **(2). OFF GRID SYSTEM :** OFF GRID SYSTEM TYPE SOLAR PLANT IS NOT CONNECTED WITH THE GRID (G.E.B ) POWER. IT IS STND ALONE SYTEM. OFF GRID TYPE SYSTEM IS ALSO OF TWO(2) TYPES.:

(1). D.C. OFF GRID SYSTEM (2). A.C. OFF GRID SYTEM:



# THEORY LESSON : 16



## (16). TYPES OF SOLAR PLANT , PLANT CAPACITY DESIGN WORK :

(1). D.C. OFF GRID SYSTEM : D.C. OFF GRID SYSTEM FUNCTION IS TO GENERATE & UTILIZE D.C. POWER SUPPLY . D.C. ELECTRICAL POWER SUPPLY GENERATED BY SOLAR PANELS IS CONNECTED CHARGE CONTROLLER OF THE SOLAR INVERTER,CHARGE CONTROLLER IS USED TO CONTROL D.C. POWER SUPPLY- CHARGE CONTROLLER IS WORKING WITH TWO FUNCTION , 1- TO CHARGE THE CONNECTED BATTERIES 2- AFTER CHARGING THE BATTERIES SUPPLIES D.C ELECTRICAL POWER TO THE CHARGE CONTROLLER FOR RUN/USE THE LOAD.

- AS THE FUNCTION OF D.C.OFF GRID SYSTEM IS FIRST- SUPPLY THE D.C. POWER SUPPLY TO RUN THE LOAD AND THEN AFTER POWER CONSUMPTION REMAINING POWER IS GOES TO CHARGE THE BATTERIES THROUGH CHARGE CONTROLLER. THE STORED BATTERY POWER CAN BE USED AFTER EVENING TIME, WHEN SOLAR PANEL CAN'T GENERATE POWER.

### > ADVANTAGES OF OFF GRID SYSTEM:

- FOR OFF GRID TYPE SOLAR PLANT SYTEM- G.E.D.A ( GUJARAT ENERGY DEVELOPMENT AGENCY) APPROVAL IS NOT REQUIRED.





# THEORY LESSON : 16



## (16). TYPES OF SOLAR PLANT , PLANT CAPACITY DESIGN WORK :

### (2). OFF GRID SYSTEM:

(2). A.C. OFF GRID SYTEM : A.C. OFF GRID SYSTEM FUNCTION : D.C. ELECTRICAL POWER GENERATED BY THE SOLAR PANEL IS CONNECTED WITH CHARGE CONTROLLER AND IT IS CONNECTED WITH BATTERIES ( BATTERY CHARGING- POWER BACK UP) , THEN D.C.POWER IS CONNECTED TO THE SOLAR INVERTER –WHICH CONVERT D.C. POWER TO A.C. POWER. WHICH IS USE TO RUN THE LOAD (CONNECTED TO THE LOAD).

- AS THE FUNCTION OF A.C.OFF GRID SY STEM IS FIRST- SUPPLY THE A.C. POWER TO RUN THE LOAD AND THEN AFTER POWER CONSUMPTION REMAINING POWER IS GOES TO CHARGE THE BATTERIES (BATTERY BANK) THROUGH CHARGE CONTROLLER. THE STORED BATTERY POWER CAN BE USED AFTER EVENING TIME, WHEN SOLAR PANEL CAN'T GENERATE POWER.





# THEORY LESSON : 17

## **(17). PANEL INSTALLATION AND INTERNAL CONNECTION WORK :**

### **(1). SOLAR PANEL INSTALLATION WORK:**

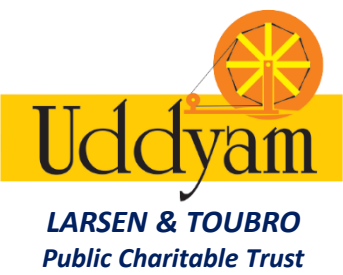
- SOLAR PANEL INSTALLATION AND IT'S INTERNAL ELECTRICAL CONNECTION IS A PART OF SOLAR PLANT INSTALLATION WORK.
- AFTER COMPLETION OF STRUCTURE MOUNTING WORK- SOLAR APNELS ARE FITTED WITH PURLIN OF STRUCTURE BY S.S.(STAIN LESS STEEL HARD WARES- BOLT, NUT, WASHER, SCREW) AS PER DRAWING- SOME PLACE IT IS ONLY ONE PART OF STRUCTURE OR MORE THAN ONE PART.
- TOTAL NOS.OF PANELS USED FOR SOLAR PLANT IS DECIDE BY DESIGN OF SOLAR PLANT.

