Code :ME05283 **RA**

III B.Tech II Semester(R07) Regular & Supplementary Examinations, April/May 2011
HEAT TRANSFER
(Mechanical Engineering)
(For students of R05 regulation readmitted to III B.Tech II Semester R07)

Time: 3 hours **Max Marks: 80**

Answer any FIVE questions
All questions carry equal marks

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1. (a) A steam pipe ($\varepsilon = 9.0$) of 0.4 diameter has a surface temperature of 500 K. The pipe is located in a room at 27 ^{0}C, and the convection heat transfer coeffcient is 25 W/m^2 K. Caluate the combined heat transfer coefficient and the rate if heat loss per unit length of pipe.
   (b) What is heat transfer co-efficient? Explain.
2. (a) Derive the general heat conduction equation for n composite slabs.
   (b) A plane wall is constructed of a material having thermal conductivity that varies as the square of the temperature according to the relation K = K$_0$ (1+ βT^2). Derive an expression for the heat transfer in such a wall.
3. (a) Explain the lumped heat capacity analysis?
   (b) An aluminum sphere weighing 5.5kg and initially at a temperature of 290^{0}C is suddenly immersed in a fluid at 15^{0}C. The convective heat transfer coefficient in 59 W/m^{2}k. Estimate the time required to cool the aluminum to 95^{0}C.
4. (a) Air at a pressure of 8 kN/m^2 and a temperature of 250^{0}C flows over a flat plate 0.3 m wide and 1 m long at a velocity of 8 m/s. If the plate is to be maintained at a temperature of 78^{0}C. Estimate the rate of heat to be removed continuously from the plate.
   (b) Discuss briefly effect of turbulence on boundary layers.
5. (a) A vertical hot plate subjected to laminar natural convection, where will be the heat flux higher (top or bottom). Why?
   (b) Avertical plate 20 cm $\times$ 60 cm size is at 110^0C in an atmosphere at 30^0C. Determine the rate of heat transfer by free convection from the plate when 20 cm side is kept vertical.
6. (a) Why does the heat transfer coefficient in nucleate boiling 10-20 times greater than in film boiling?
   (b) Water at atmospheric pressure is boiled in a kettle made of copper. The bottom of the kettle is flat, 30 cm in diameter and is maintained at a temperature of 118^oC. Calculate the rate of heat required to boil water. Also estimate the rate of evaporation of water from the kettle.
7. (a) Sketch the temperature variations in parallel flow and counter flow heat exchangers.
   (b) Show that ε = NTU / (1+ NTU) for counter flow and ε = 1 - e^{-2NTU} for parallel flow if the capacity rates of hot and cold fluids are equal.
8. A long cylinder having a diameter of 2 cm is maintained at 600^oC and has an emissivity of 0.4. Surrounding the cylinder is another long, thin walled concentric cylinder having a diameter of 6 cm and an emissivity of 0.2 on both the inside and outside surfaces. The assembly is located in a large room having a temperature of 27^oC. Calculate the net radiant energy lost by the 2 cm diameter cylinder per meter length. Also calculate the temperature of the 6 cm diameter cylinder.

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