Code No: 126VF

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech III Year II Semester Examinations, May - 2019
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)	What is the convection mode of heat transfer?	[2]
b)	What are the applications of heat transfer?	[3]
c)	What is the function of fin?	[2]
d)	What is critical radius of insulation?	[3]
e)	Differentiate the free and forced convection.	[2]
f)	What are the advantages of dimensional analysis?	[3]
g)	What is film wise condensation?	[2]
h)	What is the concept of shape factor?	[3]
i)	What is the difference between regenerator and recuperator?	[2]
j)	What are the advantages of NTU method over the LMTD method?	[3]

PART - B

(50 Marks)

2.a) A Stainless steel plate is of 2 cm thick is maintained at a temperature of 550 ^{0}C at one face and 50^{0}C on the other. The thermal conductivity of stainless steel at 300^{0}C is 19.1 W/m K. Calculate the heat transferred through the material per unit area.

b) In what way is the science of heat transfer different from thermodynamics? Explain. [5+5]

OR

3. Derive the general conduction equation for
a) Cylindrical co-ordinate
b) Spherical co-ordinates, the system being with uniform heat generation and unsteady state. [5+5]

4.a) Explain why the conductivity of metals decreases and conductivity of insulating material increases with increases in temperature.

b) A metallic plate, 3cm thick is maintained at 400 ^{0}C on one side and 100 ^{0}C on the other side. How much heat is transferred through the plate? Take k for the metallic plate as k=370 W/m-K. [5+5]

OR

5.a) What is critical thickness of insulation on a small diameter wire or pipe, explain its physical significance and derive an expression for the same.

b) Calculate the rate of heat loss for a red brick wall of length 5m, height 4m, and thickness 0.25m, the temperature of the inner surface is 110^{0}C and that of the outer surface is 40^{0}C. The thermal conductivity of red brick k = 0.70 W/m-K. Calculate also the temperature at an interior point of the wall, 20cm distance from the inner wall. [5+5]

6.a) Differentiate between mechanisms of heat transfer by free and forced convection. Mention some of the areas where these mechanisms are predominant.

b) Water at 75 ^{0}C flows through a 0.005 m diameter tube with a velocity of 1m/s. If the tube wall temperature is 25 ^{0}C, make calculations for the heat transfer coefficient. Use the correlation, St = 0.023 Re 0.2 Pr – 0.667.
The thermo-physical properties of water are:
Thermal conductivity is 0.647 W/(m.K); Viscosity is 1.977 kg/h.m;
Density is 1000 kg/m3; Specific heat 4.187 kJ/(kg.K). [5+5]

OR

7.a) Describe Buckingham's method of π-terms to formulate a dimensionally homogenous equation.

b) A flat plate 1m wide and 1.5 m long is to be maintained at 90 ^{0}C in air when free stream temperature is 10 ^{0}C. Determine the velocity at which air must flow over the plate so that the rate of energy dissipation from the plate is 3.75kW. [5+5]

8.a) Draw the boiling curve for pool boiling of water and explain flow regimes.

b) Saturated steam at a temperature of 65^{0}C condenses on a vertical surface at 55^{0}C. Determine the thickness of the condensate film at locations 0.2 m and 1.0 m from the top. Also calculate condensate flow rate at these locations. [5+5]

OR

9.a) Derive an expression for the shape factor in case of a radiation exchange between two surfaces.

b) Show that the emissive power if a black body is π – times the intensity of emitted radiation. [5+5]

10.a) Derive an expression for LMTD in case of a counter - flow heat exchanger.

b) A cross-flow heat exchanger with both fluids unmixed is used to heat water (Cp= 4.18 kJ/kgK) from 50 ^{0}C to 90 ^{0}C, flowing at the rate of 1.0 kg/s. Determine the overall heat transfer coefficient if the hot engine oil (Cp= 1.9 kJ/kgK) flowing at the rate of 3 kg/s enters at 100^{0}C. The heat transfer area is 20 m^2. [5+5]

OR

11. A chemical having specific heat of 3.3 kJ/kg k flowing at the rate of 20000 kg/hr enters a parallel flow heat exchanger at 120 ^{0}C. The flow rate of cooling water is 50000 kg/hr with an inlet temperature of 20 ^{0}C. The heat transfer area is 10 m ^{2} and the overall heat transfer coefficient is 1050 W/m^{2}K. Find
a) The effectiveness of the heat exchanger
b) The outlet temperature of water and chemical.
Take for water, specific heat=4.186KJ/kg K. [5+5]

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