Registration no: | | | | | | | | | | |

Total Number of Pages: 2

B.Tech
PCME4305

6th Semester Regular / Back Examination 2016-17
HEAT TRANSFER
BRANCH(S): AERO, MECH, PLASTIC
Time: 3 Hours
Max Marks: 70
Q.CODE: Z879
Question No.1 is compulsory and answer any five from the rest.
The figures in the right hand margin indicate marks.

1 **Answer the following questions:** **(2x10)**

a) Define thermal resistance of conduction for a slab.
b) Define thermal diffusivity and write its unit.
c) If the temperature of the black body is 200^0K, calculate the total amount of radiation leaving from it.
d) Calculate the view factors of two concentric spheres.
e) Define local Sherwood number and Schmidt number.
f) Differentiate between counter flow and cross flow heat exchanger.
g) Differentiate between condensation and boiling.
h) Define Nusselt number.
i) Define Stanton number.
j) Define thickness of thermal boundary layer.

2 **a)** Calculate the relation between average transfer coefficient and local heat transfer coefficient if the local heat transfer coefficient is approximated by the relation; $h_x = ax^{-0.12}$, where 'a' is a constant coefficient and x is the distance measured from the leading edge of the plate. **(3)**

b) Air at 27^0C and 1 atm (μ=1.85x10^{-5} kg/m.sec) flows over a flat plate at a speed of 2 m/sec. Calculate the hydraulic boundary layer thickness at a distance of 20 cm from the leading edge of the plate. Also calculate the local heat transfer coefficient at that point using the relation: $Nu_x = 0.332\, Re_x^{0.5} Pr^{\frac{1}{3}}$, if the plate is heated over its entire length to a temperature of 60^0C. (Assume at 43.65^0C, $\gamma = 17.36 \times 10^{-6}$ m^2/sec, k=0.02749 W/m^0C, Pr=0.7, C_p=1.006 kj/kg^{0}C) **(7)**

3 **a)** Calculate the critical radius of insulation for asbestos (k = 0.17 w/m^0C) surrounding a pipe and exposed to room air at 18^0C, with h=2.5 W/m^0C. Calculate the heat loss from a 180^0C, 4.5cm diameter pipe when covered with critical radius of insulation and without insulation. **(5)**

b) Derive the differential equation for a rectangular fin. **(5)**

4 a) A steel plant is placed on a non-conducting opaque surface normal to incident solar radiation of 750 W/m^2. Neglecting convection effects, work out the equilibrium temperature of the plate when it is (a) oxidized with emissivity ϵ=0.80 and polished with emissivity ϵ=0.07. Assume the body is grey and σ_b=5.67x10^{-8} W/m^{2}K^4. **(5)**

b) A thin walled duct of 0.5m diameter has been laid in an atmosphere of ambient air at 12^{0}C and conveys a particular gas at 200^{0}C. The boundary layer flow is laminar and the convective coefficient of heat transfer is given by: $h = 1.37\left(\frac{\Delta t}{l}\right)^{0.25}$ W/m^2-deg, where '*l*' is the length of the duct in metres. How this value of convective coefficient compares with that computed from the non-dimensional correlation ($\frac{hl}{k} = 0.57(Gr\,\mathrm{Pr})^{0.25}$) for laminar flow natural convection for a large vertical cylinder. Also calculate the convective heat loss from the duct when the length of the pipe is 100m. (at 110^{0}C, γ=24.10x10^{-6}m^2/sec, k=31.94x10^{-3} W/m-deg, Pr=0.704). **(5)**

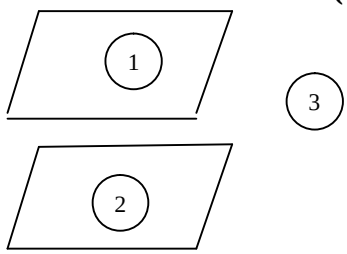
5 a) With neat sketches explain different stages of boiling. **(5)**

b) Explain the phenomena of condensation. **(5)**

6 a) Derive the log mean temperature difference for a parallel flow heat exchanger. **(6)**

b) Define effectiveness of a heat exchanger. Write the relations for the effectiveness of heat exchangers in case of boiling or condensation. **(4)**

7 Two parallel plates 0.5m by 1.0m are spaced 0.5m apart as shown in figure. One plate is maintained at 1000^{0}C and the other is at 500^{0}C. The emissivity of the plates are 0.3 and 0.4 respectively. The plates are located in a large spaced room. The room wall temperature is maintained at 27^{0}C. The plates exchange heat with each other and walls. The thermal resistance between room and wall is negligible. Find the net heat transfer to each plate and to the room. (Assume F_{12} = 0.285, σ=5.678x10^{-8} W/m^{2}K^4) **(10)**



8 Write short answer on any TWO: **(5x2)**

a) Fick's law

b) Overall heat transfer coefficient

c) Lumped heat transfer

d) Reynold's-Colburn analogy