SHAHEED BHAGAT SINGH STATE TECHNICAL CAMPUS, FEROZEPUR

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B.Tech. || ME || 6^{th} Sem

Heat Transfer

Subject Code:BTME-602 (RP)

Paper ID: M118

(2011-2014 batch)

Time allowed: 3 Hrs **Max Marks: 60**

Important Instructions:

- **All questions are compulsory**
- **Assume any missing data**

PART A (2×10)

Q. 1. Short-Answer Questions: All COs

(a) Distinguish between free and forced convection.

(b) Define fin efficiency and effectiveness.

(c) State Fourier's law of heat conduction.

(d) Define NTU of a heat exchanger.

(e) A person claims that heat cannot be transferred in a vacuum. How do you respond to this claim?

(f) What do you mean by critical radius of insulation?

(g) State the difference between filmwise and dropwise condensation.

(h) Give a few specific examples of use of fins.

(i) What is the importance of conduction shape factor?

(j) Define emissive power and Intenisty of radiation.

PART B (8×5)

Q. 2. (a) Name and explain briefly the various modes of heat transfer. CO_1, CO_2

(b) The composite wall of an oven consists of three materials, two of them are of known thermal conductivity, k_A = 20 W/ m K and k_C = 50 W / m K and known thickness L_A = 0.3 m and L_C = 0.15 m. The third material B, which is sandwiched between material A and C is of known thickness, L_B = 0.15 m, but of unknown thermal conductivity k_B.

Under steady state operating conditions, the measurement reveals an outer surface temperature of material C is 20°C and inner surface of A is 600°C and oven air temperature is 800°C. The inside convection coefficient is 25 W/m^2 K. What is the value of k_B?

OR

(a) Drive an expression for temperature distribution during steady state heat conduction in a solid sphere with internal heat generation and exposed to convection environment. CO_1, CO_2

(b) In a long nuclear reactor, 5 cm diameter cylindrical uranium rod cooled by water from outside, serves as the fuel. Heat is generated uniformly in the rod (k = 29.5 W / m K) at a rate of 7×10^7 W/m^3. If the outer surface temperature of the rod is 150°C. Calculate the temperature at the centre.

Q. 3. Explain the criteria of selection of fins. Drive an expression for heat flow in a straight triangular fin. CO_3

OR

A very long rod, 25 mm in diameter, has one end maintained at 100°C. The surface of the rod is exposed to ambient air at 25°C with convection coefficient of 10 W/m^2 K. CO_3

(a) What are the heat losses from the rods, constructed of pure copper (k = 398 W/m K) and stainless steel (k = 14 W/m K)?

(b) Estimate how long the rods must be to be considered infinite.

Q. 4. (a) What do you understand by Laminar, Turbulent and Thermal Boundary layers? CO_5

(b) Define effectiveness of heat exchanger. How maximum heat transfer rate is is obtained?

OR

A heat exchanger is required to cool 55,000 kg/h of alcohol from 66°C to 40°C using 40,000 kg/h of water entering at 5°C. Calculate (i) exit temperature of water, (ii) heat transfer rate, (iii) surface area required for (a) parallel flow type, (b) counter flow type of heat exchanger. CO_5

Q. 5. (a) Discuss the conditions under which the dropwise condensation can take place. Why the rate of heat transfer in dropwise condensation is many time that of film condensation? CO_4

(b) Explain pool boiling.

OR

Drive an expression for Nusselt number for laminar film condensation on a vertical surface. Also state the assumption made in driving expression. CO_4

Q. 6. (a) State and prove the Kirchhoffs law of thermal radiation. CO_6

(b) A hot water radiator of overall dimensions 2 x 1 x 0.2 m is used to heat the room at 18°C. The surface temperature of radiator is 60°C and its surface is black. The actual surface of the radiator is 2.5 times the area of its envelope for convection for which the convection coefficient is given by $h_c = 1.3(\Delta T)^{1/3}$ W/m^2.K.

Calculate the rate of heat loss from the radiator by convection and radiation.