Total number of printed pages:3

PG/1st/PGET1105

2021

SOLAR THERMAL ENERGY CONVERSION

Full Marks: 100

Time: Three hours

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

*Answer **any five** questions.*

1.	a)	Define and explain the following with neat diagrams: i) Solar azimuth angle ii) declination angle iii) Hour angle	9
	b)	Determine the local solar time corresponding to 14.30 hrs. (IST) on July 1st, at Mumbai (latitude of 19° 07′ N longitude 72° 51′ E).	3
	c)	Estimate the daily global radiation on a horizontal surface at Baroda (22° 13′ N, 73° 13′ E) during the month of March. If constants a and b are given as 0.27 and 0.47 respectively and average sunshine hours for day are 9.4.	8
2.	a)	What is beam solar radiation and diffused solar radiation?	4
	b)	Explain the construction and working principle of any one instrument for measuring solar radiation?	8

c) Calculate the angle made by the beam radiation with the normal to a flat plate collector, pointing due south location in New Delhi (28° 38′ N, 77° 17′ E) at 9.00 hrs. Solar time on December 1. The collector is tilted at an angle of 36° with the horizontal. Calculate the day length? 8

3. a) Explain the construction and working of solar flat plate collectors. Discuss the thermal analysis of flat plate collector? 6+8

b) Calculate the collector-plate efficiency factor F′ and heat-removal factor F_R for a smooth, 1-m-wide, 4-m-long air collector with the following design. The flow rate per unit collector area is 0.7 $m^3/min\text{-}m_c^2$ (2.1 $ft^3/min\text{-}ft_c^2$). The air duct height is 1.5 cm (0.6 in), the air density is 1.1 kg/m^3 (0.07 lb/ft^3), the specific heat is 1 kJ/kg·K (0.24 Btu/lb·°F), and the viscosity is 1.79×10^{-5} kg/m·s (1.2×10^{-5} lb/ft·s). The collector heat-loss coefficient U_c is 18 kJ/h·m2·K (5 $W/m^2 \cdot K$; 0.88 $Btu/h \cdot ft^2 \cdot °F$). 6

4. a) Compare between the concentrating collectors over Flat collector. What is concentration ratio (CR)? 10

b) Explain the thermal performance of PTC and its losses? 10

5. a) Explain sensible heat storage, latent heat storage and Thermo-chemical storage of solar energy. 10

b) Explain Thermal Energy storage for solar heating and cooling. What are limitations of solar plants? 10

6. a) Explain the operation of solar thermal power plant with neat schematic? 10

b) Explain the operation of solar distillation? 10

7. a) Explain the construction and working of a solar pond with neat sketch. What are its advantages and disadvantages? 5+5=10

b) Describe a passive solar space heating system 10