6. (a) Water flowing at the rate of 0.22 kg/s and at a temperature of 50ºC enters into 1.5 cm × 1.8 cm rectangular tube which is one metre long. The tube wall is at 90ºC. Calculate exit water temperature. Take $\rho = 978$ kg/m^3, $C_p = 4.187$ kJ/kg-K, $k = 0.667$ W/m-K, $v = 4.15 \times 10^{-8}$ m^2/s. **8**

(b) Derive governing differential equation of heat transfer for the laminar fluid flowing through a tube. **7**

Unit IV

7. (a) Give comprehensive classification of heat exchanger. **5**

(b) Water (C_p = 4200 J/kg-K) enters a counter flow double pipe heat exchanger at 38ºC flowing at 0.076 kg/s. It is heated by oil (C_p = 1880 J/kg-K) flowing at the rate of 0.152 kg/s from an inlet temperature of 116ºC. For an area of 1 m^2 and overall heat transfer coefficient 340 W/m^2-K, find total heat transfer rate. **10**

BB-84

M. Tech. EXAMINATION, May 2018

(Second Semester)

(B. Scheme) (Main & Re-appear)

(ME)

MET504B

ADVANCED HEAT TRANSFER

Time : 3 *Hours*] [*Maximum Marks :* 75

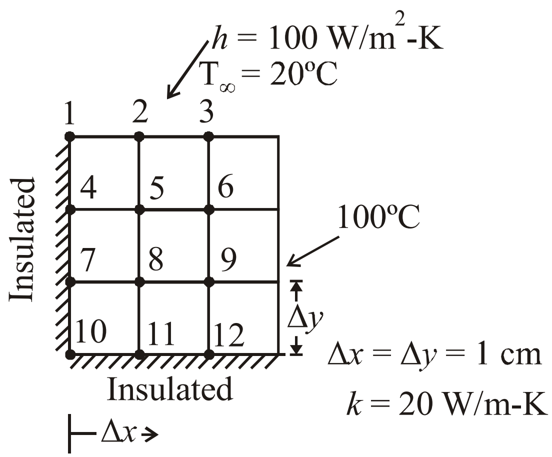
Before answering the question-paper candidates should ensure that they have been supplied to correct and complete question-paper. No complaint, in this regard, will be entertained after the examination.

Note : Attempt *Five* questions in all, selecting at least *one* question from each Unit. Use of different related Tables and Charts is permissible. All questions carry equal marks.

Unit I

1. Two rods A and B of equal diameter and equal length but of different materials are used as fins. The both rods are attached to a plain wall maintained at 160ºC, while they are exposed to air at 30ºC. The end temperature of rod A is 100ºC, while temperature of rod B is 80ºC. If the thermal conductivity of rod A is 380 W/m-K, calculate the thermal conductivity of rod B. This fin can be assumed as short with end insulated. Derive equations of temperature distribution for the same case. **15**

2. Write the nodal equations and give solution to find out the temperature at each node. **15**



Unit II

3. Derive an expressions for mean drag coefficient and Nusselt number for the mixed boundary layer formed over the flat plate. **15**

4. Air flows at a rate of 0.314 m^3/s over a cross flow heat exchanger consisting of 7 tubes in the direction of flow and eight tubes in the direction perpendicular to flow arranged in line fashion. The length of each tube is 1.25 m and its outer diameter is 1.9 cm. The longitudinal and transverse pitches are 38 mm and 28.6 mm, respectively. The temperature of the air entering the heat exchanger is 200ºC and the tube surface temperature is 96ºC. Estimate the convective heat transfer coefficient between the air and the tube. **15**

Unit III

5. Differentiate filmwise and dropwise condensation. Derive an expression for Nusselt number for laminar film condensation on a vertical surface. **15**

8. (a) Define Kirchhoff's law and prove it. **5**

(b) Two large parallel planes with emissivity 0.6 are at 900 K and 300 K. A radiation shield with one side polished with ε = 0.05 while the emissivity of the other side 0.4 is proposed to be used. Which side of the shield should face the hotter plane if the temperature of the shield is to keep minimum ? Justify your answer. **10**

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