Code No: 126EF

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech III Year II Semester Examinations, October/November - 2016
HEAT TRANSFER
(Common to ME, AME, MSNT)

Time: 3 hours **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

(25 Marks)

1.a) Differentiate between Steady, Unsteady and Periodic heat transfer. [2]
b) What are the different modes of heat transfer? Explain. [3]
c) Define thermal conductivity. [2]
d) Briefly explain lumped heat capacity method. [3]
e) Define an ideal fluid and a real fluid. [2]
f) Differentiate between laminar and turbulent flow. [3]
g) Why drop wise condensation is preferred to film wise condensation? [2]
h) What are the types of condensation processes? Explain. [3]
i) What is fouling factor? [2]
j) How are heat exchangers classified? [3]

PART - B

(50 Marks)

2. Derive the heat conduction equation in Spherical coordinates. [10]

OR

3.a) Define thermal diffusivity? What is the significance of thermal diffusivity in heat conduction process?
b) A plane wall is 150mm thick and its wall area is $4.5m^2$. Its conductivity is 9.35W/m-K and temperatures are steady at 150^0C and 45^0C on both sides. Determine the temperature gradient in flow direction. [3+7]

4. A long cylinder of (α= $6.11\times10^{-6}m^2/s$, k= 21W/m-K) 12 cm in diameter, initially at 20^0C, is placed into a furnace at 800^0C. Calculate the time required for the centre to reach 760^0C. Also calculate the temperature at a radius of 5.4 cm at the same time. (Take h= $140W/m^2$-K). [10]

OR

5. A steel pipe (k= 43.25 W/m-K) of 5cm inner diameter and 7.5cm outer diameter is covered with 2.5cm layer of asbestos insulation (k= 0.205W/m-K). The inside surface of the pipe receives heat by convection from a hot gas at a temperature of 315^0C with a heat transfer coefficient of $285W/m^2$-K while the outer surface is exposed to ambient air at 37^0C with a heat transfer coefficient of $17W/m^2$-K.
Estimate: (a) The heat loss to ambient air for 3m length of the pipe and
(b) The temperature drop across the pipe material and the insulation layer. [5+5]

6. Determine the heat transfer rate by free convection from a plate 0.3m × 0.3m for which one surface is insulated and the other surface is maintained at 110^0C and exposed to atmosphere air at 30^0C for the following arrangements:

a) The plate is vertical
b) The plate is horizontal with the heating surface facing up
c) The plate is horizontal with the heating surface facing down. [10]

OR

7.a) What are the advantages and limitations of dimensional analysis?
b) Determine the thickness of velocity boundary layer and local shear stress at x=2m from the leading edge of the plate for the boundary layer flow of air at atmosphere pressure of 80^0C with a velocity of 2m/s. [3+7]

8.a) What are the types of boiling processes?
b) Saturated water at 100^0C is boiled inside a copper pan having a heating surface area $5\times10^{-2}m^2$ which is maintained at uniform surface temperature of 110^0C. Calculate the surface heat flux and the rate of evaporation. [3+7]

OR

9.a) Define radiation shape factor.
b) Two circular disc of diameter 20cm each are placed 2m apart. Calculate the radiant heat exchange for these plates if these are maintained at 800^0C and 300^0C respectively and their corresponding emissivities are 0.3 and 0.5. [2+8]

10.a) What is a heat exchanger?
b) In a counter flow double pipe heat exchanger, water is heated from 25^0C to 65^0C by oil with a specific heat of 1.45kJ/kg-K and mass flow rate of 0.9kg/s. the oil is cooled from 230^0C to 160^0C. If overall heat transfer coefficient is $420W/m^2$-K. Calculate the rate of heat transfer, mass flow rate of water and surface area of heat exchanger. [2+8]

OR

11.a) Define effectiveness of heat exchanger.
b) Derive the equation for parallel flow heat exchanger using NTU method. [2+8]

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