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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