

R13

Code No: 126EF

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°C at one face and 50°C on the other. The thermal conductivity of stainless steel at 300°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°C on one side and 100°C on the other side. How much heat is transferred through the plate? Take k for the metallic plate as $k=370 \text{ W/m-K}$. [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°C and that of the outer surface is 40°C . The thermal conductivity of red brick $k = 0.70 \text{ W/m K}$. 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°C flows through a 0.005 m diameter tube with a velocity of 1m/s. If the tube wall temperature is 25°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/m^3 ; 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°C in air when free stream temperature is 10°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°C condenses on a vertical surface at 55°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 of 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 ($C_p = 4.18 \text{ kJ/kgK}$) from 50°C to 90°C , flowing at the rate of 1.0 kg/s . Determine the overall heat transfer coefficient if the hot engine oil ($C_p = 1.9 \text{ kJ/kgK}$) flowing at the rate of 3 kg/s enters at 100°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°C . The flow rate of cooling water is 50000 kg/hr with an inlet temperature of 20°C . The heat transfer area is 10 m^2 and the overall heat transfer coefficient is $1050 \text{ W/m}^2\text{K}$. 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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