Code: 13A03506

R13

B.Tech III Year I Semester (R13) Regular Examinations December 2015

HEAT TRANSFER

(Mechanical Engineering)

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

Time: 3 hours Max. Marks: 70

PART – A

(Compulsory Question)

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1 Answer the following: (10 X 02 = 20 Marks)

(a) Explain Newton's law of heating or cooling by convection.
(b) Define critical radius of thickness.
(c) What do you understand by the term fin effectiveness?
(d) Define Fourier number.
(e) Define Nusselt number.
(f) Write down the momentum equation for hydrodynamic boundary layer in Cartesian coordinate system over a flat plate.
(g) Differentiate between film-wise and drop-wise condensation.
(h) Draw the temperature distribution for parallel low heat exchanger.
(i) What is a black body?
(j) What is shape factor?

PART – B

(Answer all five units, 5 X 10 = 50 Marks)

UNIT – I

2 Derive the 1D steady state heat conduction equation for a slab with internal heat generation.

OR

3 A steel pipe of 50 mm OD is covered with two layers of insulation. The layer is 7.5 mm thick ad has a thermal conductivity of 0.3 W/mK and the top layer is 25 mm thick and K = 0.12 W/mK. The pipe wall is 315℃ and outside air temperature is 25℃. The convective heat transfer coefficient is 16. Determine the surface temperature and heat loss per length for 10 minutes.

UNIT – II

4 A long carbon steel rod length 40 cm and diameter 10 mm (K = 40 W/mK) is placed in such that one of its end is at 400℃ and the ambient temperature is 30℃. The film coefficient is 10 W/m^2K. Determine: (i) Temperature at mid length of the fin. (ii) Fin efficiency. (iii) Heat transfer rate form the fin.

OR

5 Write short notes on Transient heat conduction with examples.

UNIT – III

6 Glycerin at 30℃ with a flow rate of 0.01 kg/s enters a 2 cm ID tube which is maintained at uniform temperature of 80℃. Determine: (i) The thermal entry length. (ii) Assuming hydro-dynamically and thermally developed flow, determine the heat transfer coefficient and tube length required to heat the glycerin to 50℃.

OR

7 Briefly discuss about the convective heat transfer in a horizontal pipe flow.

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UNIT – IV

8 (a) What is the effect of presence of non-condensable gases on the condensation process? Explain.

(b) Explain the concept of LMTD for a counter flow heat exchanger.

OR

9 A counter flow heat exchanger is used to cool oil at a rate of 0.6 kg/s (C_P = 2.5) from 110℃ to 35℃ using water at 20℃. The overall heat transfer coefficient is 1500 W/m^{2}K. Assuming cooling water outlet temperature as 80℃ and using NTU method calculate: (i) Water flow rate. (ii) Surface area required. (iii) Effectiveness of heat exchanger.

UNIT – V

10 Two long concentric cylinders have diameters of 4 cm and 8 cm respectively. The inside cylinder is at 800℃ and the outside cylinder is at 100℃. The inside and outside emissivities are 0.8 and 0.4 respectively. Calculate the percentage reduction in heat transfer if a cylindrical radiation shield having diameter of 6 cm and emissivity of 0.3 is placed between the two cylinders.

OR

11 Write short notes on:

(a) Radiation heat exchange between black surfaces.

(b) Radiation shields.

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