Duration: 3hrs **[Max Marks:80]**

N.B. : (1) Question No 1 is Compulsory.
(2) Attempt any three questions out of the remaining five.
(3) All questions carry equal marks.
(4) Assume suitable data, if required and state it clearly.

1		Attempt **any FOUR**	**[20]**
	a	Explain the working of Solar Pond.	**5**
	b	Explain various types of Fuel Cells.	**5**
	c	Discuss the advantages & disadvantages of Geothermal energy	**5**
	d	Explain OTEC system	**5**
	e	What are the various types of biogas generation plants.	**5**
2	a	Define and explain the followings:- (a) Latitude (b) Hour angle (c) Declination	**[5]**
	b	State The various types of solar PV cells	**[5]**
	c	Calculate the variation at day length OVER A YEAR (on 26 Th of the month of year 2022) of the following location and plot the same on graph. & make your comments. Location: Mumbai (19.076^{0}N,72.877^{0}E)	**[10]**
3	a	Discuss in brief, what are the effects of various parameters on the performance of flat plate collector.	**[10]**
	b	Calculate the angle made by beam radiation with the normal to a flat plate collector on December 1, at 9.00 A.M., solar time for a location at 28° 35' N. The collector is tilted at an angle of latitude plus 10°, with the horizontal and is pointing due south.	**[10]**
4	a	Explain The Various Methods to improve the efficiency of PV cells.	**[10]**
	b	State The working principle of a solar PV system.	**[10]**

5 a Wind at1standard atmospheric pressure &15^{0}c has a velocity of 15m/s calculate, 1) the total power density in the wind 2) a maximum obtainable power density 3) the total power 4) the total torque & axial thrust.(Given data Turbine dia.=120M,turbine operating speed =40 RPM at max. efficiency assume propeller type wind turbine) **[10]**

b Discuss in details, the various Factors for selection of sites for wind mills. **[10]**

6 a The following data are given for a family biogas digester suitable for the output of 5 cows; the retention time is 20 days, temp. is 20^{0}c,dry matter consumed per day =2kg. Biogas yield is 0.24m^3/kg, the efficiency of burner is 60%, methane proportion is 0.8, heat of combustion of methane=28MJ/m^3, calculate 1) the volume of Digester & 2) power available from digester. **[10]**

b For a Rs. 12 lacs investment in solar energy equipment which meets 54 % of annual load of 160 GJ. If first year fuel cost is Rs. 750 per GJ and expected to inflate at the rate of 11 % per year. Determine **[10]**

(a) Undiscounted payback time.
(b) Discounted payback time if the discount future cost is at rate 8 %.

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