

**RENEWABLE ENERGY RESOURCES AND CHARACTERISTICS
(REEN 5101)**

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) ICE-G is more economically feasible than
(a) Solid oxide fuel cell (b) Alkaline fuel cell
(c) Phosphoric acid fuel cell (d) Polymer electrolyte membrane fuel cell
- (ii) The Stephan Boltzmann constant value is
(a) 6.67×10^{-10} (b) 5.67×10^{-8} (c) 5.67 (d) 5.67×10
- (iii) Volume expansion coefficient of ideal gas is
(a) Inversely proportional to the temperature
(b) Proportional to the temperature
(c) Inversely proportional to the density
(d) Proportional to the density
- (iv) The value of zenith angle at sunrise is
(a) 0° (b) -90° (c) $+90^\circ$ (d) $+180^\circ$
- (v) The unit of thermal resistivity is
(a) $^\circ\text{C} \cdot \text{m}^2/\text{W}$ (b) $\text{W}/\text{m}^2\text{C}$ (c) W (d) W/m
- (vi) The sun is composed of
(a) 60% hydrogen and 40% helium (b) 50% nitrogen and 50% helium
(c) 75% hydrogen and 25% nitrogen (d) 75% hydrogen and 25% helium
- (vii) Co-efficient of performance of wind machine is
(a) Proportional to third power of undisturbed wind speed
(b) Proportional to square root of undisturbed wind speed
(c) Proportional to undisturbed wind speed
(d) Inversely proportional to third power of undisturbed wind speed

- (viii) Ratio of total mass of biomass particles to the solid volume of particles + interstitial volume is defined as
 (a) True density (b) Apparent density
 (c) Bulk density (d) Both (a) and (c)
- (ix) Closed cycle OTEC is an example of
 (a) Claude cycle (b) Rankine cycle
 (c) Carnot cycle (d) Otto cycle
- (x) Power obtained from flowing water in a uniform steady flow between two cross-sections of a river with H as elevation difference between the two sections, v_1 and v_2 as the velocities, Q as the flowrate and γ as specific weight is expressed as
 (a) $P = \gamma Q \left(H + \frac{v_1^2 - v_2^2}{2g} \right)$ (b) $P = \gamma Q \left(H - \frac{v_1^2 - v_2^2}{2g} \right)$
 (c) $P = \frac{\gamma Q}{\left(H + \frac{v_1^2 - v_2^2}{2g} \right)}$ (d) $Q \left(H + \frac{v_1^2 - v_2^2}{2g} \right)$

Group- B

2. (a) Differentiate the molten carbonates fuel cell from polymer electrolyte membrane fuel cell. [(CO6) (Understand/LOCQ)]
 (b) Discuss comparative analysis between ICG and PEMFC cell. [(CO1, CO3) (Analyze/IOCQ)]
6 + 6 = 12
3. (a) Explain the relation between emissivity and absorptivity of a black body. [(CO2) (Analyse/IOCQ)]
 (b) Discuss a comparative analysis of conventional and non-conventional energy. [(CO1, CO3) (Analyze/IOCQ)]
4 + 8 = 12

Group - C

4. A glassdoor fire screen, used to reduce exfiltration of room air through a chimney, has a height of 0.82 m and width of 1.0 m and reaches a temperature of 200°C. If the room temperature is 20°C, estimate the convection heat transfer rate from the fireplace to the room. At 400 k the air properties are $k = 33.8 \times 10^{-3}$ w/mk, $\nu = 26.4 \times 10^{-6}$ m²/s, $\alpha = 38.3 \times 10^{-6}$ m²/s, Pr = 0.690, $\beta = 0.0025$ k⁻¹. [(CO2) (Evaluate/HOCQ)]
12
5. (a) Draw a schematic diagram of geometric interrelationship of radiation incident on a tilted surface. [(CO2) (Analyse/IOCQ)]
 (b) Define the Raleigh number. [(CO2) (Understand/LOCQ)]

- (c) Derive a mathematical model of heat transfer coefficient for a hot sphere.
[[CO2](Analyze/IOCQ)]

5 + 2 + 5 = 12

Group - D

6. (a) Briefly discuss the main components of a wind mill with the help of neat diagram. [[CO4] (Remember/LOCQ)]
(b) Explain the operating characteristics of a wind mill. [[CO2] (Analyze/IOCQ)]
7. (a) A hydropower station has a gross head of 8.2 m. Head loss in water conductor system is 0.5 m. Optimum discharge is 267 cubic metre/s. Calculate the potential electric power of water and the energy generated. [[CO3] (Evaluate/HOCQ)]
(b) Distinguish between low and high head hydropower plants.
[[CO3] (Understand/LOCQ)]
(c) Design a layout of a hydropower plant. [[CO3] (Understand/LOCQ)]

6 + 6 = 12

4 + 4 + 4 = 12

Group - E

8. (a) Distinguish between closed and open cycle ocean thermal energy conversion systems. [[CO3,CO5] (Evaluate/HOCQ)]
(b) Compare between closed loop and open loop geothermal heat pump systems.
[[CO4] (Evaluate/HOCQ)]
(c) Discuss the advantages and disadvantages of ocean tidal power.
[[CO2, CO3](Analyze/IOCQ)]
9. (a) Discuss the process of estimation of extractives in a woody biomass sample.
[[CO1,CO3] (Remember/LOCQ)]
(b) A sample of biomass gave the following proximate analysis: Ash 16%, VM 30.1, FC 52.6%, moisture: 1.3%. The calorific value of the sample is given by the equation:
 $C = 82 \cdot FC + a \cdot VM'$ where VM' is the volatile matter content in daf basis. Given: $a = 94$ for $VM' = 35$ and $a = 85$ for $VM' = 38$. Calculate the ash content of the sample on a dry basis and volatile matter on dmmf basis. Calculate the calorific value of the sample. [[CO3] (Evaluate/HOCQ)]
(c) Distinguish between the differential and cumulative basis of particle size analysis. [[CO2] (Analyze/IOCQ)]

5 + 3 + 4 = 12

5 + 5 + 2 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	28.57%	41.67%	30.06%

Course Outcome (CO):

After the completion of the course students will be able to

1. Ability to recognize the need of renewable energy technologies and their role in the India and world energy demand.
2. Ability to distinguish between the sustainable energy sources and fossil energy sources with emphasis on wind and photovoltaic systems.
3. Knowledge of the operating principles of renewable energy production from various renewable sources, especially.
4. Knowledge of operating principles of geothermal heat pumps.
5. Ability to compare the advantages and disadvantages of various renewable energy technologies and propose the best possible energy conversion system for a particular location.
6. Knowledge of security and operational requirements of autonomous and net connected renewable energy systems.

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

Department & Section	Submission Link
RE	https://classroom.google.com/c/NDE3NTYxNDgzOTY1/a/NDY4Njk0ODEzOTc5/details