

Code : 031828

(2)

B.Tech 8th Semester Exam., 2020

DIRECT ENERGY CONVERSION

Time : 3 hours

Full Marks : 70

Instructions :

- (i) The marks are indicated in the right-hand margin.
- (ii) There are **NINE** questions in this paper.
- (iii) Attempt **FIVE** questions in all.
- (iv) Question No. 1 is compulsory.

1. Choose the correct answer (any seven) : $2 \times 7 = 14$

- (a) Fuel cell converts chemical energy to electric energy using a reaction
- (i) that eliminates combustion of fuel
 - (ii) that requires combustion of fuel
 - (iii) that requires no ignition of fuel
 - (iv) where fuel is not required

- (b) For which of these devices do negative charge carriers flow from anode to cathode in the external circuit?

- (i) MHD generator
- (ii) Thermionic generator
- (iii) Thermoelectric generator
- (iv) Fuel cell

- (c) Which of these is a non-conventional type of power generation without prime movers?

- (i) Hydropower
- (ii) Thermal power
- (iii) Nuclear power
- (iv) Thermoelectric power

- (d) Which of the following is a non-renewable resource?

- (i) Coal
- (ii) Forests
- (iii) Water
- (iv) Wildlife

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- (e) Photovoltaic energy is the conversion of sunlight into
- (i) chemical energy
 - (ii) biogas
 - (iii) electricity
 - (iv) geothermal energy
- (f) Fuel cells are
- (i) carbon cell
 - (ii) hydrogen battery
 - (iii) nuclear cell
 - (iv) chromium cell
- (g) Thermal neutrons are
- (i) exceptionally fast neutrons
 - (ii) fast neutrons
 - (iii) moderately fast neutrons
 - (iv) slow neutrons
- (h) No moving parts are required in
- (i) MHD generator
 - (ii) tidal power plant
 - (iii) thermionic conversion
 - (iv) OTEC power plant

- (i) The value of fill factor (FF) of a solar cell is always
- (i) less than one
 - (ii) more than one
 - (iii) equal to one
 - (iv) None of the above
- (j) To increase the voltage, the PV module can be connected in
- (i) series
 - (ii) parallel
 - (iii) Both of the above
 - (iv) None of the above
2. (a) Define single and multiple stage thermoelectric power generators. Derive overall efficiency of cascade multistage operation. 7
- (b) What are various thermoelectric materials? What are the maximum thermal efficiency and maximum power output of thermoelectric generators? 7

3. (a) What is meant by direct energy conversion? How is it different from other energy conversion processes? 6
- (b) Describe the electrochemical thermodynamics of a fuel cell. 8
4. (a) What are various sources of energy which can be converted into power? Give any two examples of such energy conversion process in detail. 8
- (b) Design a thermoelectric generator to operate from a heat source of 1000 K and to reject heat at 600 K. The required output is 50 W at 6 V. The properties of the materials used are $\alpha_p = 0.001$ V/K, $k_p = 0.03$ W/cm-K, $k_n = 0.02$ W/cm-K, $\rho_p = 0.006$ ohm-cm. Assume the thermoelectric elements to be 1 cm in length. 6
5. (a) What is meant by photovoltaics? Draw and explain idealized equivalent circuit for solar cells. 7
- (b) How is the solar cell fabricated and what are the basic characteristics of solar cell and what are the various performance parameters? 7

6. (a) Define an MHD system and its working principle. Describe combined MHD-steam power plant. 7
- (b) What are meant by generation and recombination processes in solar photovoltaics? Why is the conversion efficiency of photovoltaics low? 7
7. What is fusion power generation? What are the advantages, disadvantages and limitations of fusion power? 14
8. (a) What is the working principle of fuel cells? Classify fuel cells. What are the performance parameters of fuel cells? 7
- (b) The duct of an MHD generator has a constant spacing between electrodes of 0.4 m. Each electrode has an area of 0.5 m². Ionized gas with an electrical conductivity of 30 (ohm-m)⁻¹ flows through the duct at an average velocity of 800 m/s. A cross magnetic flux of 2.5 Wb/m² is applied, and an external resistance (load) of 0.04 ohm is connected across the electrodes. What is the theoretical power output? 7

9. How is the wind energy converted into electricity? What are the various components and their functions of wind power generator? What are various limitations of wind energy conversion? 14
