

Total number of printed pages:3

2021

SOLAR THERMAL ENERGY CONVERSION

Full Marks: 100

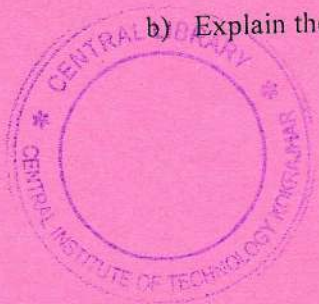
Time: Three hours

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: 9
i) Solar azimuth angle ii) declination angle iii) Hour angle
- b) Determine the local solar time corresponding to 14.30 hrs. (IST) on July 1st, at Mumbai (latitude of $19^{\circ} 07' N$ longitude $72^{\circ} 51' E$). 3
- c) Estimate the daily global radiation on a horizontal surface at Baroda ($22^{\circ} 13' N$, $73^{\circ} 13' E$) 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 ($28^{\circ} 38' N$, $77^{\circ} 17' E$) 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 $0.7 \text{ m}^3/\text{min}\cdot\text{m}^2$ ($2.1 \text{ ft}^3/\text{min}\cdot\text{ft}^2$). 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 $1 \text{ kJ/kg}\cdot\text{K}$ ($0.24 \text{ Btu/lb}\cdot^{\circ}\text{F}$), and the viscosity is $1.79 \times 10^{-5} \text{ kg/m}\cdot\text{s}$ ($1.2 \times 10^{-5} \text{ lb/ft}\cdot\text{s}$). The collector heat-loss coefficient U_c is $18 \text{ kJ/h}\cdot\text{m}^2\cdot\text{K}$ ($5 \text{ W/m}^2\cdot\text{K}$; $0.88 \text{ Btu/h}\cdot\text{ft}^2\cdot^{\circ}\text{F}$). 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

