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ME-6003-CBGS

B.E. VI Semester

Examination, December 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 conductivity, thermal diffusivity and overall heat transfer coefficient.

   b) Derive an expression of general heat conduction equation in rectangular coordinates.

2. A domestic oven has a composite wall formed by 0.5cm thick chrome-nickel (k = 19 W/mk) sheet supported by 1cm thick asbestos (k = 0.1105 W/mk) sheet. In steady state operation the hot gases inside the oven are at 350°C while atmospheric air in at 30°C. The convective heat transfer coefficient at inside and outside surface of the oven are 100 W/m ^{2}k and 15 W/ m^{2}k respectively. Determine the rate of heat losses per unit area through the oven wall.

3. a) What is an Extended surface? Name three applications of it.

   b) Define Fin efficiency and fin effectiveness.

4. a) State the Buckingham pie theorem.

   b) State principle and applications of dimensional analysis.

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:
$h = 0.32 (\theta)^{0.25}$ W/m^2-k. Where θ is mean film temperature in degree kelvin.

5. a) What is LMTD? Draw temperature profile of condenser and find the LMTD value for it.

   b) In a counter flow heat exchanger 10,000kg/h of oil having a specific heat of 2095 J/kg K is cooled from 80°C to 50°C by 8000kg/hr of water entering at 25°C. Determine the heat exchanger area for an overall heat transfer coefficient of 300w/m^{2}K. Take Cp for water as 4180 J/kg K.

6. A 4kg/sec of product stream from a distillation column is to be cooled by 3kg/sec water stream in a counterflow heat exchanger. The hot and cold stream inlet temperatures are 400K and 300K respectively and the area of heat exchanger is 30m^2. If the overall heat transfer coefficient is estimated to be 820W/m^{2}K. Determine the outlet temperature of both fluid if the specific heat is product stream is 2500J/kg k.

7. Define the following:
   i) Emissivity of surface. ii) Black body.
   iii) Film wise condensation. iv) Planck's distribution law.

8. a) Explain different regime of boiling.
   b) The filament of a 75 W light bulb may be considered a black body radiating into black enclosure at 80°C. The filament dia is 0.10m and length is 60 mm. Considering radiation only, determine filament temperature.

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