Total No. of Questions : 8]

SEAT No. :

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B.E. (Mechanical Engineering)

RENEWABLE ENERGY TECHNOLOGIES

(2019 Pattern) (Semester - VIII) (Elective - VI) (402051B)

Time : 2½ Hours] *[Max. Marks : 70*

Instructions to the candidates:

1) ***Solve Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q8.***
2) ***Neat diagrams must be drawn wherever necessary.***
3) ***Figures to the right indicate full marks.***
4) ***Use of electronic pocket calculator is allowed.***
5) ***Assume suitable data, if necessary.***

Q1) a) Describe the principle of solar photovoltaic energy conversion. How does the variation of insolation and temperature affect the I-V characteristics of a solar cell? **[6]**

b) Describe the classification of solar cells based on the type of active material used. **[6]**

c) Explain various factors contributing to losses and efficiency reduction in a solar cell. **[6]**

OR

Q2) a) State the principle of solar photovoltaic (PV) energy conversion and the applications of solar PV systems. **[8]**

b) Design a standalone PV system for the load specified in the table. **[10]**

Load	Number	Power Rating (Watt)	Usage Hr/day
LED lamp	1	40	12
Refrigerator	1	80	8
Computer	1	60	6

P.T.O.

Find:

i) Energy supplied (Wh) by the battery to inverter input considering inverter efficiency = 80 %.

ii) Considering Depth of Discharge (DOD) of 50 %, calculate the required charge capacity of battery (24V).

iii) Considering three days of autonomy, calculate battery charge capacity.

iv) Calculate no. of batteries needed for 24 V system voltage if the available battery configuration is 12 V and 100 Ah.

v) Calculate the number of panels of 40 W_p for the above case considering 8 sunshine hours of 1000 W/m^2 -day.

Assume battery efficiency = 80 %, Assume controller circuit efficiency = 100%.

Q3) a) Explain the principle of aerodynamic lift and also explain the various forces acting on aerofoil shape blade of wind turbine. **[6]**

b) Compare vertical axis wind turbine with horizontal axis turbine. **[6]**

c) List and briefly explain the various parts of horizontal axis wind turbine. **[6]**

OR

Q4) a) Explain how the wind energy systems (WECS) are classified? Discuss in brief? **[8]**

b) A propeller type wind turbine having blade diameter of 60 m is in operation at a speed of 175 rpm with a wind velocity of 25m/s. Calculate the total power density in the wind, maximum obtainable power density, total power produced with an efficiency of 30%, torque and axial thrust. Assume air density as $\rho = 1.226$ kg/m^3. **[10]**

Q5) a) Describe the working principle of grid connected SPV system with battery storage. **[6]**

b) How do you calculate annual energy yield of wind power plant? **[6]**

c) Comment on the environmental impact of wind energy. **[5]**

OR

Q6) a) Explain **[6]**

i) speed control strategies for wind turbines; and

ii) power-speed characteristics of wind turbine for different wind speed.

b) What are the determinant factors in site selection for photovoltaic projects? **[6]**

c) What is the effect of solidity on the performance of wind turbine? **[5]**

Q7) a) Compare the relative performance of a floating drum and fixed one type biogas plants? **[6]**

b) Give the advantages and disadvantages of biomass energy. **[6]**

c) What are the different biomass energy resources and what is the energy yield from each of them. **[5]**

OR

Q8) a) What is gasification? Explain the processes **[6]**

i) Drying

ii) Pyrolysis

iii) Oxidation

b) What are thermo chemical and biochemical conversions? **[5]**

c) A biomass gasifier is used to run a compression ignition engine. The engine operates in the dual fuel mode with 76 % diesel replacement. The biomass feeding rate for the gasifier is 320 kg/hr. Calculate the power produced by the engine, if the engine efficiency is 45 % and calorific value of biomass is 16800 kJ/kg. Consider efficiency of the gasifier is 0.65. **[6]**