

**RENEWABLE ENERGY SYSTEMS
(MECH 4126)**

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) Use of nuclear energy is opposed due to
(a) rapid depletion of nuclear uranium reserves
(b) its high cost
(c) possibility of accident and radioactive pollution due to nuclear waste
(d) ecological imbalance caused due to its use.
- (ii) The processes of a Rankine cycle are
(a) isochoric and isentropic
(b) isobaric and isentropic
(c) isochoric and isothermal
(d) isothermal and isobaric.
- (iii) Global warming is mainly caused due to
(a) emission of heat from engines
(b) emission of CO₂ due to burning of fossil fuels
(c) use of nuclear energy
(d) air pollution.
- (iv) The efficiency of an ideal Carnot engine depends on
(a) the working substance
(b) the temperature of both source and sink
(c) the temperature of source only
(d) the temperature of sink only.
- (v) A cylindrical parabolic concentrator requires
(a) 2-axis tracking
(b) single-axis tracking
(c) no tracking
(d) seasonal adjustments only.
- (vi) The minimum tidal range required for power generation is about
(a) 1 m
(b) 5 m
(c) 10 m
(d) 20 m.
- (vii) The range of wind speed suitable for wind power generator is
(a) 0-5 m/s
(b) 5-25 m/s
(c) 25-50 m/s
(d) 50-100 m/s.

(viii) OTEC is characterized as having

- (a) high efficiency and low installation cost
- (b) low efficiency and high installation cost
- (c) high efficiency and high installation cost
- (d) low efficiency and low installation cost.

(ix) Turbines used in tidal range plants are

- (a) Francis turbines
- (b) Pelton turbines
- (c) Kaplan turbines
- (d) Propeller turbines.

(x) Power in waves is

- (a) directly proportional to the square of its amplitude and directly proportional to the period of motion
- (b) inversely proportional to the square of its amplitude and inversely proportional to the period of motion
- (c) directly proportional to the square of its amplitude and inversely proportional to the period of motion
- (d) inversely proportional to the square of its amplitude and directly proportional to the period of motion.

Group - B

2. (a) What are the advantages and limitations of conventional energy sources? [(CO1)(Remember/LOCQ)]
(b) What do you understand by energy conservation? [(CO1)(Understand/LOCQ)]
6 + 6 = 12
3. (a) Write your views on the energy planning issues aiming to bridge the gap between energy demand and supply situation India. [(CO2)(Analyse/IOCQ)]
(b) What are the main advantages and limitations of battery-storage system? [(CO2)(Analyse/IOCQ)]
6 + 6 = 12

Group - C

4. (a) Compare the relative merits and demerits of solar energy operated LiBr-water and aqua ammonia absorption cooling systems. [(CO3)(Understand/LOCQ)]
(b) Explain the process of generation of power in solar pond with a neat sketch. [(CO3)(Understand/LOCQ)]
6 + 6 = 12
5. (a) With the help of a neat sketch describe a solar water heater. [(CO3)(Understand/LOCQ)]
(b) What is the advantage of using a glass cover in a box-type solar cooker? [(CO3)(Analyse/IOCQ)]
(c) Define Extra-terrestrial and Terrestrial solar radiation. [(CO3)(Remember/IOCQ)]
6 + 3 + 3 = 12

Group - D

6. (a) What are the major advantages and disadvantages of solar PV system?
[[CO3](Analyse/IOCQ)]
- (b) A PV system feeds a DC motor to produce 2.5 hp power at the shaft. The motor efficiency is 85%. Each module has 45 multi-crystalline silicon solar cells arranged in 9×5 matrix. The cell size is $125 \text{ mm} \times 125 \text{ mm}$ 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 kW/m^2 .
[[CO3](Evaluate/HOCQ)]
6 + 6 = 12
7. (a) A Horizontal Axis Wind Turbine (HAWT) is installed at a location having free stream wind speed of 15 m/s. The 80 m diameter rotor has 3 blades attached to the hub. Determine the rotational speed of the rotor for optimal energy extraction.
[[CO4](Evaluate/HOCQ)]
- (b) Describe the functioning of a typical vapour-dominated geothermal plant.
[[CO4](Understand/LOCQ)]
6 + 6 = 12

Group - E

8. (a) Justify the utilization of linked-basin tidal energy conversion schemes over single-basin schemes for continuity in power supply.
[[CO5](Evaluate/HOCQ)]
- (b) Calculate the time interval of a tidal cycle between two consecutive high or low tides.
[[CO5](Analyse/IOCQ)]
6 + 6 = 12
9. (a) What are the main advantages and disadvantages of ocean thermal energy resources?
[[CO6](Analyse/IOCQ)]
- (b) Briefly describe the types of sites which are considered suitable for wave power development?
[[CO6](Understand/LOCQ)]
6 + 6 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	43.75	37.5	18.75

Course Outcome (CO):

After the completion of the course students will be able to

- CO1: Describe the fundamentals and characteristics of various renewable energy sources.
CO2: Explain the technological basis for harnessing and storing renewable energy sources.

CO3: Analyze the characteristics of solar energy systems.

CO4: Analyze the characteristics of non-solar renewable energy systems.

CO5: Justify utilization of various renewable energy resources.

CO6: Formulate for implementation of various renewable energy resources.

*LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question;
HOCQ: Higher Order Cognitive Question