Total number of printed pages: 02 **M.Tech(PG)/1st/ PGET1105**

2022

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 the terms altitude angle, zenith angle, solar azimuth angle, surface azimuth angle and incident angle?		10
	b)	i)	Determine the altitude and azimuth angle at 2:25 PM (IST) on June 23 for Mumbai (φ = 18° 54′ N, longitude = 72° 49′ E).	10
		ii)	For the above location, determine the angle of incidence over a south facing with tilt angle of 18° with the horizontal.	
		iii)	Also calculate the hour of the sunrise and the length of the day.	
2.	a)	Derive the expression for the product $< \tau, \alpha >$ for a cover plate combination in terms of τ, α and ρ_d.		10
	b)	Calculate the transmittance-absorptance product (τ, α), of a flat plate collector with two glass covers each 5 mm thickness. The incident angle is 37° and the value of the extinction coefficient K is 0.10/cm. Take the value of α for the absorber plate =0.86 and the refractive index μ = 1.526		10
3.	a)	Explain any two mechanism for the occurrence of heat transfer?		10
	b)	i)	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
		ii)	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.	7
4.	a)	Classify the different solar energy measuring equipment's. What is the difference between a pyrheliometer and pyranometer?		6+4
	b)	Determine the value of H_{av} over a horizontal surface of August 8, at the altitude of 18°29′ N (Pune); if a=0.31, b= 0.43 and ratio of average daily		10

		hours of bright sun shine to maximum daily hours of bright sun shine = 0.58	
5.	a)	Explain the design procedure for a solar based force convective type dryer?	20
6.	b)	Explain the working principle of a solar flat plate collectors and obtain thermal analysis of flat plate collector?	6+8
	c)	Calculate the collector-plate efficiency factor F′ and heat-removal factor F_R for a smooth, 2 m wide, 6 m long air collector with the following design. The flow rate per unit collector area is 0.7 m^3/min-m_c^2 (2.1 ft^3 /min-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·K; 0.88 Btu/h·ft^2·°F).	6
7.	Write short note on any four of the following		4x5=20
	i)	Solar Pond	
	ii)	Solar thermal power plant	
	iii)	Thermal energy storage (types)	
	iv)	Solar distillation	
	v)	Solar concentrator	
	vi)	Beam and diffused solar radiation	

END