

BENGAL ENGINEERING & SCIENCE UNIVERSITY, SHIBPUR

Master of Engineering Examinations, 2011

Alternative Energy (ME-907)

Branch: Mechanical Engineering

Time 3 hrs

Full Marks: 70

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- i) Attempt four questions. All questions are of equal value.
ii) Use of property table/ diagram permitted

1. (a) Explain the operating principle of a central power tower solar plant. What are the benefits of using molten salt as the primary heat transfer fluid in power tower systems?
(b) Explain the roles played by the doping materials in forming an effective PN junction in a Silicon solar cell.
A high efficiency Si solar cell of area 100 sq. cm produces, under standard test conditions, an open circuit voltage of 0.7 V and a short circuit current of 3.9 A. Its fill factor was found to be 79%. Estimate the peak power and the conversion efficiency of the solar cell.
2. (a) Discuss briefly the Faraday configuration for an MHD generator and express its current density in terms of the applied magnetic field and the voltage gradient. Why seed materials are used in the gas stream in an MHD duct?
(b) An MHD generator working in Faraday configuration has a coefficient of performance of 0.5 while magnetic field strength is 2 T and the gas velocity is 50 m/s. Assuming a conductivity of 10 mho and a duct volume of 2 m³, estimate the output power of the generator.
3. (a) State the desirable characteristics of a fuel cell electrolyte. Differentiate between the electrolytic constructions of a PEM fuel cell and a SOFC.
(b) A fuel cell stack is made of 500 cells connected in series, each giving an operating voltage of 0.7 V. The cell produces a current density of 285 mA/cm², while consuming hydrogen as fuel. Effective area for each cell is 1 m². Estimate:
 - (i) power output of the stack and
 - (ii) fuel consumption for all the cells if the fuel utilization is 85%.

4. (a) How does a tidal power plant work? What are the disadvantages of tidal plants?
(b) Discuss briefly the oscillating water column and the tapered channel wave energy conversion devices. Give neat sketches for each of them.
5. (a) What is ocean thermal energy conversion (OTEC)? Why is in-house power consumption comparatively higher for an OTEC plant? Comment on the other limitations of OTEC systems.
(b) Name the different kinds of geothermal resources.
A sub-surface hydrothermal source provides warm water at 95°C . It's planned that this resource will be exploited to generate power in a geothermal plant. Assuming an environment at 25°C , estimate the ideal work potential of the resource per kg of water.
6. Write short notes on any two:
- (a) Pumped storage hydro plant
 - (b) Overpotentials in fuel cells
 - (c) Solar chimney

(Two marks reserved for neatness.)