Code No: 126EF **R13**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech III Year II Semester Examinations, May - 2017
HEAT TRANSFER
(Common to AME, ME, 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) Give an example of combined conduction and convection mode of heat transfer. [2]
b) What is thermal contact resistance? [3]
c) What is the concept of critical thickness? [2]
d) What is infinite plate in analysis of transient heat conduction? [3]
e) How Reynolds number is a criterion for dynamic similarity. [2]
f) What is Buckingham's Π theorem? [3]
g) What is radiation shape factor? [2]
h) What are the various radiation properties? [3]
i) Describe the selection criteria of heat exchanger. [2]
j) What is the range of effectiveness of a heat exchanger? [3]

PART - B

(50 Marks)

2.a) Describe the boundary conditions for steady, unsteady and periodic heat transfer.
b) An aluminum pan whose thermal conductivity is 237W/(m^0C) has a flat bottom with diameter 100mm and thickness 6 mm. Heat transferred steadily to boiling water in the pan through its bottom at a rate of 500W. If the inner surface of the bottom of the pan is at 150^{0}C, determine the temperature of the outer surface of the bottom of the pan. [5+5]

OR

3. Derive the heat conduction equation in a cylindrical coordinate system. [10]

4. Describe the temperature distribution along the length of a fin for four various boundary conditions at tip. [10]

OR

5. A very long, 10 mm diameter cooper rod (k= 370W/ (m K)) is exposed to an environment at 20^0 C. the base temperature of the rod is maintained at 120^{0}C. The heat transfer coefficient between the rod and the surrounding air is 10 W/m^2 K.
a) Determine the heat transfer rate for finite lengths, 0.02, 0.04,0.08,0.2,0.4,0.8,1 and 10 meters assuming heat loss at the end, and
b) Compare the result with that of an infinitely long fin whose tip temperature equals the environment temperature of 20^{0}C. [5+5]

6. Estimate the heat loss from a vertical wall exposed to nitrogen at one atmospheric pressure and 4^0C. The wall is 0.2m high and 2.5 m wide, and is maintained at 56^0C. The average Nusselt number Nu_H over the height of the plate for natural convection is given by $Nu_H = 0.13(Gr. Pr)^{1/3}$. The properties for nitrogen at a mean film temperature of $(56 + 4)/2 = 30^0$C are given as $\rho = 1.142$ kg/m^3, k = 0.026 W/m K, $v = 15.63 \times 10^{-6}$ m^2/s, Pr = 0.713. [10]

OR

7. Derive the expression for boundary layer thickness for free convection heat transfer on a vertical flat plate. [10]

8. Water at 1atm boils in a stainless steel kitchen pan with $\Delta T_x = 8^0$C. Estimate the heat flux which will be obtained if the same pan operates as a pressure cooker at 0.17MPa; what percentage increases in heat flux might be expected? [10]

OR

9. A room 4×4 m square by 3 × 3 m height has one side wall maintained at 260^0C; the floor is maintained at 90^0C. The other four surfaces are perfectly insulated assume that all surfaces are black. Calculate the net heat transfer between the hot wall and the cool floor. [10]

10. Describe the process followed in design of a simple shell and tube heat exchanger. [10]

OR

11. In a food processing plant, a brine solution is heated from 8^0C to 14^0C in a double pipe heat exchanger by water entering at 55^0C and leaving at 40^0C at the rate of 0.18kg/s. if the overall heat transfer coefficient is 800 W/m^{2}K, determine the area of heat exchanger required

a) For a parallel flow arrangement, and

b) For counter flow arrangement. Take c_p for water = 4.18kJ/kgK. [5+5]

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