

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/m² K, evaluate their thermal conductivity. (08 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and/or equations written eg. 42+8 = 50, will be treated as malpractice.

- b. In a thermal conductivity measuring experiment, 2 identical long rods are used. One rod is made of aluminum with $K = 200 \text{ W/m}\cdot\text{k}$. 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 $145 \text{ W/m}^2 \text{ K}$. 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)
