

RENEWABLE ENERGY I
(REEN 5102)

Time Allotted: 3 hrs

Full Marks: 70

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and Any 5 (five) from Group B to E, taking at least one from each group.

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

Group - A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1=10**
- (i) The convective heat transfer coefficient of the single cover flat plate collector can be reduced by
(a) evacuating the space between the plate and the cover
(b) using convection suppression devices
(c) using a transparent honeycomb-like structure between the plate and the cover
(d) all of the above.
- (ii) Anisotropic diffuse model includes
(a) circumsolar diffuse
(b) horizon-brightening components on a tilted surface
(c) beam radiation
(d) all the three mentioned above.
- (iii) It is preferable to use measured data from a pyrheliometer since
(a) uncertainties in estimation of beam radiation is greater than that of total radiation.
(b) uncertainties in estimation of beam radiation is lesser than that of total radiation.
(c) uncertainties in estimation of beam radiation is equal to that of total radiation.
(d) none of the above.
- (iv) Parametric radiation models require detailed information about
(a) beam & sky components (b) turbidity coefficient
(c) cloud cover (d) both (b) & (c).
- (v) A good latent heat storage medium should have
(a) low thermal conductivity in both the phases
(b) large volume change during the phase change
(c) high value of the latent heat of fusion
(d) both (b) & (c).

- (vi) Photovoltaic energy is the conversion of sunlight in to:
(a) electricity (b) chemical Energy
(c) biogas (d) geothermal energy.
- (vii) The most common material used in making solar cell is
(a) zink (b) silicon
(c) gold (d) germanium.
- (viii) 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) $8.5 \times 10^5 \text{ W/m}^2$.
- (ix) TMY stands for
(a) typical meteorological year (b) time in Minute Year
(c) total measured yardstick (d) total mean year.
- (x) Maximum efficiency from C-Si solar cell can be obtained at
(a) UV range (b) infrared range
(c) visible spectrum range (d) dark.

Group - B

2. (a) What is hour angle of sun? What is Albedo in connection of solar radiation? Write in brief about the Solar Photovoltaic
(b) Describe with necessary sketch, Collector cum storage water heater.
(2 + 2 + 2) + 6 = 12
3. (a) Calculate the hour angle at sunrise and sunset on June 21 and December 21 for a surface inclined at an angle of 10° and facing due south ($\gamma=0^\circ$). The surface is located in Kolkata ($22^\circ 34' \text{ N}$, $88^\circ 21' \text{ E}$).
(b) Describe along with necessary sketch about the solar Radiation Spectrum.
5 + 7 = 12

Group - C

4. (a) Does the radiation flux reaching the earth from the sun remain same throughout the year? Justify your answer.
(b) Estimate the diffuse radiation on a horizontal surface on 17th July in Mumbai, the global radiation being $14.61 \text{ MJ/m}^2/\text{day}$, the . Daily total extraterrestrial radiation is 37.92 MJ/m^2 and sunset hour angle is 82.29 degree.
6 + 6 = 12

5. (a) Draw the spectrum of electromagnetic radiation and mention the range of wavelength that contains maximum percentage of energy of solar radiation.
- (b) Define solar constant, solar time, irradiance and beam radiation.

$$(3 + 2) + (2 + 2 + 2 + 1) = 12$$

Group - D

6. (a) Describe about the Stand-alone and Grid tied Photovoltaic system.
- (b) Name the important parameters required for a materials to be considered for solar cell, discuss.

$$(3 + 3) + 6 = 12$$

7. (a) Why solar PV plates are placed at a certain angle?
- (b) Find out the parameters like (i). Short circuit current (I_{sc}), (ii). solar cell Temperature (T_c), (iii). Open circuit voltage, (iv). Fill factor and (v). Maximum Power (P_m) of a module formed by 33 solar cells connected in series under the operating conditions $G=700 \text{ W/m}^2$ and $T_a=34^\circ\text{C}$. The manufacturer's value under standard conditions are $I_{sc}=3\text{A}$, $V_{oc}=21\text{V}$, $P_{max}=46\text{W}$ and $\text{NOCT}=45^\circ\text{C}$.

$$2 + 10 = 12$$

Group - E

8. (a) **Write short note on**
- (i) Inverter for PV system
- (ii) Functioning of solar cell
- (iii) Solar mapping using satellite data.

$$(4 + 4 + 4) = 12$$

9. (a) What is the purpose of using "Concentrating collectors"? Briefly state their principle of operation.
- (b) What are the loss mechanisms that determine the quantum of radiation available for conversion into useful heat?
- (c) Derive the expression of transmittance considering absorption in the cover plate using Bouger's law.

$$(2+2) + 3 + 5 = 12$$