

Renewable Energy Technology (315337)

MSBTE Diploma · K-Scheme · Model Question Paper — Set A

Time: 3 Hours**Max. Marks: 70****Instructions:**

1. All questions are compulsory.
2. Answer each next main question on a new page.
3. Illustrate your answers with neat sketches wherever necessary.
4. Figures to the right indicate full marks.
5. Assume suitable data, if necessary.
6. Use of non-programmable electronic pocket calculator is permissible.
7. Mobile phone, pager and any other electronic communication devices are not permissible in the examination hall.

Q.1 Attempt any FIVE of the following:**10**

- a) Define: i) Beam (direct) radiation ii) Diffuse radiation.
- b) State the use of: i) Pyrheliometer ii) Pyranometer.
- c) Define fill factor of a solar cell. Write its expression.
- d) Define the following terms related to wind turbines: i) Cut-out wind speed ii) Power coefficient (C_p).
- e) State any four methods of hydrogen production.
- f) List any four factors affecting the generation of biogas.
- g) State any four advantages of small hydroelectric power plants.

Q.2 Attempt any THREE of the following:**12**

- a) Explain the Angstrom compensation pyrheliometer with a neat sketch.
- b) Draw the equivalent circuit of a solar cell and explain its I-V characteristics. Mark I_{sc} , V_{oc} and maximum power point on the curve.
- c) Derive the expression for the power available in the wind. Hence state the Betz limit.
- d) Explain the construction and working of a hydrogen–oxygen fuel cell with a neat diagram.

Q.3 Attempt any THREE of the following:**12**

- a) Draw the block diagram of a stand-alone (off-grid) photovoltaic power system and explain the function of each block.
- b) Explain the metal hydride method of hydrogen storage with a sketch. State its advantages.
- c) Describe the construction and working of a KVIC floating drum type biogas plant with a neat labelled diagram.

- d) Explain the closed cycle OTEC (ocean thermal energy conversion) system with a neat sketch.

Q.4 Attempt any THREE of the following:

12

- Compare focusing and non-focusing type solar collectors on any four points.
- Explain any four factors to be considered while selecting a site for a wind farm.
- State the hazards associated with hydrogen and explain the preventive measures to be taken while handling it.
- A small hydro site has a discharge of $1.8 \text{ m}^3/\text{s}$ and a net head of 9 m. Taking overall efficiency as 82 %, calculate the electrical power output. Recommend a suitable turbine for this site with justification.
- Explain the three stages of anaerobic digestion in the production of biogas.

Q.5 Attempt any TWO of the following:

12

- Explain the variable speed constant frequency (VSCF) scheme of wind energy conversion with a neat block diagram. State its advantages over a constant speed scheme.
- Explain the Chinese fixed dome type biogas plant with a neat labelled sketch. State its advantages and limitations.
- Explain the binary cycle geothermal power plant with a neat diagram. Justify why it is preferred for low and moderate temperature geothermal resources.

Q.6 Attempt any TWO of the following:

12

- A flat plate collector at Pune (latitude 18.5° N) faces due south and is tilted at 15° to the horizontal. On 21 April at 11:00 AM (solar time), calculate: i) solar declination δ ii) hour angle ω iii) zenith angle θ_z and solar altitude α iv) angle of incidence θ of beam radiation on the collector.
- A horizontal axis wind turbine has a rotor diameter of 60 m. The wind speed is 9 m/s and air density is 1.225 kg/m^3 . Calculate: i) power available in the wind ii) maximum power that can be extracted (Betz limit) iii) mechanical power developed if $C_p = 0.42$ iv) electrical output if gearbox and generator efficiency together is 90 %. Also find the power available if the wind speed rises to 12 m/s.
- i) Draw the polarization curve of a fuel cell and explain activation, resistance (ohmic) and concentration polarization. ii) For a hydrogen–oxygen fuel cell at 25°C , $\Delta G = -237.1 \text{ kJ/mol}$ and $\Delta H = -285.8 \text{ kJ/mol}$. Calculate the ideal cell voltage and the ideal (thermodynamic) efficiency. ($F = 96485 \text{ C/mol}$)

Note: This is a **model question paper prepared by Ananda Technologies** only for practice and exam preparation, based on the pattern of previous MSBTE question papers and the K-scheme syllabus. It is **not an official MSBTE paper**, and it does **not** mean that these questions will come in the exam. Answers follow standard textbook points; marks shown are indicative. Free for students — anandatechnologies.in