

Code No: RT32035

R13

SET - 1

**III B. Tech II Semester Supplementary Examinations, November - 2017****HEAT TRANSFER**

(Mechanical Engineering)

Time: 3 hours

Maximum Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B**)2. Answering the question in **Part-A** is compulsory3. Answer any **THREE** Questions from **Part-B**

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**PART -A**

- 1 a) Define Conduction, Convection and Radiation heat transfers and give examples for each case. [3M]
- b) Explain the significance of Biot and Fourier numbers used in unsteady state heat transfer. [4M]
- c) Distinguish the Forced and Natural convections and give example for each. [3M]
- d) Discuss the relative growth of hydrodynamic and thermal boundary layer growths with respect to Prandtl number. [4M]
- e) What is meant by fouling and give the causes for fouling in Heat exchangers. [4M]
- f) Explain the Planck's law of distribution and what is meant by monochromatic emissive power. [4M]

**PART -B**

- 2 a) Give the governing laws for three basic modes of heat transfer. [4M]
- b) A composite slab consists of 250mm fire clay brick ( $k = 1.09 \text{ W/mK}$ ) inside, 100 mm fired earth brick ( $k = 0.26 \text{ W/mK}$ ) and the outer layer of common brick ( $k = 0.6 \text{ W/mK}$ ) of thickness 50 mm. If the inside surface is at  $120^\circ \text{C}$  and outside surface is at  $100^\circ \text{C}$  find (i) heat flux (ii) the temperature of the interfaces and (iii) the temperature at 200 mm from the outer surface of the wall. [8M]
- c) Calculate the critical radius of insulation for asbestos surrounding a pipe and exposed to room air at  $30^\circ \text{C}$  with  $h=3 \text{ W/m}^2\text{K}$ . [4M]
- 3 a) What is a Fin? Discuss different types of fins used in engineering applications. [4M]
- b) Derive the equation for heat dissipated by a fin with an insulated tip. [6M]
- c) A Carbon steel rod ( $k = 55 \text{ W/m C}$ ) has been attached to a plane wall which is maintained at a temperature of  $35^\circ \text{C}$ . The rod is 8cm long has the cross section of an equilateral triangle with each side is 5mm. Determine the heat dissipation from the rod if it is exposed to a convection environment at  $25^\circ \text{C}$  with unit surface conductance  $100 \text{ W/m}^2\text{C}$ . Consider end surface loss to be negligible. [6M]
- 4 a) Using dimensional analysis, obtain an expression for relation among the different non dimensional numbers in the case of forced convection. [8M]
- b) A thin flat plate has been placed longitudinally in a stream of air at  $20^\circ \text{C}$  which flows with undisturbed velocity of 7.5 m/s. The surface of the plate is maintained at a uniform temperature of  $120^\circ \text{C}$ ,
  - i) Calculate the heat transfer coefficient 0.8m from the leading edge of the plate.
  - ii) Also calculate the rate of heat transfer from one side of the plate to the air over the first 0.8m length. Assume unit width of the plate. [8M]

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- 5 a) Explain the natural convection heat transfer on a Vertical hot plate with the help of velocity and temperature profiles. [8M]
- b) Estimate the heat transfer coefficient for a laminar fully developed fluid ( $k=0.175\text{W/mK}$ ) inside a 6mm inner diameter tube under uniform wall temperature boundary condition. Also compute heat transfer rate between the tube wall and the fluid for a length of 8m if the mean temp difference between the wall and the fluid is  $50^{\circ}\text{C}$ . [8M]
- 6 a) Draw pooling boiling curve and discuss the difference regimes in it. [8M]
- b) A double pipe parallel flow heat exchanger is employed in a food processing unit to heat the brine solution from  $-6.5^{\circ}\text{C}$  to  $12^{\circ}\text{C}$  by means of water flowing at the rate of 540 kg/h. The water enters at  $35^{\circ}\text{C}$  and leaves at  $20.5^{\circ}\text{C}$ . If the overall heat transfer coefficient is  $860\text{ W/m}^2\text{K}$ , calculate the heat transfer area. [8M]
- 7 a) What is Stefan Boltzman law and prove Stefan Boltzman constant  $5.67 \times 10^{-8}\text{ W/m}^2\text{ K}$ . [8M]
- b) A black body having surface area  $0.2\text{m}^2$  has an effective temperature 800 K. Determine the following (i) total emission (ii) intensity of radiation (iii) wavelength for maximum spectral emissive power. [8M]

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