Total No. of Questions – [4] Total No. of Printed Pages : 2

G.R. No.	

paper code : U359-153 (T1)

October 2019/ INSEM (T1)

T. Y. B. TECH. (MECH ENGG) (SEMESTER -I)

COURSE NAME: Heat Transfer
COURSE CODE: MEUA31173

(PATTERN 2017)

Time: [**1 Hour**] [Max.Marks: **30**]

(*) Instructions to candidates:

1) **Answer Q.1 OR Q.2 and Q.3 OR Q.4.**
2) **Figures to the right indicate full marks.**
3) **Use of scientific calculator is allowed**
4) **Assume and Use suitable data where ever required**

Q.1) a) A wall is constructed of several layers. The first layer consists of brick (k = 0.66 W/m.K), 25 cm thick, the second layer 2.5 cm thick mortar (k = 0.7 W/m.K), the third layer 10 cm thick limestone (k = 0.66 W/m.K) and outer layer of 1.25 cm thick plaster (k = 0.7 W/m.K). The heat transfer coefficients on interior and exterior of the wall fluid layers are 5.8 W/m^2.K and 11.6 W/m^2.K, respectively. Find : (i) Overall heat transfer coefficient, (ii) Rate of heat transfer per m2, if the interior of the room is at 26°C while outer air is at – 7°C. [6]

b) A steam pipe of 5 cm inside diameter and 6.5 cm outside diameter is covered with a 2.75 cm radial thickness of high temperature insulation (k = 1.1 W/m.K). The surface heat transfer coefficient for inside and outside surfaces are 4650 W/m^2.K and 11.5 W/m^2.K, respectively. The thermal conductivity of the pipe material is 45 W/m.K. If the steam temperature is 200°C and ambient air temperature is 25°C, determine : (i) Heat loss per meter length of pipe. (ii) Temperature at the interface. [6]

c) i) State Fourier's Law of Heat Conduction with its mathematical equation. [4]
ii) Define Thermal Conductivity.

OR

Q.2) a) An electric cable of 20 mm diameter is insulated with rubber, which is exposed to atmosphere at 30°C. Calculate the most economical thickness of rubber insulation (k = 0.175 W/m.K). When cable surface temperature with and without insulation is at 70°C. Also calculate the percentage increase in [6]

heat dissipation and current carrying capacity when most economical thickness is provided. Take heat transfer coefficient, h = 9.3 W/m^2.K.

b) A hollow sphere of inside radius 30 mm and outside radius 50 mm is electrically heated at itsinner surface at a constant rate of 105 W/m^2. The outer surface is exposed to a fluid at 30°C, with heat transfer coefficient of 170 W/m^2.K. The thermal conductivity of the material is 20 W/m.K. Calculate inner and outer surface temperatures. [6]

c) Explain i) Thermal Diffusivity, ii) Thermal Contact Resistance [4]

Q.3) a) A very long 25 mm diameter copper (k = 380 W/m.K) rod extends from a surface at 120°C. [6]
The temperature of surrounding air is 25°C and the heat transfer coefficient over the rod is 10 W/m^{2}K. Calculate:
(i) Heat loss from the rod,
(ii) How long the rod should be in order to be considered infinite?

b) A Steel rod (K= 30 W/mK) 1 cm in diameter and 5 cm long protrudes from a wall which is maintained at 100 ^{0}C. The rod is exposed to an environment with temperature 30^{0}C and h= 50 W/m^{2}K. Calculate fin efficiency, temperature of tip fin and rate of heat dissipation from the base of fin. Assume fin with insulated tip. [4]

c) Derive general differential equation of pin fin. [4]

$$\frac{d^2\theta}{dx^2} - m^2\theta = 0$$

OR

Q.4) a) A hot surface at 100°C is to be cooled by attaching 3 cm long, 0.25 cm diameter aluminum fins (k = 237 W/m.K) to it, with a center to center distance of 0.6 cm. The temperature of surrounding air is 30°C and heat transfer coefficient on surface is 35 W/m^2.K. Calculate the rate of heat transfer from the surface for a 1 m × 1 m section of the plate. Also determine the overall effectiveness of the fins. [6]

b) The 4 mm thick fins of Mild Steel are used to transfer heat from water to air. Decide the utility of fin on either side. The heat transfer coefficient of air is 80 W/m^{2}K while that of water is 5600 W/m^{2}K. Take thermal conductivity of mild steel as 45 W/mk. [4]

c) Define i) Fin Efficiency, [4]
ii) Fin Effectiveness

**** Best Wishes *****