

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

ME-6003-CBGS

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[2]

3. a) Define fin effectiveness and fin efficiency. 4
b) A steel rod ($k = 30 \text{ W/m-deg}$) 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 $h = 50 \text{ W/m}^2\text{-deg}$ and $t_a = 30^\circ\text{C}$. Calculate the fin efficiency and temperature at the tip of fin. 10
4. a) State the Buckingham pi 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 $1.25\text{m} \times 1\text{m}$. Calculate the heat loss by natural convection. The convective film coefficient for free convection is given by the following empirical relation:
 $h = 0.32 (\theta)^{0.25} \text{ W/m}^2\text{-k}$. 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.

ME-6003-CBGS