ENERGY RESOURCE
(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
<u>any 5 (five)</u> from Group B to E, taking <u>at least one</u> 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 earth becomes very hot in the summer due to
          (a) heat coming from the sun by convection to the earth
          (b) heat coming from the sun by radiation to the earth
          (c) entire visible spectrum of light coming from the sun to the earth
          (d) UV radiation coming from the sun to the earth.

   (ii)   Radiated heat from heat source can be equated to temperature (T) of the source with the help of the following equation, where σ is the Stefan-Boltzmann constant & T is the absolute temperature
          (a) $E = \sigma^2 T^2$ (b) $E = \sigma T^4$ (c) $E = \sigma^4 T$ (d) $E = \sigma T$.

   (iii) Which of the following resource of energy is non-renewable?
          (a) geothermal energy   (b) atomic energy from Plutonium
          (c) solar energy   (d) biomass.

   (iv)   Heat transfer takes place in the atmosphere mostly by
          (a) diffusion   (b) convection
          (c) advection   (d) radiation.

   (v)   Solar energy can be stored for days together in the form of
          (a) heat energy   (b) light energy
          (c) mechanical energy   (d) magnetic energy.

   (vi)   Radiated heat is a form of
          (a) gravitational wave   (b) mechanical wave
          (c) electromagnetic wave   (d) acoustic wave.

   (vii) Green-house gas emission per unit of power is the minimum for the following power generation process
          (a) biogas power plant   (b) atomic Power plant
          (c) thermal Power plant   (d) diesel Power generation units.

   (viii) Of all renewable energy resources, the largest source of emission free renewable energy is
          (a) solar energy   (b) hydel energy
          (c) wind energy   (d) geothermal energy.

   (ix)   What kind of energy of wind is converted in the generation of wind power?
          (a) potential energy   (b) pressure-volume energy
          (c) kinetic energy   (d) surface energy.

   (x)   Wien's displacement constant is represented by
          (a) λT_{max} (b) $\lambda_{max} T$ (c) $\lambda_{max} T_{max}$ (d) λT.

Group – B

2. (a)   Classify renewable and non-renewable energy forms with due regard to their importance in different locations and seasons on the earth.

   (b)   Derive Bernoulli's equation with due assumptions and considerations involved.

   (c)   How would you explain the sustainability of different renewable energy resources?

                                                              3 + 5 + 4 = 12

3. (a)   Derive an expression for the rate of heat transfer in a flat plate collector.

   (b)   What are the dimensionless quantities involved in heat transfer process through convection?

   (c)   Explain graphically the Wien's displacement law and enumerate displacement constant.

                                                              3 + 3 + 6 = 12

Group – C

4. (a)   Describe the working principle of solar water heating system with natural circulation water heater and find out an expression for the thermal overall efficiency of the system.

(b) Define irradiance, irradiation and radiosity and emissive power of a radiant energy relating to the source and the receiver.

(c) Explain the working principle of a Pyranometer for the measurement of total hemispherical solar radiation usually on a horizontal surface.

6 + 3 +3 = 12

5. (a) Calculate design parameters for the performance of a solar distillation unit related to the drinking water supply.

(b) What are extrinsic semiconductors and how would you evaluate the p-n junction characteristics of such semiconductors for application in solar photovoltaic (PV) cells.

6 + 6 = 12

Group – D

6. (a) How many different types of hydroelectric power generation plants are feasible for operation? Explain the operational differences between them.

(b) Mention the different locations in India where large and micro Hydel power plants are operationally viable and mention the total power generation capacities.

(c) How would you account for the fact that Biomass provides renewable energy?

3 + 3 + 6 = 12

7. (a) Classify different water turbines and explain the working principle and function of impulse turbine.

(b) What are the basic requirements for constructing a Hydel Power plant including equipment & water requirement?

6 + 6 = 12

Group – E

8. (a) Explain the origin of geothermal energy and its viable applications.

(b) Classify different geothermal resources based on the enthalpy of geothermal fluids.

(c) Derive a mathematical expression for the time constant for useful heat extraction with a pumped water extraction methodology from a hot aquifer.

4 + 4 + 4 = 12

9. (a) Explain the existence of other types renewable sources of energy and how would they be made viable and feasible for power generation?

(b) Make a comprehensive cost comparison between the renewable and fossil fuel energy including the Environmental Impact Analysis.

4 + 8 = 12