CBCS SCHEME

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18ME63

Sixth Semester B.E. Degree Examination, July/August 2022
Heat Transfer

Time: 3 hrs. Max. Marks: 100

Note : 1. ***Answer any FIVE full questions, choosing ONE full question from each module.***
2. Use of Heat Transfer Data Handbook and Seam tables are permitted.

Module-1

1 a. Explain different modes of Heat transfer citing one example for each mode. **(05 Marks)**

b. A steam pipe of 4cm outer radius is covered with a layer of asbestos insulation of 1cm thickness , thermal conductivity, 0.15 W/m°C that is in turn covered by 3cm thick glass fibre insulation (K = 0.05 W/m° C). The surface of steam pipe is at 330°C and the outer surface of glass fibre layer is at 30°C. Determine interface temperature and the heat loss per meter length of pipe. **(07 Marks)**

c. Obtain the 3-D heat conduction equation in Cartesian co-ordinates stating the assumptions made. **(08 Marks)**

OR

2 a. What are Boundary Conditions? Explain BC 3rd kind for cylindrical geometry. **(05 Marks)**

b. A wire of 2mm diameter is heated electrically while it dissipates heat to the ambient with h = 125 W/m°C. If the wire is covered with 0.2mm thick insulation with K = 0.175 W/m° C. What are your interpretations on increase or decrease in heat loss from the wire? **(07 Marks)**

c. Explain the following terms with illustrations : i) Variable thermal conductivity
ii) Series and parallel arrangement of thermal resistances.
iii) Thermal diffusivity.
iv) Thermal contact resistance. **(08 Marks)**

Module-2

3 a. Explain the significance of fin efficiency and fin effectiveness. **(05 Marks)**

b. A cylinder 1m long and 50mm in diameter is placed in an ambience at 45°C with h = 17W/m^2 °C. It has 12 numbers of longitudinal straight fins (K = 120 W/m°C , height = 12.7mm , thickness = 0.76mm). Evaluate the total heat transfer rate if these fins behave as end – insulated fins when the cylinder surface temperature is held constant at 150°C. **(07 Marks)**

c. A spherical thermocouple junction of 0.706mm diameter measures gas temperature. The convective heat transfer coefficient on the bead surface is 400W/m^2 °C. If the properties of junction material are given to be K = 20W/m°C ; C_p = 400 J/kg K ; δ = 8500 kg/m^3. Estimate the time taken by bead of reach 298°C, when placed into a hot stream of gas at 300°C. The temperature of the bead is initially at 30°C. **(08 Marks)**

OR

4 a. Explain the significance of Biot number and Fourier number in transient heat conduction. **(05 Marks)**

b. An ordinary egg can be approximated as a sphere of 5cm diameter. The initial temperature of the egg is 5°C before it is dropped into 95°C water with convective heat transfer coefficient of 1200W/m^2 °C. Assume the egg properties to be same as that of water and evaluate the time required for the centre of egg to attain a temperature of 70°C. **(07 Marks)**

c. A hot surface at 100°C is to be cooled by attaching 100 numbers of pin fins 3cm long, 0.25cm diameter made of aluminum (end insulated).(K = 237 W/m°C) while surrounding medium is at 35W/m^2 C and 30°C. the 1m × 1m system has heat dissipation through these fins of equal size. Determine the rate of heat transfer from the fin mounted surface. **(08 Marks)**

Module-3

5 a. Explain Explicit scheme of solution to the One – dimensional transient heat conduction problem without heat generation. **(10 Marks)**

b. Briefly illustrate the applications connected with Stefan Boltzmann law. A surface is maintained at a temperature of 800K and radiates heat to another surface at 500K with a unity view factor. If the emissivity of the surfaces are 0.85 evaluate the net exchange of heat between these two surfaces by radiation process. **(10 Marks)**

OR

6 a. Briefly explain the use of numerical techniques to solve the heat transfer problems. Explain the process of discretizate based on finite difference methodology. **(10 Marks)**

b. Explain the following laws with reference to thermal radiation heat transfer :
i) Stefan – Boltzmann law ii) Wein – Displacement law iii) Kirchhoff's law
iv) Lamberts Cosine rule. **(10 Marks)**

Module-4

7 a. Explain the formation of boundary layers (thermal and hydrodynamic) for flow over a flat plate. **(05 Marks)**

b. Engine oil at 60°C flows over the upper surface of a 5m long flat plate whose temperature is 20°C with a velocity of 2m/s. Determine the total drag force and the rate of heat transfer per unit width of plate. **(07 Marks)**

c. Distinguish between Free convection and Forced convection on basis of the associated dimensional numbers. **(08 Marks)**

OR

8 a. Explain the concept of developed and developing flow with respect to internal flow through circular pipe. **(05 Marks)**

b. A long 10cm diameter steam pipe whose external surface is at 110°C passes through some open area that is not protected against winds. Determine the rate of heat loss from the pipe when air is at 1 atmp and 10°C moving at 8m/s. **(07 Marks)**

c. A 6m long section of an 8cm diameter horizontal pipe passes through a large room whose temperature is 20°C. If the outer surface temperature of the pipe is 70°C, evaluate the rate of heat loss from the pipe by natural convection. **(08 Marks)**

Module-5

9 a. Discuss the different regimes of pool boiling curve. **(10 Marks)**

b. Steam condenses at 60°C on shell side of a steam condenser , while cooling water flows inside tubes at 3kg/S. The inlet and outlet temperature of water are 20°C and 50°C respectively. Considering U_m = 2000 W/m^2°C. Calculate the surface area required. **(10 Marks)**

OR

10 a. Distinguish between Drop wise and Film wise condensation. **(08 Marks)**

b. A 2 – shell pass , 4 tube pass heat exchanger is used to cool processed water from 75°C to 25°C on the tube side at a rate of 5kg/S with cold water entering shell side at 10°C with flow rate of 6kg/S. If U_m = 750 W/m^2 °C, find heat exchange area. **(12 Marks)**

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