### **(2). SOLAR PANEL INTERNAL CONNECTION WORK:**

- SOLAR PANEL INTERNAL CONNECTION IS WORK OF ELECTRICAL CONNECTION OF INSTALLED (FITTED) EACH AND ALL PANELS.
- FOR HOUSE HOLD (DOMESTIC) TYPE SOLAR PLANTS ARE SMALL POWER (KW) CAPACITY TYPES SO ALL THE SOLAR PANELS ARE NEEDS TO CONNECT IN SERIES TYPE ELECTRICAL CONNECTION.



# THEORY LESSON : 17



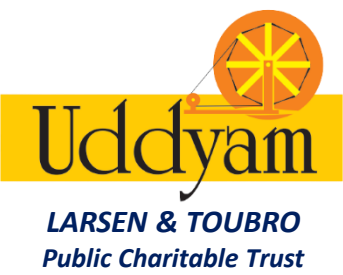
## **(17). PANEL INSTALLATION AND INTERNAL CONNECTION WORK :**

### **(2). SOLAR PANEL INTERNAL CONNECTION WORK:**

- SOLAR PANELS SERIES CONNECTION IS THE PROCESS – FIRST SOLAR PANELS POSITIVE WIRE IS CONNECTED WITH (NEXT)SECOND PANELS NEGATIVE WIRE WITH MC4 TYPE CONNECTOR. MC4 CONNECTORS ARE MALE AND FEMALE TYPE. THIS WAY ALL SOLAR PANELS ARE CONNECTED ELECTRICALLY AND AT LAST ONE POSITIVE & ONE NEGATIVE WIRE WHICH IS OUT PUT OF SOLAR PANEL'S (PLANTS) GENERATED D.C. ELECTRICAL POWER AND THIS IS CONNECTED NEXT WITH D.C. BOX( D.C.DISTRIBUTION BOARD(BOX)).PANELS INTERNAL CONNECTION IS ELECTRICAL WORK



# THEORY LESSON : 18



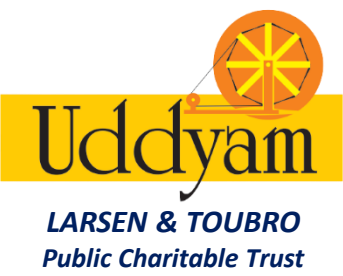
## **(18). STUDY OF MARKING AND STRUCTURE MOUNTING WORK :**

### **(1). MARKING WORK:**

- FOR INSTALLATION OF SOLAR PLANT LAYOUT DRAWING, STRUCTURE DRAWING IS IMPORTANT. THERE ARE DIMENSION AND MEASUREMENT ARE GIVEN. ALL DISTANCE, GAP AND POSITION OF FOUNDATION ALSO MENTIONED WITH STRUCTURE DRAWING. FIRST (1<sup>st</sup>) DRAWING IS USED FOR MARKING OF FOUNDATION AND GAP, SPACE . SECOND (2<sup>nd</sup>) DRAWING IS USED FOR STRUCTURE PARTS DIMENSION AND POSITIONING OF STRUCTURE PARTS.
- MARKING WORK IS THE BASIC PREPARATION FOR STRUCTURE INSTALLATION.
- MARKING WORK IS VERY FIRST WORK FOR THE INSTALLATION OF SOLAR PLANT,
- MARKING WORK IS TO BE PERFORMED AT THE PLACE(FLOOR- TERRACE) , WITH THE HELP OF DRAWING, MEASURING TOOLS ( MEASURE TAPES ETC.) , MARKING TOOLS.



