

**APPLICATION OF GREEN ENERGY
(ECEN 4249)**

Time Allotted : 2½ hrs

Full Marks : 60

Figures out of the right margin indicate full marks.

*Candidates are required to answer Group A and
any 4 (four) from Group B to E, taking one from each group.*

Candidates are required to give answer in their own words as far as practicable.

Group – A

1. Answer any twelve:

12 × 1 = 12

Choose the correct alternative for the following

- (i) Which of the following is not renewable energy source?
 - (a) Hydropower
 - (b) Tidal power
 - (c) Geothermal power
 - (d) Fuel cell
- (ii) Which fossil fuel is most often used to heat homes?
 - (a) Coal
 - (b) Natural Gas
 - (c) Oil
 - (d) Wind
- (iii) Which of the following is not an advantage of wind power?
 - (a) They produce emissions free electricity (they don't pollute)
 - (b) They can generate electricity at any time
 - (c) Building and maintaining them provides jobs for people
 - (d) They are cost effective after initial startup
- (iv) The radiation intensity on the surface of the sun is approximately
 - (a) $6.33 \times 10^7 \text{ W/m}^2$
 - (b) $13.53 \times 10^5 \text{ W/m}^2$
 - (c) $7.53 \times 10^5 \text{ W/m}^2$
 - (d) $8.5 \times 10^5 \text{ W/m}^2$
- (v) Air mass ratio is minimum when the sun is
 - (a) at zenith
 - (b) at sunrise
 - (c) at sunset
 - (d) at 06:00 GMT
- (vi) Which of the following is an example of passive solar technology?
 - (a) Photovoltaic
 - (b) Solar furnace
 - (c) Active solar water heating system
 - (d) Solar thermo-mechanical system
- (vii) Photovoltaic cells...
 - (a) Store heat from the sun
 - (b) Transform the energy from the sun into electrical energy
 - (c) Take pictures of the sun
 - (d) Prevent the spread of bacteria

- (viii) If no load is connected to solar P-V system
 (a) it will stop absorbing light
 (b) it will dissipate energy in the panel and increase its temperature
 (c) its voltage will go on increasing till its breakdown
 (d) it will start reflecting the light
- (ix) Which of the following is the band gap for the materials used in a solar cell?
 (a) 1 to 1.8 ev (b) 1 to 1.5 ev
 (c) 1 to 2 ev (d) 0 to 2 ev
- (x) Which of the following solar cell technologies typically exhibits the highest power conversion efficiency?
 (a) Amorphous Silicon Solar Cell (b) Heterojunction Solar Cell
 (c) Perovskite Solar Cell (d) Tandem Solar Cell

Fill in the blanks with the correct word

- (xi) Series and parallel combination of the solar cell is known as_____.
- (xii) Full form of FF in the solar field is_____.
- (xiii) During the collection of e-h pairs, holes are collected by _____.
- (xiv) Fuel cells are reliable, efficient, and have no _____moving _____ parts.
- (xv) HIT solar cells are a type of heterojunction solar cell that incorporates _____ layer between the p- and n-type layers.

Group - B

2. (a) Explain the reasons, why wind mills are more popular as alternative energy sources? Explain the importance of non-conventional energy sources in the context of global warming. [[CO2](Analyse/IOCQ)]
- (b) What is the relationship between the power delivered and the wind speed? [[CO2](Remember/LOCQ)]
- (c) Derive, if the tip of a wind rotor blade is travelling at 120km/h and the wind speed is 20km/h, obtain the tip-speed ratio. [[CO2](Evaluate/HOCQ)]
- (2 + 4) + 3 + 3 = 12**
3. (a) State the advantages & disadvantages of geothermal energy. [[CO2](Remember/LOCQ)]
- (b) What role does artificial intelligence (AI) play in optimizing the efficiency and management of Green Energy energy systems? [[CO1](Apply/IOCQ)]
- (c) How does the site selection for a micro hydel plant impact its efficiency and sustainability? [[CO1](Apply/IOCQ)]
- 4 + 4 + 4 = 12**

Group - C

4. (a) What is Global Radiation? How you can estimate the Global radiation? [[CO3](Remember/LOCQ)]
- (b) What does it mean the “air mass ratio”? [[CO3](Remember/LOCQ)]

- (c) Compare with beam radiation and total solar radiation in connection of solar energy source. For a city located at 80.50 longitudes, Calculate the solar time on March 15, 2017 at 10.30 am Indian standard time. [[CO3](Evaluate/HOCQ)]
(2 + 3) + 3 + 4 = 12
5. (a) Evaluate the monthly average clearness index for 11 March 2001, at a surface located at latitude 30° N. The monthly average daily terrestrial radiation on a horizontal surface is 26.1 MJ/m²/day. [[CO3](Evaluate/HOCQ)]
 (b) Compare the advantage and disadvantages of concentrating collectors over a flat plate collector? [[CO3](Remember/LOCQ)]
 (c) What is the difference between solar insolation and irradiance? What is solar azimuth angle? [[CO3](Remember/LOCQ)]
(2 + 2) + 4 + 4 = 12

Group - D

6. (a) Describe the key semiconductor materials commonly used in the fabrication of solar cells. Discuss their essential properties that make them suitable for solar energy conversion applications. [[CO4](Understandr/LOCQ)]
 (b) Explain the band structure of semiconductor materials and its relevance to solar cell operation. [[CO4](Understandr/LOCQ)]
 (c) Explain how doping affects the electrical properties and performance of solar cell devices. [[CO4] (Remember/LOCQ)]
(2 + 4) + 3 + 3 = 12
7. (a) Why solar PV panels are placed with a certain angle? Explain the current – voltage characteristic and Fill Factor of solar cell. [[CO5](Analyse/IOCQ)]
 (b) A solar cell array is required to deliver 100W peak output at 120V DC bus voltage the solar cells to be used are rated for 0.1W peak output at 0.4V. Assuming that there are no assembly losses, define the array. [[CO4] (Evaluate/HOCQ)]
(2 + 4) + 6 = 12

Group - E

8. (a) What is Tandem Solar cell? Explain with diagram? Why these types of solar cells are used in satellite? [[CO5] (Understand/LOCQ)]
 (b) Illustrate the Maximum Power Point Tracking (MPPT) of a Photovoltaic Plant. Elucidate your idea about the relation of MPPT with solar irradiance and temperature. [[CO5](Remember/LOCQ)]
(2 + 3 + 2) + 5 = 12
9. (a) Compare and contrast the fabrication techniques of sputtering, physical vapor deposition (PVD), chemical vapor deposition (CVD), and plasma-enhanced chemical vapor deposition (PECVD) in terms of their scalability, film quality, deposition rate, and production cost. Assess the suitability of each technique for different types of solar cell architectures and material systems. [[CO6](Analyse/IOCQ)]

- (b) Explain the different parameters of battery and their losses. *[(CO5)(Understand/LOCQ)]*
- (c) How does the cyclic performance of supercapacitors compare to that of lithium-ion batteries when used in solar-powered systems, and what factors influence their degradation? *[(CO5)(Remember/LOCQ)]*

(2 + 2 + 2) + 3 + 3 = 12

| Cognition Level | LOCQ | IOCQ | HOCQ |
|-------------------------|------|------|------|
| Percentage distribution | 58 | 24 | 18 |