Total No. of Questions : 8] *[Total No. of Printed Pages : 2*

Roll No .....

ME-6003-CBGS

B.E. VI Semester

Examination, June 2020

Choice Based Grading System (CBGS)

Heat and Mass Transfer

Time : Three Hours

Maximum Marks : 70

Note: i) Attempt any five questions.

ii) All questions carry equal marks.

iii) Use of heat and mass transfer data book is permitted.

1. a) Define thermal resistance and conductance. 4

b) A Furnace wall comprises three layers: 13.5cm thick inside layer of fire brick, 7.5cm thick middle layer of insulating brick and 11.5cm thick outside layer of red brick. The furnace operates at 870 °C and it is anticipated that the outside of this composite wall can be maintained at 40 °C by the circulation of air. Assuming close bonding of layers at their interfaces, find the rate of heat loss from the furnace. The wall measures 5m × 2m and thermal conductivities are as follows:

Fire Brick, k_1 = 1.2 W/m-deg

Insulating Brick, k_2 = 0.14 W/m-deg

Red Brick, k_3 = 0.85 W/m-deg.

2. a) State Fourier's law and Stefan Boltzmann Law. 4

b) What are different modes of heat transfer? Explain with examples. 4

c) Establish analogy between flow of heat and electricity. 6

3. a) Define fin effectiveness and fin efficiency. 4
   b) A steel rod (k = 30 W/m-deg) 1cm in diameter and 5cm long protrudes from a wall which is maintained at 100°C. The rod is insulated at its tip and is exposed to an environment with h = 50 W/m^2-deg and t_a = 30°C. Calculate the fin efficiency and temperature at the tip of fin. 10

4. a) State the Buckingham pie theorem. 4
   b) State principle and applications of dimensional analysis. 4
   c) A horizontal heated plate at 200°C and facing upwards has been placed in still air at 20°C. If the plate measures 1.25m × 1m. Calculate the heat loss by natural convection. The convective film coefficient for free convection is given by the following empirical relation:
   h = 0.32 (θ)$^{0.25}$ W/m^2-k. Where θ is mean film temperature in degree kelvin. 6

5. a) Give classification of heat exchangers. 4
   b) Establish the expression for log mean temperature difference for a counter flow heat exchanger. 10

6. a) Explain Fick's law of diffusion and diffusion coefficient. 6
   b) Explain steady state diffusion through stationary medium. 8

7. a) Explain Planck's distribution law. 4
   b) Define emissive power, gray surface and black surface. 6
   c) Explain film wise and drop wise condensation. 4

8. Write short notes on any four of the following: 14
   a) Regimes of boiling
   b) Free and Forced convection
   c) Radiation Shields
   d) Critical thickness of insulation
   e) Shape factor.

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