# THEORY LESSON : 18



## **(18). STUDY OF MARKING AND STRUCTURE MOUNTING WORK :**

### **(2). STRUCTURE MOUNTING WORK:**

- STRUCTURE MOUNTING WORK IS DEFINED AS THE WORK TO INSTALL (FITTING) SOLAR PLANT'S STRUCTURE PARTS( BASE PLATE,LEG,RAFTER,PURLIN ,SUPPORTS, CLAMPS) BY USING S.S.( STAIN-LESS STEEL TYPE HARDWARES( BOLT, NUT, SCREW ,WASHERS), AS PER STRUCTURE DRAWING .
- STRUCTURE IS A STRONG & RIGID DESIGNED SUPPORT FOR SOLAR PANEL INSTALLATION.
- ALL STRUCTURE PARTS SHOULD BE FITTED ALIGNED, LEVELED BY USE OF SPIRIT LEVEL.  
ALL STRUCTURE PARTS MUST BE G.I.(GALVANISED IORN)COATING TYPE AND HARDWARE MUST BE S.S.( STAINLESS STEEL) TYPE AS PER G.E.D.A.(GUJARAT ENERGY DEVELOPMENT AGENCY).

## (19). ELECTRICAL EQUIPMENTS AND COMPONENTS USED FOR SOLAR PLANT :

- AS SOLAR PLANT IS GENERATING AN ELECTRICAL POWER, SO THERE ARE FOLLOWING TYPES OF ELECTRICAL EQUIPMENTS, COMPONENTS AND ACCESSORIES ARE USED.

### > FOLLOWING EQUIPMENTS ARE USED FOR SOLAR PLANT :

- (1). **SOLAR PANELS** ( SOLAR PANEL MODULES( POLY CRYSTALLINE/ MONO CRYSTALLINE TYPE)
- (2). **D.C. BOX / D.C. D.B.** ( D.C. DISTRIBUTION BOX (BOARD)).
- (3). **SOLAR INVERTER** ( ON GRID / OFF GRID TYPE).
- (4). **A.C. BOX / A.C. D.B.** ( A.C. DISTRIBUTION BOX (BOARD)).
- (5). **ENERGY METER** (SOLAR METER, BI- DIRECTIONAL METER).
- (6). **EARTHING SYSTEM** (EARTH ELECTRODES AND LIGHTENING ARRESTER).



# THEORY LESSON : 19

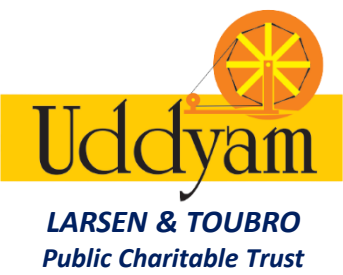
## (19). ELECTRICAL EQUIPMENTS AND COMPONENTS USED FOR SOLAR PLANT :

> FOLLOWING COMPONENTS AND ACCESSORIES ARE USED FOR SOLAR PLANT :

- (1). **MC4 CONNECTORS** (MC4 TYPE MALE AND FFEMALE CONNECTORS).
- (2). **ISOLATOR SWITCHES** (POWER ON/OFF SWITCHES).
- (3). **CIRCUIT BREAKERS** (MCCB & MCB).
- (4). **PROTECTION FUSE** (D.C. FUSES).
- (5). **SPD** (SURGE PROTECTION DEVICE).
- (6). **A.C. AND D.C. CABLES** (A.C. & D.C. CABLES AND WIRES).
- (7). **CONDUITS** (HDPE PIPES FOR CABLE).



# THEORY LESSON : 20



## (20). WIRING OF D.C. AND A.C. CABLE , CONDUITING AND CABLE LAYING :

- WIRING IS ALSO VERY IMPORTANT WORK FOR SOLAR PLANT INSTALLATION AND COMMISSIONING.
- AS SOLAR PLANT IS GENERATING D.C. ELECTRICAL POWER , D.C. WIRING IS THERE.
- FROM SOLAR PANEL- D.C.BOX(D.C. D.B) TO INVERTER ( **D.C. WIRING**).
- FROM SOLAR INVERTER- A.C.BOX(A.C. D.B) TO ENERGY METER ( **A.C. WIRING**).

### > PART –(1) D.C. WIRING ( SOLAR PANEL , D.C. BOX TO SOLAR INVERTER).

- FROM SOLAR PANELS TO D.C .BOX(D.C.D.B), D.C. WIRES OR D.C. CABLES ARE CONNECTED TO SUPPLY D.C. ELECTRICAL POWER TO SOLAR INVERTER.
- D.C. WIRES/CABLES ARE MADE FROM SPECIAL INSULATING MATERIAL AND IT IS UV (ULTRA VIOLET) PROTECTED TYPE.
- ALL D.C. WIRES/CABLES ARE LAID UNDER P.V.C/ HDPE CONDUITS.



