CHRIST
COLLEGE (AUTONOMOUS)
IRINJALAKUDA, KERALA
Reaccredited by NAAC with 'A++' grade

# CERTIFICATE COURSE ON
# SOLAR PHOTOVOLTAIC TECHNOLOGY BASICS

**Department : Physics**

**Name of course: solar PV technology basics**

**Syllabus hrs: 32 hrs**

**Course outcomes:**

- **Understand different energy sources, renewable energy sources.**
- **Learn fundamentals of photovoltaics**
- **Learn different solar cell technologies**
- **Learn different fabrication technologies of solar cells.**

**Course Coordinator**
**Dr.Edwin Jose**
**Assistant Professor**
**Dept. of Physics**

**Fr.Jolly Andrews CMI**
**Principal**
**Christ College (Autonomous), irinjalakuda**

# SOLAR PHOTOVOLTAIC TECHNOLOGY BASICS

## Value Added Certificate Course

## Assessment Procedure

**Solar photovoltaic (PV) technology** is crucial in the global transition toward sustainable energy due to its ability to harness the sun's abundant and renewable energy. As concerns about climate change and the depletion of fossil fuels grow, solar PV offers a clean, carbon-free alternative that can significantly reduce greenhouse gas emissions. It provides a reliable source of electricity for homes, businesses, and industries, helping to decrease dependence on non-renewable energy sources and increase energy security. Moreover, solar PV systems are scalable, ranging from small rooftop installations to large utility-scale power plants, making them adaptable to a wide variety of needs. With technological advancements driving down costs and improving efficiency, solar PV is becoming an increasingly accessible and economically viable solution for addressing the world's energy demands while protecting the environment for future generations. This course offers the student to gain skill and moral ability that foster them into the world of renovation and helps to actively take research in future in this area. After introducing about the importance of renewable energy the course opens to the manufacturing and characteristics of solar cells and also to the experimental techniques which can be used by them in the future.

The department conducted an exam which is for 25 marks consisting of 20 MCQ questions and an essay question. Students scoring above 9 marks is considered to pass the course.

**Sample Questions**

1. **What is the primary function of a solar photovoltaic (PV) system?**

a) To convert electrical energy into mechanical energy
b) To store electrical energy
c) To convert sunlight into electrical energy
d) To generate heat from sunlight
Answer: c) To convert sunlight into electrical energy

2. **Which of the following is a disadvantage of polycrystalline silicon solar cells?**

a) Higher efficiency
b) More expensive than monocrystalline cells
c) Lower efficiency
d) Long lifespan
**Answer**: c) Lower efficiency

### 3. What does a solar inverter do in a solar PV system?

a) Converts AC to DC
b) Converts DC to AC
c) Stores electricity in batteries
d) Regulates the temperature of solar panels

**Answer**: b) Converts DC to AC

### 4. What is the average efficiency range of monocrystalline silicon solar cells?

a) 5%–10%
b) 10%–15%
c) 15%–20%
d) 18%–22%

**Answer**: d) 18%–22%

# SOLAR PHOTOVOLTAIC TECHNOLOGY BASICS - CPCC67

# Value Added Certificate Course

### Teacher Coordinator Report 2023-24

| | |
|---|---|
| Number of students | 41 |
| Date of examination | DECEMBER ,18, 2023 |
| Total students who passed exam | 41 |
| Total course duration | 32 Hrs. |

## Feedback analysis:

- Students appreciated the online training session to study the basic working of a solar cell
- Students appreciated the advantage of future research scopes in the production of thin film solar cells
- The students enjoyed interactive activities and group discussions
- Students demanded more such courses to develop their practical skills

**Course In-charge : Afsana P.S & Stiji jose T ,Dept. of Physics**

**Course Coordinators: Dr. Edwin Jose, Dept. of Physics**

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DEPARTMENT OF PHYSICS
CERTIFICATE COURSE EXAMINATION
SOLAR PHOTOVOLTAIC TECHNOLOGY

**Time- 30 min** **Mar ks- 25**

1. **What is a common environmental benefit of using renewable energy sources?**
   They reduce carbon emissions
   B) They require large amounts of fossil fuels
   C) They produce radioactive waste
   D) They deplete natural resources quickly

2. **In a semiconductor, what happens when energy (such as heat or light) is applied?**

   A) Electrons are excited from the valence band to the conduction band
   B) The material becomes an insulator
   C) The material becomes a superconductor
   D) The electron configuration of the atom remains unchanged

3. **A major challenge of solar energy is:**

A) High costs of photovoltaic panels
B) Lack of available sunlight
C) Inefficient conversion to electricity
D) Low energy density compared to fossil fuels

4. **Which of the following best describes the concept of "net metering" in the context of solar energy?**

A) A system to store excess energy from solar panels in batteries
B) A method to balance the electrical grid by using solar energy
C) A system that allows solar panel owners to sell excess energy back to the grid
D) A technology that makes solar panels more efficient

5. **What is one of the biggest challenges to widespread adoption of renewable energy technologies?**
   Lack of renewable resources
   B) High installation costs and long payback periods
   C) Overabundance of fossil fuels
   D) Immediate availability of energy storage solutions

