RENEWABLE ENERGY RESOURCES AND CHARACTERISTICS
(REEN 5101)

Time Allotted : 2½ hrs **Full Marks : 60**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 4 (four) from Group B to E, taking one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A

1. Answer any twelve: **12 × 1 = 12**

Choose the correct alternative for the following

(i) Which one of the following is not a Greenhouse Gas?
(a) Methane (b) Hydrogen
(c) Nitrous oxide (d) Ozone.

(ii) Which of these resources does not produce CO2 during electricity generation?
(a) Coal (b) Methane
(c) Uranium (d) Biogas.

(iii) Solar irradiance measuring device is
(a) Venturimeter (b) Anemometer
(c) Thermocouple (d) Pyranometer.

(iv) The tilt factor of reflected radiation for the surface with respect to sun is
(a) $R_r = \rho(\frac{1-cos\beta}{2})$ (b) $R_r = \rho(\frac{1+cos\beta}{2})$
(c) $R_r = (\frac{1-cos\beta}{2})$ (d) $R_r = (\frac{1+cos\beta}{2})$

(v) Wind speed measuring device is
(a) Venturimeter (b) Anemometer
(c) Thermocouple (d) Pyranometer.

(vi) Tip speed ratio is defined as
(a) $TSR = \frac{Blade\ tip\ speed}{Wind\ speed}$ (b) $TSR = \frac{Rotor\ tip\ speed}{Wind\ speed}$
(c) $TSR = \frac{Blade\ tip\ number}{Wind\ speed}$ (d) $TSR = \frac{Blade\ tip\ area}{Wind\ speed}$

(vii) The biogas is having calorific value between
(a) 15 and 30 Kcal/kg (b) 100 and 100 Kcal/kg
(c) 5000 and 5500 Kcal/kg (d) Above 10000 Kcal/kg

(viii) The value of Betz limit is
(a) 0.15 (b) 10
(c) 0.593 (d) 0.9.

(ix) Geopressured resources contains dissolve
(a) Carbon dioxide (b) Benzene
(c) Water (d) Methane.

(x) The biogas is obtained in anaerobic digestor
(a) In absence of oxygen (b) In presence of carbon dioxide
(c) In presence of oxygen (d) In absence of carbon dioxide.

Fill in the blanks with the correct word

(xi) Black gold is referred to as _____.

(xii) _____ is the highest quality of coal.

(xiii) The temperature of the working fluid of flat plate collector can be raised only upto_____.

(xiv) The binary cycle power plants operated at lower temperature of about _____.

(xv) Producer gas is obtained by _____ of wood or any cellulose organic material.

Group - B

2. (a) Describe the difference between renewable and non-renewable energy. *[(CO1)(Analyse/HOCQ)]*

(b) Write a short note on the formation of fossil fuels and its processing methods. *[(CO2)(Understand/IOCQ)]*

4 + 8 = 12

3. (a) Describe the various types of fuel cell and its important. *[(CO1)(Analyse/HOCQ)]*
(b) Describe the working principle of PEMFC. *[(CO1)(Understand/IOCQ)]*

6 + 6 = 12

Group - C

4. (a) Discuss the Working Principle, configuration, and application of Pyrheliometer with the help of a diagram. *[(CO2)(Analyse/HOCQ)]*
(b) Write a short note on heliostat. *[(CO2)(Understand/IOCQ)]*
(c) What is the expression of heat removal factor of a cylindrical parabolic collector? *[(CO2)(Remember/LOCQ)]*

6 + 5 + 1 = 12

5. (a) What is solar pond? Discuss the principle of operation on which the solar pond works. *[(CO2)(Apply/HOCQ)]*
(b) Explain the current – voltage characteristics of solar cell. Also define the fill factor. *[(CO2)(Analyse/IOCQ)]*
(c) What is photovoltaic effect of a solar cell? *[(CO2)(Remember/LOCQ)]*

(1 + 5) + (4 + 1) + 1 = 12

Group - D

6. (a) Discuss the comparison between different types of wind turbines used to extract wind energy. *[(CO2)(Understand/HOCQ)]*
   (b) What is Betz limit? *[(CO2)(Remember/LOCQ)]*
   (c) A horizontal axis wind turbine with 30 m rotor diameter produces 1.0 MW electricity at a wind speed of 60 km/h. Calculate the following
      (i) Blade tip speed for a tip speed ratio of 4.25
      (ii) Overall percent conversion efficiency of the wind turbine. Air density is 1.222 kg/m^3. *[(CO2)(Analyse/IOCQ)]*

5 + 1 + 6 = 12

7. (a) Discuss the advantages and disadvantage of pumped storage power plant. *[(CO4,CO5)(Understand/IOCQ)]*
   (b) Discuss the classification of hydropower plants. *[(CO4,CO5)(Remember/LOCQ)]*
   (c) Write a short note on bulb turbine. *[(CO4)(Apply/IOCQ)]*

5 + 4 + 3 = 12

Group - E

8. (a) Explain the production process of ethanol from biomass. *[(CO4)(Understand/LOCQ)]*
   (b) Write short notes on the followings
      (i) Proximate analyses of woody biomass.
      (ii) Ultimate analyses of woody biomass. *[(CO4)(Remember/LOCQ)]*

6 + 6 = 12

9. (a) Write short notes on any two of the followings
   (i) Tidal barrage (ii) Tidal lagoon (iii) Tidal turbine. *[(CO3)(Remember/LOCQ)]*
   (b) Discuss the working principle of OTEC with the help of neat diagram. *[(CO3)(Analyse/HOCQ)]*

(3 × 2) + 6 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	26.04	39.58	34.38

Course Outcome (CO):

After the completion of the course students will be able to

1. Recognize the need of renewable energy technologies and their role in the India and world energy demand.
2. Distinguish between the sustainable energy sources and fossil energy sources with emphasis on wind and photovoltaic systems.
3. Understand the operating principles of geothermal heat pumps and principles of renewable energy production from various renewable sources, especially.
4. Compare the advantages and disadvantages of various renewable energy technologies and propose the best possible energy conversion system for a particular location.
5. Understand 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.*