

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) Energy conservation means [CO1]
(a) reducing energy consumption by reducing quality of production
(b) reducing energy consumption without compromising quality and quantity of production
(c) reducing the output
(d) increasing the output.
- (ii) The change in entropy for a reversible adiabatic process is [CO1]
(a) zero (b) minimum (c) infinite (d) unity.
- (iii) Energy loss of a flywheel may be reduced by [CO2]
(a) reducing its diameter
(b) reducing its inertia
(c) putting it in a sealed vacuum chamber and providing magnetically levitated bearings
(d) increasing its speed.
- (iv) In evacuated tube collectors [CO3]
(a) both conduction and convection losses are suppressed
(b) only conduction losses are suppressed
(c) only convection losses are suppressed
(d) only radiation losses are suppressed.
- (v) The turbine used in a tidal range plant is [CO4]
(a) Francis turbine (b) Propeller turbine
(c) Kaplan turbine (d) Pelton turbine.
- (vi) The range of wind speed suitable for rotary wind power generator is [CO4]
(a) 0-5m/s (b) 5-25m/s
(c) 25-50m/s (d) 50-75m/s.

- (vii) Linear velocity of a particle at the crest of a wave is [CO4]
(a) $a\omega$ (b) a/ω (c) ω/a (d) $a+\omega$.
- (viii) The power available in the wind will be _____, if the wind speed is doubled [CO4]
(a) doubled (b) 4 times (c) 8 times (d) 16 times.
- (ix) Tip speed ratio of a wind turbine is the ratio between [CO4]
(a) blade tip speed and rotor angular speed
(b) blade tip speed and incoming wind speed
(c) rotor angular speed and incoming wind speed
(d) rotor angular speed and downstream wind speed.
- (x) OTEC is characterized as having [CO5]
(a) high efficiency and low installation cost
(b) low efficiency and high installation cost
(c) low efficiency and low installation cost
(d) high efficiency and high installation cost.

Group - B

2. (a) What is per capita energy consumption? How it is related with standard of living? [(CO1) (Understand/LOCQ)]
(b) Why thermodynamic analysis plays an important role in determining the performance of non-conventional power generation? [(CO1)(Evaluate/HOCQ)]
6 + 6 = 12
3. (a) Why energy storage is necessary in the context of variable demand? [(CO2) (Understand/LOCQ)]
(b) What are the main advantages and limitations of battery storage systems? [(CO2)(Analyze/IOCQ)]
6 + 6 = 12

Group - C

4. (a) The following observations were made at a site:
Theoretical maximum possible sunshine hours = 9.5 h
Average measured length of a day during April = 9.0 h
Solar radiation for a clear day, $H_0 = 2100 \text{ kJ/m}^2/\text{day}$
Constants: $a = 0.27$, $b = 0.50$
Calculate the average daily global radiation. [(CO3) (Analyze/IOCQ)]
(b) Propose a geometry and shape of an efficient solar collector and justify. [(CO3)(Create/HOCQ)]
4 + 8 = 12
5. (a) What is the basic difference between active and passive solar heating system? [(CO3) (Analyze/IOCQ)]
(b) What is the future prospect of solar water desalination systems? [(CO3)(Evaluate/HOCQ)]
6 + 6 = 12

Group - D

6. (a) Briefly discuss the reasons behind the local wind circulation.
 [(CO4) (Remember/LOCQ)]
 (b) Evaluate the applicability of small wind turbines in rural region.
 [(CO5)(Evaluate/HOCQ)]
- 6 + 6 = 12**
7. (a) What is plate tectonic theory and how is it related to Geothermal energy?
 [(CO4)(Remember/LOCQ)]
 (b) Discuss the working principle of vapour-dominated Geothermal electric power plant. [(CO4)(Analyze/IOCQ)]
- 6 + 6 = 12**

Group - E

8. (a) Explain the working of Single-basin single-effect tidal plant.
 [(CO4)(Remember/LOCQ)]
 (b) What are the main hurdles in the development of tidal energy?
 [(CO5)(Analyze/IOCQ)]
- 6 + 6 = 12**
9. (a) What types of sites are considered suitable for wave power development?
 [(CO6)(Understand/LOCQ)]
 (b) What are the relative advantages and limitations of floating and shore-based OTEC plants? [(CO6)(Analyze/IOCQ)]
- 6 + 6 = 12**

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	37%	35%	28%

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

Department & Section	Submission link:
ME	https://classroom.google.com/c/NDA1MjM1NjQ1Mzky?cjc=3squdyb