Registration No : | | | | | | | | | | |

Total Number of Pages : 02

B.Tech
PME5I102

5th Semester Regular / Back Examination 2019-20
HEAT TRANSFER
BRANCH : MECH
Max Marks : 100
Time : 3 Hours
Q.CODE : HRB171

Answer Question No.1 (Part-1) which is compulsory, any EIGHT from Part-II and any TWO from Part-III.
The figures in the right hand margin indicate marks.

Part- I

Q1 Only Short Answer Type Questions (Answer All-10) (2 x 10)

a) Write 1-D heat conduction equation for spherical coordinates.
b) What happens to the conductivity of gas when it temperature increase and why?
c) Define lumped heat analysis.
d) What is the physical significance of Biot number with fin effectiveness?
e) What is a contact resistance? Define it for a unit area of the interface. Also for this give its units
f) Define Grashof number and give its physical significance. Give its unit.
g) Define diffused reflection and how it is different from a specular reflection?
h) What is a view factor? What assumptions are typically associated with computing the view factor between two surfaces?
i) Draw the temperature profile of Condenser and Evaporator.
j) How does dropwise condensation differ from film condensation?

Part- II

Q2 Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve) (6 x 8)

a) The inner surface at r = a and outer at r =b of hollow sphere are mounted at uniform temperature T_1 and T_2 respectively. The thermal conductivity of solid “K” is constant.
   a. Develop an expression for 1-D, steady state temperature distribution T_r in sphere.
   b. Develop an expression for radial heat flow rate ‘Q’ through the hollow sphere.
   c. Develop an expression for thermal resistance of hollow sphere.

b) Explain 1st kind,2nd kind and 3rd kind boundary condition with proper diagram.

c) Consider steady 1D heat flow in a plate of 20 mm thickness with uniform heat generation 80 MW/m^3 .The left face and right faces are kept at a constant temperature 160^0C and 120^0C respectively. The plate has constant thermal conductivity of 200W/m-K . Find a) The location of maximum temperature within the plate from its left side b) The maximum temperature within the plate

d) A person is found dead at 5 PM in a room where temperature is 20^0C .The temperature of body is measured to be 25^0C when found. The heat transfer coefficient is 8 $w/m^2\ ^0C$ .Modeling the body of 30 cm diameter, 1.7 m long cylindrical shape .Estimate the approximation time of death of that person. If water properties at 31^0C is K=0.617 W/m^0C ,ρ= 996 kg/m^3 and Cp =4178 J/kg^0C (Assume body temperature from basic knowledge)

e) Derive the temperature distribution and the heat transfer rate equations for a rectangular short fin considering insulated tip condition

f) Heat is being transferred by convection from water at 48^0C to a glass plate whose surface temperature is exposed to the water at 40^0C .The thermal conductivity of water is 0.6 W/m K and the thermal conductivity of glass is 1.2 W/m K .The spital gradient of temperature in the water at water glass interference is $\frac{dt}{dy} = 10^4$ k/m ,Find the value of temperature in glass at water glass interference in k/m and heat transfer coefficient ‘h’ in W/m^{2}K

g) Define fin Fouling in heat exchanger? Explain different types of fouling.

h) Derive radiative resistance and space resistance for grey enclosure.

i) State the Buckingham’s π Theorem. Explain the various parameter used in forced convection. Using dimensional analysis obtain an expression for Nusselt number in terms of Reynolds number and Prandtl number.

j) With neat sketch explain the concept of Hydrodynamic and thermal boundary layers for flow over a flat plate.

k) With neat sketch explain the boiling regimes for pool boiling.

l) Water at 20^0C at 1 atm flows over flat plate at a speed of 0.7 m/s .The width of the plate is 1.5 m .The plate is entirely heated to temperature of 60^0C .Calculate the heat transfer in first 40 cm length using Reynolds Colburn analogy. Properties at 40^0C is $\mu = 6.556 \times \frac{10^{-4} Kg}{ms}$,$C_p = 4.174 \frac{kL}{Kg}$°C$, K_f = 0.6328\ W/\ m$°C$, Pr = 4.334\ \rho = 992.04\ kg/m^3$

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

Q3 Prove that $T = T_\infty + \frac{\dot{q}R}{2h} + \frac{q_g R^2}{4k}\left[1 - \left(\frac{r}{R}\right)^2\right]$ for solid cylinder with uniform heat generation. **(16)**

Q4 Derive the conservation of momentum and energy equations for 2-dimensional incompressible flow of a fluid. **(16)**

Q5 Explain the ε- NTU method of analysis for both parallel flow and counter flow heat exchanger. **(16)**

Q6 What is a Radiation shield? Explain the Electrical analogy for two parallel infinite planes separated by one Radiation shield. **(16)**