Ref. No.: Ex/ME/5/T/522A/2019

BACHELOR OF ENGINEERING (MECHANICAL ENGINEERING)

5th Year 2nd Semester Examination, 2019

Sub: Solar Energy

Time: 3 Hours **Full Marks: 100**

(Answer any five)

(Assume necessary data if required)

1. What is meant by ecliptic plane? Draw the diagram and discuss about the different position of earth at each solstice and equinox. (3+17)

2. A solar energy collector uses a single glass cover 2.45 mm thick. In the visible solar range the refraction index of the glass is 1.528, and its extinction coefficient is $0.1cm^{-1}$. Calculate the reflectivity, transmissivity, and absorptivity of the glass sheet at an angle of incidence of 60^0. (20)

3. Write the shot notes (any four) (4x5)

i) Circle of illumination, ii) Solar declination angle, iii) Zenith angle, iv) Summer solstice , v) An antifreeze solution .

4. A solar storage tank of loss coefficient- area product 12.0 w/K and contains 1600 kg of water of temperature of 35° C at 6:30 AM. The outside normal temperature is 20° C. Consider the delivery of solar energy rate is expressed as $Q_u = Q_{u\,mas} \sin(180/\tau)$, where peak delivery rate = 78MJ/h and τ = 11 h. Calculate the temperature of the water tank for 24 hrs periods. (20)

5. Discuss about the Bougers law in determining the transmissivity based on absorption. Drive the equation $\tau = e^{-kL}$ (all symbols have usual meaning). (5+15)

6. Determine the solar collector area to supply 100 % hot water needs of a residence of a family of five, based on the average daily total insolation in June as specified H_t = 23,000 kJ/m^2 , assuming 50 % of solar efficiency . The desired hot water temperature is 60° C and cold water supply is at 15° C. Estimate the solar contribution to the heating of water in the month of January. The January average daily insolation on the tilted collector surface is H_t = 15,100 kJ/m^2. (20)