# THEORY LESSON : 20



## (20). WIRING OF D.C. AND A.C. CABLE , CONDUITING AND CABLE LAYING :

### > PART –(2) A.C. WIRING (SOLAR INVERTER- A.C.BOX TO ENERGY METER).

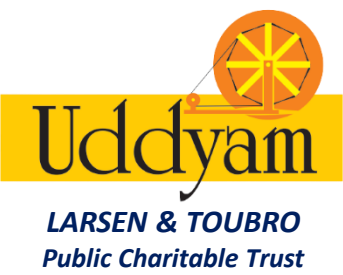
- FROM SOLAR INVERTER TO A.C .BOX(A.C.D.B), A.C.WIRES OR A.C. CABLES ARE CONNECTED TO SUPPLY A.C. ELECTRICAL POWER TO ENERGY METER (SOLAR METER & BI- DIRECTIONAL METER).

- FLEXIBLE COPPER WIRES/CABLES AND ARMoured COPPER CABLES ARE USED TO SUPPLY A.C. POWER FROM SOLAR INVERTER TO ENERGY METER. - ALL A.C. WIRES/CABLES ARE LAID UNDER HDPE CONDUITS AND IF REQUIRED A.C. ARMoured CABLE LAID UNDERGROUND.





# THEORY LESSON : 21



## (21). GROUNDING SYSTEM (EARTHING) FOR SOLAR PLANT:

- EARTHING IS VERY ESSENTIAL AND IMPORTANT FOR SOLAR PLANT .
- **EARTHING** :THE PROCESS OF TRANSFERRING THE IMMEDIATE DISCHARGE OF THE LEAKGE CURRENT FROM THE ELECTRICAL EQUIPMENT, SYSTEM,WIRING TO THE EARTH BY LOW RESISTANCE WIRE.
- MAIN FUNCTION OF EARTHING IS TO PROTECT ELECTRICAL EQUIPMENT-MACHINE-SYSTEM ,WIRING AND HUMAN BEING FROM LEAKAGE CURRENT PRODUCED DUE TO ANY ELECTRICAL FAULT.
- ELECTRICAL POWER IS GENERATED AND ELECTRICAL EQUIPMENTS ARE CONNECTED BY ELECTRICAL WIRING WITH SOLAR PLANT, SO EARTHING SYSTEM IS REQUIRED COMPULSARY FOR ELECTRICAL SAFETY AGAINST ANY FAULT CONDITION AND LEAKAGE CURRENT.
- EARTHING SYSTEM AND LIGHTENING ARRESTER IS REQUIRED COMPULSARY FOR SOLAR PLANT APROVAL FROM GOVERNMENT AUTHORITY (G.E.D.A.- GUJARAT ENERGY DEVELOPMENT AGENCY).



# THEORY LESSON : 21

## **(21). GROUNDING SYSTEM (EARTHING) FOR SOLAR PLANT:**

### **> FOLLOWING THREE EARTHINGS REQUIRED FOR SOLAR PLANT :**

- (1). SOLAR INVERTER EARTHING:** FOR PROTECTION OF INVETER SYSTEM AND POWER .
- (2). SOLAR PANEL EARTHING :** FOR PROTECTION OF SOLAR PANEL AND ITS INTERNAL WIRING.
- (3). STRUCTURE EARTHING :** FOR PROTECTION OF D.C. POWER LEAKAGE CURRRENT.

- **(A). LIGHTENING ARRESTER:** FOR PROTECTION OF WHOLE SOLAR PLANT AGAINST NATURAL LIGHTENING OF MONSOON (RAINY) SEASON.
- COPPER CONDUCTOR STRIP, WIRE USED FOR EARTHING.
- GREEN COLOUR WIRE IS USED FOR EARTHING WIRING OF ELECTRICAL EQUIPMENTS-SYSTEM.



# THEORY LESSON : 22

## (22). INSTALLATION OF ENERGY METERS (SOLAR METER , NET METER) :

- **FUNCTION OF ENERGY METER:** ELECTRICAL ENERGY METER IS USED TO MEASURE ,CALCULATE AND DISPLAY GENERATED AND CONSUMED ELECTRICAL POWER(P) -(KWHR) / UNIT.
- SOLAR PLANT IS GENERATING ELECTRICAL POWER SO, ENERGY METER MEASURE THE GENERATING POWER OF THE SOLAR PLANT.

