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Roll No .....

MMTP-103

M.E./M.Tech., I Semester

Examination, December 2016

Heat And Mass Transfer

Time : Three Hours

Maximum Marks : 70

Note : i) Answer any five questions.
ii) All questions carry equal marks.

1. a) Derive an expression to determine the heat flow through a composite cylindrical shell with two layers. Assume no heat generation and that steady state is reached.
   b) Explain why fins are widely used. Discuss a few commonly used types of fins.

2. Engine oil at 30°C is flowing with a velocity of 2m/s along the length of a flat plate, maintained at 90°C. Calculate at a distance of 40cm from the leading edge:
   i) Hydrodynamic and thermal boundary layer thickness by the exact method
   ii) Local and average value of friction coefficient
   iii) Local and average value of heat transfer coefficient
   iv) Heat transferred from the first 40cm of the plate for unit width

3. a) With the aid of neat sketch of a boiling curve for water (for pool boiling), explain the various regimes of boiling.
   b) Differentiate between film condensation and drop wise condensation. In which case is the heat transfer higher?

4. a) A blind cylindrical hole of diameter 2cm and length 3cm is drilled into a metal slab having emissivity 0.6, if the metal slab is maintained at a temperature of 350°C, find the heat escaping out of the hole by radiation.
   b) What is meant by view factor? When is the view factor of a surface to itself equal to zero.

5. Hydrogen gas at 2 bar, 25°C is flowing through a vulcanised rubber tube, 30mm ID, 50mm OD solubility of H_2 in rubber is $0.053 m^2$ of H_2 per atm. per m^3 of rubber at 25°C. Diffusivity of H_2 through rubber is 10×10^{-11} m^2/s. Density of H_2 is $0.0899 kg/m^3$ at 1 bar pressure at 0°C. Calculate percentage reduction in H_2 loss if the rubber pipe is covered by 2.5mm thick steel tubing. Assume diffusivity of H_2 through steel as $1.0 \times 10^{-12} m^2/s$ at 25°C.

6. a) State the general differential equation for steady state heat conduction in cylindrical and spherical co-ordinates.
   b) Explain the difference between natural and forced convection in laminar and turbulent flow.

7. a) Explain the following:
      i) Black body and Gray body
      ii) Thermal Radiation
   b) State Fick's law of mass transfer by diffusion and explain its analogy with Fourier's law of conduction.

8. Write short note on (any three)
   a) Diffusion coefficient
   b) Steady and unsteady state heat transfer
   c) Buckingham π-theorem
   d) Modified latent heat of evaporation

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