Section-D

8. Hot exhaust gases which enters a finned tube cross flow heat exchanger at 300°C and leave at 100°C, are used to heat pressurized water at a flow rate of 1 kg/s from 35 to 125°C. The exhaust gas specific heat is approximately 1000 J/kg.K and the overall heat transfer co-efficient based on the gas side surface area is Uh=100W/m²K. Determine the required gas side surface area A using the NTU method. 15

Take Cp_c at Tc=80°C is 4197 J/kg.K and Cp_h=1000 J/kg.K.

9. Define effectiveness of a heat exchanger. Derive an expression for the effectiveness of a double pipe parallel flow heat exchanger. State the assumptions made. 15

B. Tech. (ME) 6th Semester (G Scheme)

Examination, July-2022

HEAT TRANSFER

Paper-PCC-ME-306-G

Time allowed : 3 hours] *[Maximum marks : 75*

Before answering the questions, candidate should ensure that they have been supplied the correct and complete question paper. No complaint in this regard, will be entertained after examination.

Note : *Attempt **five** questions in all, selecting **one** question from each section. **Question No. 1 is compulsory.** All questions carry equal marks.*

1. Describe the following : 6×2.5=15

   (a) Critical thickness of insulation

   (b) Effectiveness of fin

   (c) Transient heat conduction

   (d) Types of heat exchanger

   (e) Biot number

   (f) Drop wise condensation

[P.T.O.

Section-A

2. Derive an expression for 3-D heat conduction equation in Spherical coordinate system. 15

3. A furnace wall consists of three layers. The inner layer of 10 cm thickness is made of firebrick (k=1.04 W/mK). The intermediate layer of 25 cm thickness is made of masonry brick (k=0.69 W/mK) followed by a 5 cm thick concrete wall (k=1.37 W/mK). When the furnace is in continuous operation the inner surface of the furnace is at 800°C while the outer concrete surface is at 50°C. Calculate the rate of heat loss per unit area of the wall, the temperature at the interface of the firebrick and masonry brick and the temperature at the interface of the masonry brick and concrete. 15

Section-B

4. An aluminium rod (k=204 W/mK) 2 cm in diameter and 20 cm long protrudes from a wall which is maintained at 300°C. The end of the rod is insulated and the surface of the rod is exposed to air at 30°C. The heat transfer coefficient between the rod's surface and air. Calculate the heat lost by the rod and the temperature of the rod at a distance of 10 cm from the wall. 15

5. During a heat treatment Process, alloy steel Spherical balls of 12 mm diameter are initially heated to 800°C in a furnace. Subsequently these are cooled to 100°C by keeping them immerged in an oil bath 35°C with convection coefficient 20 W/m^2–K. Determine the time required for the cooling process. Proceed to calculate the value of convection coefficient if it is desired to complete the cooling process in a period of 10 minute. The physical properties of steel balls are : Density 7750 Kg/m^3; Specific heat 520 J/kg-K and conductivity 50 W/m-K ? 15

Section-C

6. Two large parallel planes with emissivities 0.35 and 0.85 exchange heat by radiation. The planes are respectively 1073K and 773 K. A radiation shield having the emissivity of 0.04 is placed between them. Find the percentage reduction in radiation heat exchange and temperature of the shield. 15

7. Explain for fluid flow along a flat plate : 2×7.5=15

   (i) Velocity distribution in hydrodynamic boundary layer

   (ii) Temperature distribution in thermal boundary layer