Total No. of printed pages = 5

PG/1st Sem/PGET 103

2021

FUNDAMENTALS OF ENERGY TECHNOLOGY

Full Marks –100

Time –Three hours

The figures in the margin indicate full marks for the questions.

Answer any *five* questions.

1. (a) Write the names of common forms of energy. 5

   (b) Sixty watt rated ceiling fan operates for five hours per day. What will be the total cost if one unit cost is Rs. six ? 5

   (c) Explain the different modes of harnessing the solar energy. 5

   (d) Draw the sketch of liquid flat plate collector showing its different components. 5

[Turn over

2. (a) Write about Beam radiation. 5

(b) Derive the expression of transmissivity based on absorption. 5

(c) A solar water heater has following data :

Capacity : 100 litres

Radiation : 5.5 kWh/m^2

Collector efficiency : 52%

Absorber area : 2 m^2

Water inlet temperature : 23°C

Specific heat of water : 4.18 kJ/kg-K

Geyser efficiency : 96%

Unit cost of electricity : Rs. 6.

Calculate the temperature rise. Also calculate the savings of monthly electricity bill. 10

3. (a) Write the role of absorber plate of flat plate collector. 5

(b) Write the classification of solar cell. 5

(c) Write the types of absorber plate. 10

4. (a) Write the working principle of a solar cell. 10

(b) Derive the expression of total power contained in the wind flowing through the swept area A. 5

(c) Calculate the optimum wavelength of light for photovoltaic generation in a CdS cell. Band gap for CdS is 2.42 eV. 5

5. (a) A wind power plant (WPP) of 80m rotor diameter is rotating at a particular windy site with the average wind speed of 6 m/s at a power coefficient of 0.4. Assuming the air temperature as 25°C with a density of 1.225 kg/m^3. Calculate the

(i) total power available in the wind

(ii) maximum power density

(iii) actual power density

(iv) power output from WPP. 10

(b) What is tip speed ratio ? 5

(c) Write the factors affecting performance of rotor of a wind power plant. 5

6. (a) Write down the equation for estimating the capacity of a hydropower project by naming the variables used and providing the respective units of measurement. 4

(b) Suppose you know the 50% dependable discharge in a stream as being 100 litre/sec (i.e., 0.1 m3s-1) and you know where to put the intake and the powerhouse from a reconnaissance visit to the stream so that you can estimate the gross head as being 10m, then assuming a 2% loss in the water conductor system (from experience of Small Hydropower projects in similar setting), and adopting the efficiencies of the turbine and the generator as being 90% and 96% respectively, estimate the power that might be generated from the project with 50% dependability. Further, assess the annual energy that would be derived from this project if the 50% dependable discharge as given to you is assumed to be available on an average during March to November (9 months) in a calendar year. 4+2=6

(c) What are the conventional classifications of hydropower projects according to station capacities ? Describe by providing schematic diagrams any one of the three broad categories of Small Hydropower Project (SHPs) based on the scheme of utilizing available water resources. Label your diagrams by indicating the major components and structures that are required to be constructed for implementing each of these three categories of SHP. 4+6=10

7. (a) What do you mean by Ocean Thermal Energy Conversion (OTEC) technology? Describe the primary conditions for viability of OTEC projects. Give a schematic diagram by suitably labelling and explaining the operations of a closed-cycle OTEC power system. State a rule of thumb for assessing the quantity of water required for producing 100 MW of electricity in a renewable energy project employing OTEC technology. 4×2=8

(b) Describe the principles of generating energy 3×4=12

(i) by Wave Energy Conversion (WEC)

(ii) by Geothermal energy conversion and

(iii) from tidal power.