R09

Code: 9A03505

B.Tech III Year I Semester (R09) Supplementary Examinations June 2016

HEAT TRANSFER

(Mechanical Engineering)

Time: 3 hours Max Marks: 70

Answer any FIVE questions

All questions carry equal marks

Use of heat transfer data book and steam tables is permitted in the examination hall

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1 (a) Heat is generated within a sphere at 2.07 x 10^8 W/m^3. The sphere is 8 cm in diameter. The surface temperature is 370 K. (i) Calculate the temperature at the center of the sphere. (ii) Calculate the temperature at a radial distance of 2 cm.

(b) Define and distinguish between: (i) Steady state. (ii) Unsteady state. (iii) Transient state of heat transfer.

2 (a) The surface of steel plate measuring 0.9 m long × 0.6 m wide × 0.025 m thick is maintained at a uniform temperature of 300^{0}C and the plate loses 250 W by radiation. If air is at 15^{0}C temperature and 20 W/m^2K convective heat transfer coefficient blows over the plate, calculate the temperature on inside surface of the plate. Take thermal conductivity of plate as 45 W/mK.

(b) Derive expressions for temperature distribution during steady sate heat conduction in a solid sphere.

3 (a) What is lumped mass model? Derive the equation for the temperature of a lumped body for the specified transient condition.

(b) A thick bronze plate (α = 0.86 x 10^{-5} m^2/s and K = 26 W/mK) is initially at a uniform temperature of 250^{0}C. Suddenly the surface is exposed to a coolant at 25^{0}C. Assuming h = 150 W/m^2K, determine the temperature at 5 cm from the surface after 10 min of exposure.

4 (a) What is the significance of Grashof Number and Rayleigh Number?

(b) Water is heated while flowing through 1.5 cm x 3.5 cm rectangular cross section tube with a velocity of 1.2 m/s. The entering temperature of water is 40^{0}C and the tube wall is maintained at 85^{0}C. Determine length of the tube required to raise the temperature to 70^{0}C.

5 (a) Why the mean temperature is to be considered instead of ambient temperature for internal flows? Explain

(b) Air at 20^{o}C is flowing along a heated flat plate at 150℃ at a velocity of 3 m/sec. The plate is 2 m long and 1.5 m wide. Calculate the thickness of the hydrodynamic boundary layer and the skin friction coefficient at 30 cm from the leading edge of the plate. Kinematic viscosity of air at 20^{o}C is 15.06 x 10^{-6} m^2/s.

6 (a) Discuss the different types of processes for condensation of vapours on solid surfaces with suitable diagrams.

(b) Water is boiled at the rate of 25 kg/h in a polished copper pan, 280 mm in diameter, at atmospheric pressure. Assuming nucleate boiling conditions, calculate the temperature of the bottom surface of the pan.

7 (a) Define heat exchanger effectiveness and explain its significance.

(b) In a counter flow double pipe heat exchanger water is heated from 40^{0}C to 80^{0}C with an oil entering at 105^{0}C and leaving at 70^{0}C. Taking the overall heat transfer coefficient as 300 W/m^2K and the water flow rate as 0.1 kg/s. Calculate the heat exchanger area.

8 (a) State Kirchhoff's and Wien's laws of thermal radiation. Derive the Wien's law from basic Planck's distribution law.

(b) A gray surface is maintained at a temperature of 860^{o}C. If the maximum spectral emissive power at that temperature is 1.5 x 10^{10} W/m^2, determine the emissivity of the body and the wavelength corresponding to maximum spectral intensity of radiation.

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