

**RENEWABLE ENERGY POWER PLANTS**

Time Allowed: 3 Hours

Full Marks: 60

Answer to Question No. 1 of Group A must be written in the main answer script. In Question No. 1, out of 2 marks for each MCQ, 1 mark is allotted for right answer and 1 mark is allotted for correct explanation of the answer. However, no marks will be given for wrong explanation of the answer of each MCQ type question.

Answer any Five (05) Questions from Group-B.

**GROUP-A**

1. Choose the correct answer from the given alternatives and explain your answer (any ten): 2x10=20
- i) Which renewable energy source has seen significant growth in India due to the implementation of feed-in tariffs and other supportive policies?  
 a) Solar energy      b) Wind energy      c) Biomass energy      d) Hydroelectric energy
- ii) Which gas is typically main component of the Gobar gas?  
 a) Hydrogen      b) Methane      c) Carbon monoxide      d) Carbon dioxide
- iii) Which of the following materials is commonly used in the manufacturing of solar photovoltaic cells?  
 a) Aluminium      b) Copper      c) Silicon      d) Lead
- iv) The nacelle of wind turbines houses:  
 a) Generator      b) Brakes      c) Gearbox      d) All of these
- v) What is the primary function of a solar inverter in a photovoltaic power plant?  
 a) Converts DC electricity into AC electricity.      b) Stores excess electricity in batteries.  
 c) Regulates the flow of solar energy.      d) Increases the efficiency of solar panels.
- vi) What is the value of cut-in speed of a wind turbine?  
 a) 3 m/s      b) 8 m/s      c) 12 m/s      d) 0 m/s
- vii) Which of the following is foremost advantage of micro hydro power plants as compared to large-scale hydroelectric plants?  
 a) Higher efficiency      b) Lower environmental impact  
 c) Greater storage capacity      d) Reduced cost of installation
- viii) What is the value of Fill Factor of an 'Ideal' solar cell?  
 a) 0%      b) 50%      c) 80%      d) 100%
- ix) The \_\_\_\_\_ state of India has highest solar insolation level.  
 a) West Bengal      b) Rajasthan      c) Madhya Pradesh      d) Bihar
- x) The typical efficiency of a Solar Flat Plate Collector is:  
 a) 20-30%      b) 40-50%      c) 50-60%      d) 70-80%
- xi) What does the fill factor (FF) indicate in the V-I curve of a PV cell?  
 a) The ratio of maximum power to open-circuit voltage  
 b) The ratio of maximum power to short-circuit current  
 c) The efficiency of the PV cell  
 d) The quality of the PV cell's semiconductor material
- xii) What percentage (approx.) of kinetic energy in the wind can be theoretically captured by a wind turbine according to the 'Betz limit'?  
 a) 25%      b) 39%      c) 59%      d) 78%

- xiii) What is the primary function of a parabolic trough collector in a solar thermal power plant?  
 a) To convert sunlight directly into electricity.      b) To store thermal energy for later use.  
 c) To concentrate sunlight onto a receiver tube.      d) To generate steam for turbine operation.
- xiv) What is the primary product of biomass gasification?  
 a) Liquid biofuels      b) Solid char      c) Producer gas      d) Ash residue
- xv) Which of the following biomass feedstock is commonly used for biogas production in anaerobic digestion?  
 a) Corn      b) Soybeans      c) Cow dung      d) Wheat straw

### GROUP-B

Answer any Five (05) questions.

2. a) With the help of block diagrams, describe different types of Solar Photovoltaic Power Plants.  
 b) Define Beam and Diffuse radiation. 6+2
3. a) Explain the Photovoltaic effect.  
 b) Neatly draw P vs. V and I vs. V characteristics of a solar cell and explain all related parameters. 3+5
4. a) Write three disadvantages of a Solar Thermal Power Plant.  
 b) Explain the working principle of any one Concentrated Solar thermal Power plant (CSP) with proper diagram. 3+5
5. a) Draw and explain the construction & working principle of a solar Pyranometer.  
 b) Define Solar Azimuth angle. Write down the expression of Declination angle and state its importance. 4+(2+2)
6. a) Describe the different components of a geared type wind turbine with proper diagram.  
 b) Classify different types of wind turbines with example. 5+3
7. a) Derive the expression of wind power available for conversion in a wind turbine system. Hence, write down the expression of wind power density.  
 b) Explain how Doubly-Fed Induction Generators (DFIG) are implemented in WECS to feed electric power into the grid in a variable wind speed environment. 4+4
8. a) Classify different types of water-turbines used in Micro Hydro power plants.  
 b) Draw and explain the layout of a Micro Hydro power station. 3+5
9. a) Draw the layout and explain working of a bio-chemical based power plant.  
 b) Write down any three properties of gaseous biofuels.  
 c) What is bio-diesel? 4+3+1