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(Pages : 2) **Name**.....

Reg. No.....

FIFTH SEMESTER B.TECH. (ENGINEERING) DEGREE EXAMINATION DECEMBER 2008

ME 04 502—HEAT AND MASS TRANSFER

(2004 admissions)

Time : Three Hours **Maximum : 100 Marks**

Answer Parts A and B completely.
Use of Heat transfer data hand book is permitted.
Any missing data can be suitably assumed.

Part A

Answer **all** *questions.*

I. 1 Differentiate between steady and transient heat conduction.

2 What is critical thickness of insulation on a small diameter wire or pipe ? Explain its physical significance.

3 Distinguish between Biot and Prandtl numbers.

4 Compare the variation of velocity and local heat transfer co-efficient along a vertical plate for the plate under natural convection and forced convection.

5 It is observed that the intensity of the radiation emitted by the sun is maximum at a wavelength of 0.5 μ . Assuming the sun to be a black body, estimate its surface temperature and emissive power.

6 What is a black body radiation ? Deduce Stefan's law from thermodynamic considerations.

7 What is the expression for LMTD in a counterflow exchanger when the capacity rates (m_c) for the hot and cold fluids are the same.

8 Define Ficks Ist and IInd laws of diffusion.

(8 × 5 = 40 marks)

Part B

II. 9 Derive an expression for the temperature distribution in a plane wall for which the thermal conductivity varies according to $K = K_0\, e^{-X/L}$ where K_0 is constant and L is the wall thickness. The temperatures on two sides of the wall are T_1 and T_2.

Or

10 A copper fin 12 mm dia and 250 mm long spans two walls one at 200°C and the other at 120°C. The thermal conductivity of the material is 330 W/mK. Air at 30°C flows between the walls and the convective coefficient over the rod is 56.8 W/m^{2}K. Determine the heat flow through the rod. Also find the temperature at the mid section and the location and the value of minimum temperature.

Turn over

Write a note on :

(a) The various regimes in boiling Heat Transfer.

(b) Filmwise and dropwise condensation.

(c) Film boiling and pool boiling.

Or

Air flows over a thin plate with a velocity of 2.5 m/sec. The width of the plate is 1 m and its length is also 1 m. Calculate the boundary layer thickness at the end of the plate and the force necessary to hold the plate in the stream of air. The properties of air are $\rho = 1.12$ kg/m^3. $\mu = 0.86 \times 10^{-5}$ NS/m^2.

Calculate the shape factor F_{12} between a small area A_1 and a circular segment of a spherical surface of radius R (area A_2). Area A_2 is located symmetrically at the centre of the sphere and the segment subtends an angle 211 at A_1.

Or

A cylindrical shaped furnace is 1 m dia. and 1 m high. The top surface having an emissivity of 0.7 has a uniform heat flux of 7 kW/m^2. The bottom surface with an emissivity of 0.4 is maintained at 350 K. The sides are insulated and function as reradiating surfaces. Determine the heat transfer to bottom surface and also the temperatures of the top and sides.

Define effectiveness of a Heat Exchanger. Derive an expression for the same for a parallel flow heat exchanger.

Or

A 1-shell-2 tube pass steam condenser consists of 3,000 brass tubes of 20 mm diameter. Cooling water enters the tubes at 20°C with a mean flow rate of 3000 kg/s. The heat transfer coefficient for condensation is 2.3×10^8 w when the steam condenses at 50°C. Determine :

(a) the outlet temperature of the cooling water.

(b) the overall heat transfer coefficient.

(c) the tube length per pass using the NTU method.

(d) the rate of condensation of steam.

(4 × 15 = 60 marks)