Please check that this question paper contains_____ questions and _____ printed pages within first ten minutes.

[Total No. of Questions: 09] [Total No. of Pages: 02]

Uni. Roll No. …….

Program: B.Tech.
Semester: Sem. 5th
Name of Subject: Heat Transfer
Subject Code: PCME-112
Paper ID: 16378

13-01-2022(E)

Time Allowed: 02 Hours **Max. Marks: 60**

NOTE:

1) Each question is of 10 marks.
2) Attempt any six questions out of nine
3) Any missing data may be assumed appropriately

1. What is conduction heat transfer? How does it differ from convective heat transfer? Also discuss the significance of heat transfer.
2. Derive general heat conduction equation in spherical co-ordinates.
3. A wall of a furnace is made up of inside layer of silica brick 120 mm thick covered with a layer of magnesite brick 240 mm thick. The temperatures at the inside surface of silica brick wall and outside surface of magnesite brick wall are 725^0C and 110^0C respectively. The contact thermal resistance between the two walls at the interface is 0.0035^0C/W per unit wall area. If thermal conductivities of silica and magnesite bricks are 1.7 W/m ^{0}C and 5.8 W/m^{0}C, calculate:
i. The rate of heat loss per unit area of walls and,
ii. The temperature drop at interface.
4. A small electric heating application uses wire of 2 mm diameter with 0.8 mm thick insulation (k = 0.12 W/m^{0}C). The heat transfer coefficient (h_0) on the insulated surface is 35 W/m^2 ^{0}C. Determine the critical thickness of insulation in this case and the percentage change in the heat transfer rate if the critical thickness is used, assuming the temperature difference between the surface of the wire and surrounding air remains unchanged.
5. A steel rod (k = 32 W/m^{0}C), 12 mm in diameter and 60 mm long, with an insulated end, is to be used as a spine. It is exposed to surroundings with a temperature of 60^0C and a heat transfer coefficient of 55 W/m^2 ^{0}C. The temperature at the base of fin is 95 ^{0}C. Determine:
i. The fin efficiency;
ii. The temperature at the edge of the spine;
iii. The heat dissipation.
6. A tube 5 m long is maintained at 100^0C by steam jacketing. A fluid flows through the tube at the rate of 2940 kg/h at 30^0C. The diameter of the tube is 2 cm. Find out average heat transfer coefficient.
Take the following properties of the fluid:
ρ = 850 kg/m^3, c_p = 2000 J/kg ^{0}C, v = 5.1 x 10^{-6} m^2/s and k = 0.12 W/m^{0}C.

7. Steam at atmospheric pressure enters the shell of a surface condenser in which the water flows through a bundle of tubes of diameter 25 mm at the rate of 0.05 kg/s. The inlet and outlet temperatures of water are 15^0C and 70^0C respectively. The condensation of steam takes place on the outside surface of the tube. If the overall heat transfer coefficient is 230 W/m^2 ^{0}C, calculate the following, using NTU method:

i. The effectiveness of the heat exchanger,

ii. The length of the tube, and

iii. The rate of steam condensation.

Take the latent heat of vaporisation at 100^0C = 2257 kJ/kg

8. Differentiate between the mechanism of filmwise and dropwise condensation.

9. A 70 mm thick metal plate with a circular hole of 35 mm diameter along the thickness is maintained at a uniform temperature 250^0C. Find the loss of energy to the surrounding at 27 ^{0}C, assuming the two ends of the hole to be as parallel discs and the metallic surfaces and surroundings have black body characteristics.

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