

Group - E

8. (a) State *four* advantages and *four* limitations of biomass energy use.
- (b) Calculate the volume of a cow-dung based biogas plant required for cooking needs of a family of *six* adults, and lighting needs with *four* 100 CP lamps for *three* hours daily. The biogas required for cooking is about $0.226 \text{ m}^3/\text{person}/\text{day}$. The gas required for lighting one 100 CP lamp is $0.126 \text{ m}^3/\text{hour}$. Assuming that a single cow yields 10 kg of dung per day, and the dung that can be collected is 80% of the yield, calculate the required number of cows to feed the plant. The percentage weight of dry solid mass in the dung is 21% and the gas yield is 0.36 m^3 per kg of dry matter. Assume that the digester slurry is made by mixing with equal quantity of water, and a 60-day retention time is necessary. Take the volume percentage of slurry in the digester as 90%, and the slurry density as $1090 \text{ kg}/\text{m}^3$.

4 + 8 = 12

9. Write short notes on
- (i) Wave energy
 - (ii) Ocean thermal energy
 - (iii) Tidal energy.

4 + 4 + 4 = 12

**RENEWABLE ENERGY SYSTEMS
(MECH 3262)**

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 best way to generate electrical power from hydrogen is through
 - (a) conversion of hydrogen to a liquid fuel for use in a generator-coupled IC engine
 - (b) hydrogen-fired turbine coupled to a generator
 - (c) direct conversion using fuel cell
 - (d) none of the above.
 - (ii) Which of the following is *not* true about battery storage?
 - (a) long storage life.
 - (b) ability of rapid switchover between charging and discharging operations.
 - (c) modular and portable source of energy.
 - (d) high cost of battery storage.
 - (iii) The most important advantage of a solar furnace is
 - (a) cheap low-grade heating.
 - (b) availability of both heat and light.
 - (c) heating without contamination and in absence of electromagnetic field.
 - (d) heating available throughout the day.
 - (iv) A grid-interactive solar system
 - (a) always supplies power to the grid.
 - (b) always receives power from the grid.
 - (c) supplies power to as well as receives power from the grid as required.
 - (d) works only when the grid fails.

- (v) If no load is connected to a solar PV system, it will
 (a) stop absorbing light
 (b) dissipate energy in the panel and result in temperature rise
 (c) start reflecting the light
 (d) eventually break down due to continual increase in voltage.
- (vi) The charge carrier available in a semiconductor material has
 (a) only electrons (b) only holes
 (c) free electrons and holes (d) positively charged ions.
- (vii) Yaw control for wind turbines is used to
 (a) change the wind speed
 (b) keep the rotor aligned in wind direction
 (c) keep the rotor misaligned with wind direction
 (d) stop the wind rotor.
- (viii) Single basin tidal schemes
 (a) are more economical than Two basin schemes.
 (b) generate on both flood and ebb cycles.
 (c) are costlier than Two basin schemes.
 (d) none of these.
- (ix) Ocean-thermal energy conversion systems are suitable for power generation in
 (a) tropical region (b) sub-tropical region
 (c) cold region (d) moderate climate region.
- (x) The available wind power within the swept area for a wind turbine is proportional to
 (a) incoming wind speed (b) (incoming wind speed)²
 (c) (incoming wind speed)³ (d) (incoming wind speed)⁴

Group - B

2. (a) What do you understand by energy chain? What is green power?
 (b) An industry requires 20 MW electrical power and 40 MW process heat for production. There are two alternative options: (i) use a cogeneration unit having an overall efficiency of 65%, or (ii) use two separate units for electrical and thermal outputs. The efficiencies of electrical and thermal power units are 25% and 80% respectively. Which option would be preferable on the basis of the overall efficiencies in each case?

(3 + 2) + 7 = 12

3. (a) What do you understand by energy conservation? Explain its various aspects.
 (b) What do you understand by energy audit? What is meant by *ECOs* and *ECMs*?

(2 + 6) + (2 + 2) = 12**Group - C**

4. (a) How energy is continuously produced in the sun? Mention four indirect forms of solar energy.
 (b) Calculate the number of daylight hours (sunshine hours) at Bangalore on 21 June and 21 December in a leap year. The latitude of Bangalore is 12°58'N.

(3 + 4) + 5 = 12

5. (a) What is a greenhouse? How adequate supply of CO₂ is maintained in a greenhouse?
 (b) What is the basic difference between an active and passive solar heating system?
 (c) State the major limitations of solar thermo-mechanical systems.

(2 + 3) + 4 + 3 = 12**Group - D**

6. (a) What is the principle of solar photovoltaic energy conversion? Briefly explain the phenomenon of photoconduction in an intrinsic semiconductor.
 (b) A PV system feeds a dc motor to produce 1.5 hp power at the shaft. The motor efficiency is 88%. Each module has 36 multi-crystalline silicon solar cells arranged in 9 × 4 matrix. The cell size is 125mm × 125mm and the cell efficiency is 15%. Calculate the number of modules required in the PV array. Assume global radiation incident normally to the panel as 1.5 kW/m².

(2 + 5) + 5 = 12

7. (a) Classify wind turbines with neat sketches.
 (b) Briefly describe the environmental aspects of wind-diesel hybrid systems.

8 + 4 = 12