THAPAR INSTITUTE OF ENGINEERING AND TECHNOLOGY,PATIALA
DEPARTMENT OF MECHANICAL ENGINEERING
End Semester Examination, December -2006
B.E, 4th Year (Backlog)

Course: ME 009 (Heat and Mass Transfer) **Instructor: Satish Kumar**
Max Marks-36 **Time-3 hours**

Note: Section A is compulsory. Attempt any four questions from Section B.
Assume suitable data wherever necessary. See your answer sheets on 12/12/06

Section-A

1 (a) A hollow sphere of inside radius 2.5cm and outside radius 7.5cm has corresponding surface temp of 300°C and 25°C.caculate the heat loss by conduction if thermal conductivity of sphere material is 15 kcl/m-hr-deg-k (4)

(b) Define the following (i) Critical radius (ii) Fins (iii) solid angle (v) Diffuse Surface (4)

Section-B

Q.2 (a) A thin shield of emissivity €s (on both sides) is placed between two infinite parallel plates of emissivities €1 and €2, and temperature T1 and T2 respectively. If €1=€2=€3, show that temperature of the shield is given by:

[(T1 4 + TI 4)/2] ¼ (5)

(b) A stainless steel plate €=0.6 at 100C faces a brick wall (€=0.75) 500C. Estimate the heat flux and the radiant heat transfer coefficient. (2)

Q.3 (a) A metal (k=45w/m-deg)steam pipe 5cm internal dia and 6.5cm external dia is lagged with a2.75cm radial thickness of high temp insulation having thermal conductivity of 1.1w/m-deg.the surface heat transfer coefficient for inside and outside are 4650 and 11.5w/m-deg.if the steam temp is 200c and the ambient temp is 25c then calculate.

(i) heat loss per meter length of the pipe
(ii) temp of the interfaces
(iii)overall coefficient of heat transfer referred to inside and outside surfaces (5)

(b) Define thermal diffusity and explain its physical significance. (2)

Q.4 Heat transfer coefficient depends upon the following parameters: fluid viscosity, density, thermal Conductivity, specific heat, ($\beta g \Delta t$) length. By using dimensional analysis establish the correlation. (7)

Q.5 (a) A Steam pipe50 mm dia and 2.5 m long has been placed horizontally and exposed to still air at 25°C. If the pipe wall temp is 295°C, determine the rate of heat loss. At the mean temp the properties of air are: $\nu = 30.9 \times 10^{-6}$ m2/sec, $K = 3.64 \times 10^{-2}$ W/m-deg, Pr=0.682.
Use the correlation $Nu = 0.53(GrPr)^{1/4}$ (4)

(b) Define Nusselt Number, Grashoff Number, Prandtl Number and explain it physical significance. (3)

Q. 6 (a) Derive an expression for the effectiveness of a counter flow heat exchanger (4)

(b) Differentiate between nucleate and film boiling with neat sketch. (3)