### - TYPES OF ENERGY METER FOR SOLAR PLANT :

- (1). SOLAR METER
- (2). NET METER / BI-DIRECTIONAL METER

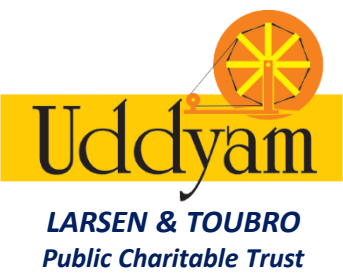
(1). **SOLAR METER :** SOLAR METER IS USE FOR ALL THREE(3) TYPES OF SOLAR PLANTS TO MEASURE AND DISPLAY GENERATED ELECTRICAL POWER (KWHR) OF THE SOLAR PLANT.

(2). **NET METER / BI-DIRECTIONAL METER :** NET METER / BI- DIRECTIONAL METER IS MOSTLY USED FOR ON-GRID TYPE SOLAR PLANT, THIS METER IS CALCULATE THE CONSUMPTION OF ELECTRICAL POWER BY THE CONSUMER.





# THEORY LESSON : 22



## (22). INSTALLATION OF ENERGY METERS (SOLAR METER , NET METER) :

### (2). NET METER / BI-DIRECTIONAL METER :

- ALSO MAIN FUNCTION OF THE METER IS TO CALCULATE ,MEASURE AND DISPLAY THE IMPORT POWER AND EXPORT POWER.
- > **IMPORT POWER** : THE POWER USE BY CONSUMER FROM GRID (G.E.B). IMPORT POWER IS DEFINE AS THE CONSUMER USE THE POWER-WHEN SOLAR PLANT IS NOT GENERATE THE POWER AT EVENING & NIGHT OR CONSUMER NEEDS MORE POWER THAN SOLAR PLANTS GENERATION.
- > **EXPORT POWER** : EXPORT POWER IS THAT REMAINING EXTRA POWER AFTER CONSUMPTION OF CONSUMER , WHICH POWER GOES(FEED) TO GRID (G.E.B).
- NET METER/ BI- DIRECTIONAL METER IS GIVEN EXACT NET VALUES OF IMPORT & EXPORT POWER. THIS METER IS WORKING FOR BI -(2) DIRECTIONS OF POWER ( IMPORT & EXPORT) SO IT IS CALLED BI-DIRECTIONAL METER.



# THEORY LESSON : 22

## (22). INSTALLATION OF ENERGY METERS (SOLAR METER , NET METER) :

### ➤ INSTALLATION OF ENERGY METER:

- ELECTRICAL ENERGY METER IS USED TO MEASURE ,CALCULATE AND DISPLAY GENERATED AND CONSUMED ELECTRICAL POWER(P) -(KWHR) / UNIT.
- ENERGY METERS ARE CONNECTED AT THE END PART OF THE SOLAR PLANT. SOLAR PLANTS A.C. OUT PUT POWER IS GOES FOR USE TO RUN THE LOAD .
- FOR SOLAR PLANT TWO TYPES OF ENERGY METERS ARE INSTALLED.
  - (1). SOLAR METER.
  - (2). NET METER (BI- DIRECCIONAL METER)
- SINGLE PHASE AND THREE PHASE TYPE ENERGY METERS ARE USED AS PER REQUIREMENT AND AS PER THE POWER CAPACITY OF SOLAR PLANT AND CONSUMER LOAD.
- **TERMS AND CONDITION** : AS PER TERMS AND CONDITION OF GRID(G.E.B) AND G.E.D.A ( GUJARAT ENERGY DEVELOPMENT AGENCY). THE ELECTRICAL ENERGY METERS ARE INSTALLED(FITTED) BY GRID(G.E.B)-ELECTRICAL AUTHORITY. ENERGY METERS ARE TESTED & PROVIDED BY GRID(G.E.B).
- ENERGY METERS ARE THE PROPERTY OF GRID (G.E.B) / D.G.V.C.L
- CONSUMERS ELECTRICITY BILL IS CALCULATED AS PER EXPORT AND IMPORT KWHR(UNIT) FROM NET METER ( BI- DIRECTIONAL METER) BY GRID (G.E.B) / D.G.V.C.L





# THEORY LESSON : 23

## (23). COMMISSIONING OF SOLAR PLANT :

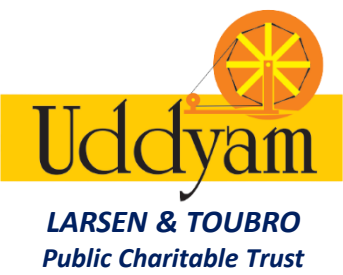
- > **COMMISSIONING WORK:** COMMISSIONING WORK FOR SOLAR PLANT IS IMPORTANT WORK, COMMISSIONING WORK TO BE START AFTER COMPLETION OF ALL INSTALLATION WORK AND BEFORE OPERATION OF SOLAR PLANT.

