Reference Number:PG/PE/T/127E

Master of Power Engineering 2nd Semester Examination 2019

Subject: Non Conventional Power Engineering

Time 3 Hours **Full Marks 100**

Attempt any Five

1. a) What is Charge Controller of a Battery System. Why they are required. **05**

b) Design a solar PV system for a rooftop mounted system for the loads, whose details are given in Table below. Minimum sunshine hours may be assumed as 5 hrs. Given: Solar PV panel to be used are: W_p = 72 W, V_m = 17.6 V , I_m = 4.0A. Operating factor = 0.70, Battery efficiency = 95%, Inverter efficiency = 90% , Charge controller efficiency = 92%. Days of autonomy = 2, Use a PV module: whose data are given as: Peak power = 72 W_p , Voltage at peak power (V_{pp}) = 17.6V, current at peak power (I_{pp}) = 4.0 A, Assume operating factor of 0.75. **15**

Load	Rating (Watts)	Number	Power (Watts)	Hours/Day	Wh
CFL	9	3	27	3	81
Fan	60	1	60	4	240
TV	100	1	100	3	300
Computer	250	1	250	2	500
Total	-	-	**437**	-	**1121**

2. a) An aero-generator, installed at sea shore, generates an output of 1200 W at wind speed of 6m/s at a temperature of 27°C. What will be the output, if the same aero-generator is installed on top of a hill where the temperature is 15°C, pressure is 0.85 atm and wind speed is 8m/s ? **05**

b) Design a Wind Mill Power Plant of capacity 20 MW, evacuating power at 11KV, 3 Phase, 3 Wire, 50 Hz systems. Assume the Cut off and Cut in Wind speed, other related temperature and pressure. **15**

3.a) What is pyrolysis. What are different gases that are produced due to it. **05**

b) A group of 15 families in a village plans to install a KVIC biogas plant for energy needs of cooking, bathing and lighting, Calculate the volume of gasholder and digester of the plant and number of cattle required. Use following Data: Number of persons = 60, Mass of wet cow dung produced/cattle/day = 10kg, Heat energy required for cooking = 1725kJ/Person/day. Heat energy required for breakfast, snacks etc. may be assumed to be half of that required for cooking. Room temperature is 20°C. Assume that 15 litre of water at 47°C is required for bathing per person, assume that 2 lamps of 40W are used for 4hrs daily by each family for the purpose of lighting. The efficiency of lamp may be assumed as 40%. Gas burner efficiency is 60%. Heating value(L.C.V) of biogas = 17500kJ/m^3 . Gas yield of cow dung is 0.38m^3/kg of dry matter. Density of slurry = 1080Kg/m^3. Retention period = 40 days. **15**

4. a) Where from Geothermal Energy be obtained. State some harnessing methodologies.

b) A 0.5KM thick hot aquifer is located at a depth of 3km and has a porosity of 6%. The density of the under sediments is 3000kg/m^3 and its specific heat is 750J /kgK. The temperature gradient in the overlaying material is 40°C/km. Density and specific heat of water is 1000kg/m^3& 4200J/kgK respectively. Find:

i.) The heat content per sq. km above 42°C and the initial temperature of the aquifer, if the average surface temperature is 10°

ii.) The time constant for useful heat generation with pumped water extraction at a rate of 0.5$m^3s^{-1}km^{-2}$

iii.) The thermal power extractable per sq. Km initially and after 15 years. **5+ 15**

5. a) Mention and illustrate the ways of Tidal Power Evacuation. **05**

b) A single basin type tidal power plant has a basin area of 4 sq. km. The tide has an average range of 12m. Power is generated during flood cycle only. The turbine stops operating when the head on it falls below 3m. Calculate the average power generated by the plant in single filing process of the basin if the turbine generator efficiency is 0.70. Estimate the average annual energy generation of the plant. **15**

6. a) Find the emf generated at standard condition, in a fuel cell supplied with methane as fuel. The overall cell reaction (including reformation) is as follows:

$$CH_4 + 2H_2O = CO_2 + 8H^+ + 8e^-$$

The change in the Gibb's free energy, at standard conditions $\Delta G^\circ = -817.97\ kJ/mol$.

b) Design an Energy system incorporating a Fuel Cell System, PV System and Battery for Supplying 5 MW of Power to a residential Colony. Assume and State the Conditions. **5 + 15**

7. a) Design an Hybrid Energy system incorporating a PV System, Wind and Battery for Supplying 20 MW of Power to a regional Grid. Assume and State the Conditions. **15**

b) Provide detail economics of the above system designed in 7 (a) **05**

8 a) What are the different precautions required for MHD Generation system **05**

b) Design a MHD generation System generating 100 KW at a three phase 4 wire system. State your assumptions. **15**

9a) What is Fluidised Bed based Power Generation. What are the fuels generally used **05**

b) Design a Biomass Fuel based Fluidised Power generation System generating 25 MW at a three phase 4 wire system. State your assumptions. Design the switchyard also. **15**