

R13

Code No: 126EF

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 4.5m². Its conductivity is 9.35W/m-K and temperatures are steady at 150°C and 45°C on both sides. Determine the temperature gradient in flow direction. [3+7]
4. A long cylinder of ($\alpha = 6.11 \times 10^{-6} \text{m}^2/\text{s}$, $k = 21 \text{W/m-K}$) 12 cm in diameter, initially at 20°C, is placed into a furnace at 800°C. Calculate the time required for the centre to reach 760°C. Also calculate the temperature at a radius of 5.4 cm at the same time. (Take $h = 140 \text{W/m}^2\text{-K}$). [10]

OR

5. A steel pipe ($k = 43.25 \text{W/m-K}$) of 5cm inner diameter and 7.5cm outer diameter is covered with 2.5cm layer of asbestos insulation ($k = 0.205 \text{W/m-K}$). The inside surface of the pipe receives heat by convection from a hot gas at a temperature of 315°C with a heat transfer coefficient of 285W/m²-K while the outer surface is exposed to ambient air at 37°C with a heat transfer coefficient of 17W/m²-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 $0.3\text{m} \times 0.3\text{m}$ for which one surface is insulated and the other surface is maintained at 110°C and exposed to atmosphere air at 30°C for the following arrangements:
- The plate is vertical
 - The plate is horizontal with the heating surface facing up
 - 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 $x=2\text{m}$ from the leading edge of the plate for the boundary layer flow of air at atmosphere pressure of 80°C with a velocity of 2m/s . [3+7]

- 8.a) What are the types of boiling processes?
b) Saturated water at 100°C is boiled inside a copper pan having a heating surface area $5 \times 10^{-2}\text{m}^2$ which is maintained at uniform surface temperature of 110°C . 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°C and 300°C 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°C to 65°C 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°C to 160°C . If overall heat transfer coefficient is $420\text{W/m}^2\text{-K}$. 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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