“THE WORK OF TESTING, CHECKING, FUNCTION CHECKING FOR STRUCTURE, ALL ELECTRICAL EQUIPMENTS (SOLAR PANELS, D.C. BOX, SOLAR INVERTER, A.C. BOX, POWER CONTROL DEVICES, ENERGY METERS), D.C. WIRING, A.C. WIRING, POWER CONTROL ACCESSORIES ( MCB, MCCB, FUSE, ISOLATOR SWITCHES, FUSES) WIRING CONNECTIONS, EARTHING SYSTEM, LIGHTENING ARRESTER AS PER TECHNICAL STANDARD IS DEFINED AS COMMISSIONING WORK.”

- COMMISSIONING WORK IS TO CHECK ALL MECHANICAL AND ELECTRICAL PARTS OF THE SOLAR PLANT BY VARIOUS MEASURING AND FITTING TOOLS .
- COMMISSIONING WORK TO BE PERFORM AS PER STANDARD CHECK LIST.
- MECHANICAL STRUCTURE PARTS CHECKED BY STRUCTURE DRAWING .



# THEORY LESSON : 23



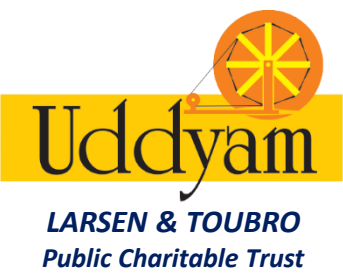
## **(23). COMMISSIONING OF SOLAR PLANT :**

### **> COMMISSIONING WORK:**

- ELECTRICAL EQUIPMENTS , WIRING CHECKED AS PER SPECIFICATIONS, PLANT DESIGN AND ELECTRICAL DRAWING. ALL ELECTRICAL TERMINAL-CONNECTION TO BE CHECK.
- CHECK D.C. VOLTAGE OF EACH SOLAR PANELS AND ALSO CHECK STRING VOLTAGE AND SOLAR PLANT'S OUT PUT VOLTAGE.
- EARTHING SYSTEM CHECKING: TOTAL THREE(3) EARTHINGS AND LIGHTENING ARRESTER REQUIRED.
- AFTER SUCCESSFUL COMPLETION WORK OF COMMISSIONING WORK, COMMISSIONING REPORT REQUIRED TO PREPARE.
- AFTER COMMISSIONING WORK SOLAR PLANT IS READY FOR OPERATION (FUNCTION).



# THEORY LESSON : 24



## (24). MAINTENANCE OF SOLAR PLANT :

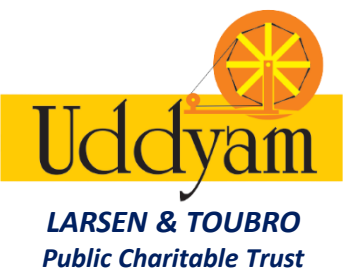
- **MAINTENANCE** : “ MAINTENANCE IS THE PROCESS BY WHICH ANY EQUIPMENT, MACHINE, SYSTEM CAN BE MAINTAIN IN PROPER AND EFFICIENT CONDITION.”
- MAINTENANCE WORK HAVE THE THREE PARTS: ROUTINE MAINTENANCE, PREVENTIVE MAINTENANCE, BREAKDOWN MAINTENANCE.
- **MAINTENANCE WORK OF SOLAR PLANT** : FOR ALL TYPES OF SOLAR PLANT, ROUTINE MAINTENANCE IS TO CLEANING OF SOLAR PANELS WEEKLY. AS DUST AND DIRT ON SOLAR PANELS NEEDS TO CLEAN AS THE DIRT LAYER IS REDUCE THE INTENSITY OF SUN LIGHT TO THE PANEL, HENCE POWER GENERATION CAN BE AFFECT.
- MAINLY CLEANING OF SOLAR PANEL EVERY WEEK IS IMPORTANT ROUTINE MAINTENANCE WORK.
- IT IS ALSO ADVIISABLE TO NOTE READINGS OF POWER KWHR/UNIT BY SOLAR ENERGY METER DAILY ONCE FOR TESTING OF PERFORMANCE AND EFFICIENCY OF SOLAR PLANT.
- ALSO CHECK EARTH PIT OF EARTHING EVERY MONTH. (MAINTAIN MOISTURE ).







