R09

Code No: 56020

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY, HYDERABAD

B. Tech III Year II Semester Examinations, November/December - 2015

HEAT TRANSFER

(Common to ME, AME, MSNT)

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

Answer any five questions

All questions carry equal marks

* * *

1.a) What is Thermal Diffusivity? Explain its importance in heat Conduction problems.

b) Derive an expression for the boundary condition at the outer surfaces of a solid cylinder of radius R dissipating heat by convection with a Heat transfer coefficient h into a medium at zero temperature. [6+9]

2.a) A metal plate of 4mm thickness (k = 95.5 W/m^0C) is exposed to vapour a 100^0C on one side and cooling water at 25^0C on the opposite side. The heat transfer coefficients on vapour side and water side are 14500 $w/m^{20}C$ and 2250 $w/m^{20}C$ respectively. Determine:

i) The rate of heat transfer,

ii) The overall heat transfer coefficient, and

iii) Temperature drop at each side of heat transfer.

b) Explain the following:

i) Efficiency of fin.

ii) Effectiveness of fin. [9+6]

3.a) What are Heisler Charts? Explain their significance in solving transient conduction problems.

b) An egg with mean diameter of 40 mm and initially at 20^0C is placed in a boiling water pan for 4 minutes and found to be boiled to the consumer's taste. For how long should a similar egg for same consumer be boiled when taken from a refrigerator at 5^0C. Take the following properties for egg:

k = 10 W/m^0C, ρ = 1200 kg/m^3, c =2kJ/kg^0C and h = 100 $W/m^{2\,0}C$. Use lumped system theory. [6+9]

4.a) Discuss briefly the effect of turbulence on boundary layers.

b) Air is heated from 50^0C to 350^0C by passing it through 100mm diameter pipe of a packed bed heat exchanger, packed with 8mm diameter spheres. If the flow rate is 18 kg/h and pipe surface temperature is maintained at 400^0C, calculate the length of bed required. [6+9]

5. A vertical plate measuring 180 mm× 180mm and at 50^0C is exposed to atmosphere at 10^0C. Compare the free convection heat transfer from this plate with that which would result due to forced convection over the plate at a velocity equal to twice the maximum velocity which would occur in free convection boundary layer. [15]

6.a) Differentiate between pool boiling and forced convection boiling.

b) Water at atmospheric pressure is to be boiled in polished copper pan. The diameter of the pan is 350mm and is kept at 115^{0}C. Calculate the following:

i) Power of the burner;

ii) Rate of evaporation in kg/h;

iii) Critical heat flux for these conditions. [6+9]

7.a) What are the limitations of LMTD method? How is ε-NTU method superior to LMTD method?

b) The flow rates of hot and cold water streams running through a parallel flow heat exchanger are 0.2kg/s and 0.5kg/s respectively. The inlet temperature on the hot and cold sides are 75^{0}C and 20^{0}C respectively. The exit temperature of hot water is 45^{0}C. If the individual heat transfer coefficient on both side are 650 W/m^2 ^{0}C, calculate the area of the heat exchanger. [6+9]

8.a) What benefit can be derived from a radiation shield and reradiating surface?.

b) The net radiation from the surfaces of two parallel plates maintained at T_1 and T_2 is to be reduced by 99%. Calculate the number of screens to be placed between the two surfaces to achieve this reduction in heat exchange assuming the emissivity of the screens as 0.05 and that of surfaces as 0.8. [5+10].