KERALA AGRICULTURAL UNIVERSITY
B.Tech.(Agri. Engg) 2017 Admission
IV Semester Final Examination- June 2019

Fape.2203

Heat and Mass Transfer (2+0)

Marks: 50
Time: 2 hours

I Fill in the blanks.

1 With increase in temperature thermal conductivity of insulators will _____.
2 In the SI system, the unit for thermal conductivity is _____.
3 The temperature profile in a plane wall under steady conduction will be a straight line if thermal conductivity is _____ .
4 Fins may be modeled as _____ _____ system.
5 Fin effectiveness is generally _____ than one.
6 Flow transition is generally judged by _____ number.
7 The value of transition Reynolds number in the case of flow over flat plate is _____.
8 The heat capacity of the fluid stream is the product of _____ and _____ .
9 LMTD method of analysis is suitable when _____ are known.
10 The ratio of emissive power of a body to the emissive power of a black body is defined as _____.

II Write short notes on ANY FIVE

1 Describe the mechanism of heat transfer by conduction.
2 State the Fourier law of heat conduction.
3 Draw the equivalent circuit for conduction through a slab under steady state conduction with convection on both surfaces.
4 Differentiate between laminar and turbulent flow.
5 State Stefan-Boltzmann law.
6 Explain the concept "intensity of radiation". How does it relate to emissive power?
7 Compare parallel flow and counter flow exchanger in terms of area requirements.

III Answer any FIVE of the following. **(5x4=20)**

1 A double glazed window is made of 2 glass panes of 6 mm thick each with an air gap of 6 mm between them. Assuming that the air layer is stagnant and only conduction is involved, determine the thermal resistance and overall heat transfer coefficient. The inside is exposed to convection with h = 1.5 W/m^2K and the outside to 9 W/m^2K. Compare the values with that of a single glass of 12 mm thickness. The conductivity of the glass = 1.4 W/mK and that for air is 0.025 W/mK.
2 Insulation is added in 3 cm layers over a steel pipe of 30 cm dia. The convection on the outside is 25 W/m^2K. The conductivity of the material is 0.47 W/mK. Determine the total thermal resistance for the addition of 5 such layers. Compare the % increase in resistance and % increase in the volume of material over the first layer.
3 Two rods of dia D mm and length L mm have one of the ends at 120°C and are exposed to air at 30°C. The conductivity of the material of one rod is 45 W/mK and the temperature of the rod at the end is measured as 80°C, while the end temperature of the other rod was 60°C. Determine the conductivity of the other material.

P.T.O

4 Investigate the effect of various parameters on the average value of convection coefficient in laminar flow over a flat plate.

$\overline{Nu}_L = 2Nu_x = 0.664 . Re_L^{0.5} Pr^{0.33}$

5 The inlet and outlet temperature of hot and cold fluids in a double pipe heat exchanger are 220°C, 100°C and 80°C and 120°C. Determine whether the exchanger is parallel flow or counter flow. Also determine the LMTD and effectiveness of the exchanger and the capacity ratio.

6 Determine the shape factor values between two short coaxial cylinders of diameters 0.5 m and 1 m of length 1 m and also between the cylinder to each end annular surface.

7 Derive an expression for the diffusion of one component into a non diffusing (stationary) component.

IV **Answer any ONE of the following** **(1x10=10)**

1 Derive a 3-Dimensional general conduction equation in Cylindrical co-ordinates for a homogeneous material.

2 Two large parallel plates are at 1000 K and 600 K. Determine the heat exchange per unit area. (i) if surfaces are black (ii) if the hot one has an emissivity of 0.8 and the cooler one 0.5 (iii) if a large plate is inserted between these two, the plate having an emissivity of 0.2.

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