KERALA AGRICULTURAL UNIVERSITY

B.Tech.(Agri. Engg) 2016 Admission

IV Semester Final Examination-July 2018

Fape.2203 **Heat and Mass Transfer (2+0)**

Marks: 50

Time: 2 hours

1 A Fill in the blanks. **(10x1=10)**

1 Free convection is the result of motion of fluid due to .....

2 .....is highest thermal conductive material.

3 Conductive heat transfer thermal resistance in case of cylindrical surface can be obtained using the relation.....

4 The unit of diffusion coefficient is .....

5 The incident radiation distributed uniformly in all direction is called.....

B State True/False

6 Radiation heat transfer cannot take place in the presence of any medium

7 Thermal conductivity of gas increases with the increase of temperature

8 Transmissivity of opaque body is unity

9 The value of LMTD for counter flow heat exchanger is higher than parallel flow heat exchanger

10 Effectiveness of heat exchanger can be greater than one ($\epsilon>1$)

II Write short notes on ANY FIVE **(5x2=10)**

1 Significance of thermal diffusivity in heat transfer?

2 Effect of contact resistance in conductive heat transfer?

3 Why it is advisable to use log mean temperature difference instead of arithmetic mean temperature difference to evaluate the performance of a heat exchanger?

4 Importance of fouling factor in design of a heat exchanger?

5 Why critical thickness of insulation is relevant only for curved surfaces? Why not for plane wall?

6 What is the difference in emissivity of black, gray and real bodies?

7 Define Wien's displacement law.

P.T.O

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

1 Estimate the diffusion coefficient for ammonia in air at 25°C temperature and one atmospheric pressure. Consider molecular weights as 17, 29 and molecular volumes as 25.81 cm^3/gm mole, 29.89 cm^3/gm mole, respectively for ammonia and air.

2 What do you understand by the term Thermal Boundary Layer? How Prandtl number affects thermal and hydraulic boundary layer for a hot surface?

3 Define radiosity and irradiation. Also derive the relation between radiosity and irradiation for a non black opaque surface.

4 Consider atmospheric air at 25°C in parallel flow at 5 m/s over both side of 1m long flat plate maintained at 75°C. Determine the boundary layer thickness and heat flux at the trailing edge. Consider for Air : $\rho = 1.085$ kg/m^3, $\nu = 18.2 \times 10^{-6}$ m^2/s, k = 0.028 W/m.K, Pr = 0.707 and $Nu = 0.332\ Re^{1/2}\ Pr^{1/3}$.

5 Determine whether it is safe to store a radioactive waste that generating 0.5 MW of energy per unit volume in a hollow spherical vessel of Lead having 0.50 m inner and 0.60 m outer diameter. The lead vessel is further covered with another spherical vessel of Steel having 0.62 m diameter. The whole vessel is surrounded by a fluid of 10 °C temperature having convective heat transfer coefficient as 500 W/m^2 K. Assume, melting point of Lead as 330 °C, thermal conductivity of lead and steel as 35.3 W/m K and 15.1 W/m K respectively.

6 Determine the overall heat transfer coefficient for liquid to liquid heat transfer through a 0.003 m thick steel plate [k = 50 W/ m.K] for given fouling factor and heat transfer coefficient as h_i = 2.5 kW/m^2, h_o = 1.8 kW/m^2, R_{fi} = 0.0002 m^2.K/ W.

7 A very long copper rod 20 mm in diameter extends horizontally from a plane heated wall maintained at 100 °C. The surface of the rod is exposed to an air environment at 20 °C with convective heat transfer coefficient of 8.5 W/m^2-deg. Workout the heat loss if the thermal conductivity of copper is 400 W/m-deg. Also estimate how long the rod be in order to be considered as of infinite length.

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

1 Derive the expression for effectiveness of a counter flow heat exchanger in terms of capacity ratio (C) and NTU. Also enumerate the assumptions made for this derivation and draw a plot between effectiveness and NTU .

2 Explain Fourier's Law. Derive the three dimensional Fourier Conduction Equation.

****