6. **What happens at the junction between P-type and N-type semiconductors?**

   A) A depletion region forms
   B) A magnetic field is generated

C) The material becomes a superconductor
D) A large current flows freely

7. **What is the main characteristic of a semiconductor?**
   It is a good conductor of electricity at all temperatures
   B) It is a poor conductor of electricity at all temperatures
   C) Its conductivity lies between that of conductors and insulators
   D) It only conducts electricity when it is cold
8. **Which of the following is the purpose of doping in semiconductors?**

A) To increase the resistivity of the semiconductor
B) To increase the number of free charge carriers
C) To make the material completely conductive
D) To make the semiconductor material non-conductive

9. **The most commonly used material in the production of solar cells is:**

A) Copper
B) Silicon
C) Lead
D) Gold

10. **What type of semiconductor device is used to regulate voltage in power supplies?**

A) Photovoltaic cell
B) Diode
C) Zener diode
D) Transformer

11. **In a typical solar cell, the layer responsible for generating electric current is called the:**

A) Conductor
B) P-N junction
C) Electrode
D) Cathode

12. **The efficiency of a solar cell depends on:**
    A).The amount of sunlight it receives
    B) The temperature of the surrounding environment
    C) The material used and the structure of the cell
    D) All of the above

13. **Which of these solar cell technologies has the lowest efficiency but is cheaper to manufacture?**

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A) Monocrystalline silicon cells
B) Polycrystalline silicon cells
C) Thin-film solar cells
D) Gallium arsenide solar cells

14. **What is the main advantage of using solar energy over fossil fuels?**

A) Solar energy is more efficient
B) Solar energy does not emit harmful greenhouse gases
C) Solar energy is less expensive to produce
D) Solar energy can be stored easily

15. **What is the primary purpose of connecting a solar power system to the grid?**

A) To store energy in batteries
B) To sell excess power to the grid and reduce electricity bills
C) To increase the voltage of the solar system
D) To ensure the solar system works during cloudy weather

16. **Which of the following components in a vacuum cleaner creates suction?**

A) Filter
B) Motor
C) Hose
D) Dustbin

17. **What is the device used to synchronize the electricity generated by solar panels with the grid?**

A) Solar inverter
B) Solar battery
C) Grid-tied meter
D) Solar controller

18. **What type of vacuum cleaner would you most likely use for cleaning high places like curtains or ceiling fans?**

A).Stick vacuum cleaner
B) Handheld vacuum cleaner
C) Upright vacuum cleaner
D) Canister vacuum cleaner

19. **What is the main benefit of using a cordless vacuum cleaner?**
It offers higher suction power than corded models
B) It is more eco-friendly
C) It provides greater mobility and convenience due to the lack of a power cord
D) It is more powerful and long-lasting

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20. **In the photovoltaic effect, when photons hit a semiconductor, they:**

    A) Increase the temperature of the material
    B) Cause electrons to jump from the valence band to the conduction band
    C) Cause the material to glow
    D) Change the color of the material

21. Draw the V-I graph of Solar cell and write the terms involved in the characteristic study of a solar cell

    **OR**

22. Write the steps in manufacture of solar cells (5 marks)

# SOLAR PHOTOVOLTAIC TECHNOLOGY BASICS

## Value Added Certificate Course

## Summary Report 2024

The course started on July , 2024. There were 41 students and 41 students completed the course. The course was 32 hrs duration. Students actively participated and recommended for more courses like this.

**Course outcomes:**

- **Understand different energy sources, renewable energy sources.**
- **Learn fundamentals of photovoltaics**
- **Learn different solar cell technologies**
- **Learn different fabrication technologies of solar cells.**

Course In-Charges – Ms. Afsana P.S & Ms. Stiji Jose

Course Coordinator: Dr. Edwin Jose , Dept. of Physics

Department Head- Prof. Sudheer Sebastin

## Department: Physics (Aided)

## Name of Value added course: Solar Photovoltaic Technology Basics

## Syllabus hours: 32 Hours

## Course outcomes:

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## Syllabus:

**Unit 1: Introduction to Solar Energy (6 hrs)**

Energy- Energy consumption- Renewable energy sources-Status and prospects of solar energy- Properties of Sunlight- Basics of Light- Terrestrial Solar Radiation- Solar Photovoltaics

**Unit 2: Photovoltaic fundamentals (14 hrs)**

Semiconductors- Basics- Bandgap- Absorption of Light- Generation of carriers- p-n junctions- Ideal solar cells- Solar cell parameters- Characterisation of solar cells

**Unit 3: Different solar cell technologies (6 hrs)**

History of solar cells- Silicon solar cells- Thin film solar cells- Polymer solar cells- Recent technologies

**Unit 4: Fabrication technologies (6 hrs)**

Clean room- Vacuum production- Vacuum pumps- Crystalline Si Cell Technologies- Thin Film Technologies

**Textbooks**

Photovoltaics: Devices, Systems and Applications; Honsberg, C., and S. Bowden http://www.pveducation.org/pvcdrom/

Solar Energy Fundamentals, Technology, and Systems; Klaus Jäger, Olindo Isabella, Arno H.M. Smets, René A.C.M.M. van Swaaij, Miro Zeman, Delft University of Technology, 2014 https://courses.edx.org/c4x/DelftX/ET.3034TU/asset/solar_energy_v1.1.pdf

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# CERTIFICATE OF COMPLETION

**This is to certify that .....has successfully completed certificate course in SOLAR VOLTAICS TECHNOLOGY AND BASICS, by Department of Physics, Christ College (Autonomous), Irinjalakuda.**

**Course coordinator** **Principal** **HOD**