CBCS SCHEME

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15AE53

Fifth Semester B.E. Degree Examination, Dec.2018/Jan.2019
Heat and Mass Transfer

Time: 3 hrs. Max. Marks: 80

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. Use of Heat Transfer data hand book is permitted.

Module-1

1 a. Derive an equation for heat transfer through convection. **(08 Marks)**

b. Explain the types of mass transfer with examples. **(08 Marks)**

OR

2 a. Derive an equation for heat transfer through radiation. **(08 Marks)**

b. Derive an equation for radiation exchange between two bodies. **(08 Marks)**

Module-2

3 a. Derive the three dimensional general heat conduction equation in cylindrical coordinate system. **(08 Marks)**

b. Explain the effect of variable thermal conductivity on heat transfer in solids. **(08 Marks)**

OR

4 a. Explain the types of fins with applications. **(08 Marks)**

b. Derive an equation for an infinitely long fin of uniform cross section along the length. **(08 Marks)**

Module-3

5 a. Dry air at atmospheric pressure and 20°C is flowing with a velocity of 3m/s along the length of a long flat plate, 0.3m wide, maintained at 100°C. Calculate the following quantities at x = 0.3m.

i) Boundary layer thickness
ii) Average friction coefficient
iii) Thickness of thermal boundary layer
iv) Rate of heat transfer from the plate between x = 0 and x = x by convection. **(08 Marks)**

b. Define fin efficiency. Derive an equation for the efficiency of,

i) infinitely long fin ii) fin with insulated tip. **(08 Marks)**

OR

6 a. Three 10mm diameter rods A, B and C protrude from a steam bath at 100°C to a length of 25cm into the atmosphere at 20°C. The temperature at the other ends are found to be 26.27°C for A, 32°C for B and 36.96°C for C. Neglecting the effect of radiation and assuming a surface heat transfer coefficient as 23W/m^2 K, evaluate their thermal conductivity. **(08 Marks)**

b. In a thermal conductivity measuring experiment, 2 identical long rods are used. One rod is made of aluminum with K = 200 W/m-k. The other rod is a specimen. One end of both the rod is fixed to a wall at 100°C, while the other end is suspended in air at 25°C. The steady temperature at the same distance along the rods were measured and found to be 75°C on aluminum, and 60°C on the specimen rod. Find the thermal conductivity for the specimen. Assume that the fin is insulated at the tip. **(08 Marks)**

Module-4

7 a. With assumption, derive an expression for LMTD for a counter flow heat exchanger. **(08 Marks)**

b. 8000 kg/hr of air at 105°C is cooled by passing it through a counter flow heat exchanger. Find the exit temperature of air, if water enters at 15°C and flows at a rate of 7500 kg/hr. The heat exchanger has heat transfer area of $20m^2$ and overall heat transfer coefficient corresponding to this area is 145 W/m^2 K. Take C_p of air as 1kJ/kg K and that of water as 4.18 kJ/kg K. **(08 Marks)**

OR

8 a. Derive an expression for E-NTU relation for a counter flow heat exchanger. **(08 Marks)**

b. Obtain an expression for the rate of heat transfer when radiation shield is introduced between two parallel plates **(08 Marks)**

Module-5

9 a. With a neat diagram, explain diffusive mass transfer. **(08 Marks)**

b. What is Aerodynamic heating, explain. **(08 Marks)**

OR

10 a. Explain ablative heat transfer. **(08 Marks)**

b. A circular plate of 25cm diameter with both surfaces maintained at a uniform temperature of 100°C is suspended horizontally in atmospheric air at 20°C. Determine the heat transfer from the plate. **(08 Marks)**

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