# THEORY LESSON : 24



## **(24). MAINTENANCE OF SOLAR PLANT :**

- FOR PREVENTIVE MAINTENANCE : EVERY SIX MONTH- ALL ELECTRICAL EQUIPMENTS TO BE CLEAN AND CHECK THE ELECTRICAL CONNECTIONS & RE- TIGHT IT.
- FINALLY BREAKDOWN MAINTENANCE IS VERY LESS FOR THE SOLAR PLANT.
- FOR SOLAR PLANT, OVER ALL MAINTENANCE AND COST OF MAINTENANCE IS VERY LESS. IT IS A BIG ADVANTAGE FOR SOLAR PLANT.



# SOLAR PANEL TECHNICIAN- WORK TYPE



SOLAR PLANT INSTALLATION

SITE SURVEY & LOAD ASSESSMENT

G.E.D.A. APPROVAL

PLANT DESIGN

MATERIAL ORDER

LAYOUT WORK

MARKING & FOUNDATION

STRUCTURE INSTALLATION

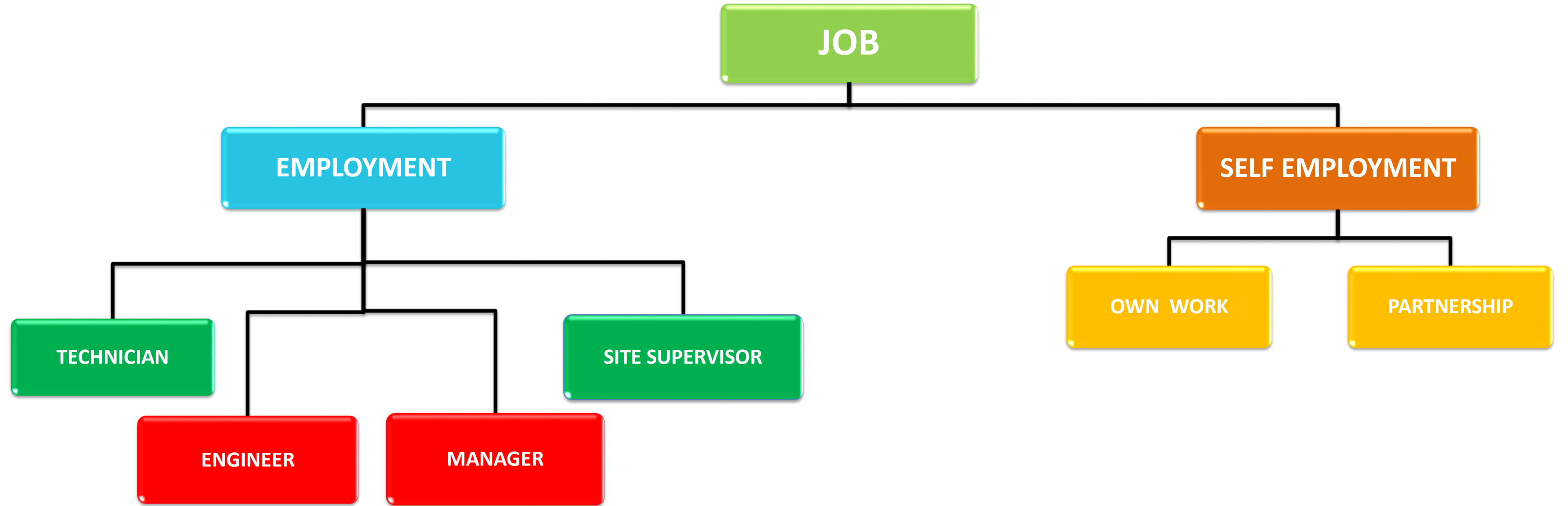
PANEL FITTING & WIRING

EARTHING & PLANT TESTING





# JOB OPPORTUNITY- SOLAR PANEL TECHNICIAN





# ANIL NAIK TECHNICAL TRAINING CENTER-KHAREL



# THANK YOU

