2106

Code No: 5221AV

R15

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech II Semester Examinations, August - 2017

CONVECTIVE HEAT TRANSFER

(Thermal Engineering)

Time: 3hrs **Max.Marks:75**

Note: This question paper contains two parts A and B.
Part A is compulsory which carries 25 marks. Answer all questions in Part A. Part B consists of 5 Units. Answer any one full question from each unit. Each question carries 10 marks and may have a, b, c as sub questions.

PART - A

5 × 5 Marks = 25

1.a) What is meant by critical Reynolds number? [5]
b) Define thermal boundary layer thickness. [5]
c) Define the Bulk temperature. [5]
d) What is Reynolds analogy? [5]
e) What is Darcy flow model? [5]

PART - B

5 × 10 Marks = 50

2.a) Sketch the boundary layer development of a flow over a flat plate and explain the significance of the boundary layer.
b) Atmospheric air at 275 K and a free stream velocity of 20 m/s flows over a flat plate 1.5 m long that is maintained at a uniform temperature of 325 K. Calculate the average heat transfer coefficient over the region where the boundary layer is laminar, the average heat transfer coefficient over the entire length of the plate and the total heat transfer rate from the plate to the air over the length 1.5 m and width 1 m. Assume transition occurs at $Re = 2\times10^5$. [5+5]

OR

3. Derive the Navier–Stokes equation, stating the various the assumptions made in it. [10]

4. A cylindrical body of 300mm of diameter and 1.6m height is maintained at a constant temperature of 36.5 ^{0}C. The surrounding temperature is 13.5^0 C. Find out the amount of heat to be generated by the body per hour if $\rho = 1.025$ kg/m^3, $Cp = 0.96$ kJ/kg ^{0}C, $\nu = 15.06\times10^{-6}$m^2/s, $k = 0.0892$ kJ/m-h ^{0}C and $\beta = 1/298$ K. Assume $N_U = 0.12\ (Gr.Pr)^{1/3}$. [10]

OR

5. Describe the dimensionless numbers and their physical significance in Forced and Natural convection. [10]

6. Explain convective heat transfer in a Cooling of a moving sheet. [10]

OR

7. Derive the Equations of the thermal boundary layer and give the Scale analysis. [10]

OR

8. Air at 400 K and 1 atm pressure flows at a speed of 1.5 m/s over a flat plate of 2 m long. The plate is maintained at a uniform temperature of 300 K. If the plate has a width of 0.5 m, estimate the heat transfer coefficient and the rate of heat transfer from the air stream to the plate. Also estimate the drag force acting on the plate. [10]

OR

9.a) Carry out the dimensional analysis for the forced convection obtain the following relationship through a long tube and Nu = f (Re, Pr).

b) A 60 watt lamp is buried in soil (whose thermal conductivity is 0.0084 J/s cm ^{0}C) at 0^0C and burned until steady state is reached. Find the temperature 30 cm away if the lamp produces 60 J/s. [5+5]

10. Explain the basic problem in heat convection through porous media consists of predicting the heat transfer rate between a deferentially heated, solid impermeable surface and a fluid-saturated porous medium. [10]

OR

11. Derive the value for the Nusselt number for fully developed flow through a porous medium-filled pipe with a uniform heat flux at the wall. [10]

---ooOoo---