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18CH45

Fourth Semester B.E. Degree Examination, June/July 2023
Process Heat Transfer

Time: 3 hrs. Max. Marks: 100

Note: *Answer any FIVE full questions, choosing ONE full question from each module.*

Module-1

1 a. Derive an expression to determine temperature distribution of a rate of heat transfer through a hollow sphere. **(12 Marks)**
   b. Discuss the three modes of heat transfer. **(08 Marks)**

OR

2 a. State and explain Fourier's law of heat conduction. **(06 Marks)**
   b. A furnace is constructed with a 229mm thick layer of fire brick, a 115mm thick layer of insulation brick and again a 229mm thick layer of building brick. The inside temperature is 950°C and the temperature at the outer most wall is 50°C. The thermal conductivities of fire brick, insulating brick and building brick are 6.05, 0.581 and 2.33W/(m.k) respectively. Find the heat lost per unit area and the temperature at the interface. **(10 Marks)**
   c. What are the different properties and types of insulating materials? **(04 Marks)**

Module-2

3 a. Derive an expression for the heat loss through a rectangular fin with insulated end. **(12 Marks)**
   b. One end of a very long aluminum rod of 3mm in diameter is connected to a wall at 140°C, while the other end protrudes into a room whose air temperature is 15°C. Determine the total heat dissipiated by a rod.
   Data : K for aluminum = 150 W/(m.k)
   h between the rod surface and environment = 300W/(m^2.K). **(08 Marks)**

OR

4 a. Using dimensional analysis, show that Nusselt number is a function of Reynold's number and Prandtl number for a forced convective heat transfer. **(10 Marks)**
   b. Starting the assumptions, derive an expression for LMTD (Log Mean Temperature Difference). **(10 Marks)**

Module-3

5 a. Compare Colburn, Reynolds and Prandtl analogies. **(12 Marks)**
   b. Discuss film wise condensation. **(08 Marks)**

OR

6 a. With a neat sketch explain a typical shell-and-tube heat exchanger, used in process industry. **(10 Marks)**
   b. Discuss different types of condensers used in a process industry. **(10 Marks)**

Module-4

7 A shell-and-tube heat exchanger has to be installed in a process industry. Explain in detail the design procedure for a given duty. **(20 Marks)**

OR

8   Explain in detail the design steps of double pipe heat exchanger.   **(20 Marks)**

Module-5

9   a.   Discuss different types of evaporators.   **(12 Marks)**
    b.   Discuss the 'Black body' and 'Kirchoff's law'.   **(08 Marks)**

OR

10   Write short notes on the following :
    a.   Multiple effect evaporator
    b.   Emissive power
    c.   Stefan Boltzman's law
    d.   Gray body.   **(20 Marks)**

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