KERALA AGRICULTURAL UNIVERSITY
B.Tech.(Food Engg) 2018 Admission
II Semester Final Examination- June 2019

Fden.1202 **Heat and Mass transfer (1+1)**

Marks: 50
Time: 2 hours

I **Fill up the blanks** **(10x1=10)**

1 The ratio of radiation passing through a body to the total radiation which falls on the body is called its .....
2 The reflectivity of black body is equal to .....
3 The convection heat transfer in which a vapour changes into its liquid near the surface is called .....
4 The driving force in natural convection heat transfer is ..... force
5 The ratio of thermal conductivity to heat capacity of a material is called its .....
6 The unit of mass diffusion coefficient is .....

State True or False

7 In the case of pure conduction heat transfer through gases, there is movement of gaseous molecules.
8 The unit of thermal resistance is K/W
9 For the same geometry and flow the effectiveness of parallel flow heat exchanger is more than that of a counter flow heat exchanger.
10 Evaporation of water from a pool in to stationary dry air is an example of convective mass transfer.

II **Write Short notes on any FIVE of the following** **(5x2=10)**

1 Mechanism of heat conduction in solids.
2 Significance of critical thickness of insulation.
3 Reynolds number
4 Stefan-Boltzmann equation.
5 Fick's Law of diffusion
6 Film condensation and drop-wise condensation
7 Overall heat transfer coefficient in conduction – convection systems

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

1 A cold storage 2m long, 2m height and 1m wide is to be maintained at a temperature of -10^0C. The four sides and top are made of composite walls with three different materials. The innermost layer is a 3 mm thick stainless steel (k= 16 W/mK), a middle layer of 8 cm thick fibre insulation (k= 0.08 W/mK) and a 2 mm thick Galvanised Iron sheet (k = 40 W/mK) on the outside. If the temperature on the outermost surface of the cold storage is 20^0C, what is the rate at which heat will be leaked into the cold storage, under steady conditions?Assume one dimensional heat conduction across the four side walls and the top wall. Neglect the heat loss at the bottom.
2 Obtain the relation for critical radius of insulation overa cylindrical body.

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3 A metallic spherical body at a temperature of 400^0C is placed in a large enclosure whose walls are maintained at 27^0C. Calculate the radiation exchange between the two if the emissivity of the metallic body is 0.6.

4 A hemispherical concave surface is enclosed at its open end by a circular disc. Calculate the radiation shape factor from the hemispherical surface to itself.

5 Water is heated at the rate of 1.4 kg/s from 40^0C to70^0Cby an oil entering at 110^0C and leaving at 60^0C in a counter flow heat exchanger. If the overall heat transfer coefficient is 350 W/m^{2}K, calculate the surface area required.$c_{p,water}$ = 4.187kJ/kgK, c_{poil}=1.9kJ/kgK.

6 Hydrogen gas is maintained at concentrations 7.5 x 10^{-3}kg mol/m^3 and 1.5x 10^{-3}kg mol/m^3 on opposite sides of a plastic membrane which is 0.3 mm thick. Binary diffusion coefficient of Hydrogen in plastic is 8.7 x 10^{-8} m^2/s. What is the mass flux of hydrogen by diffusion through the membrane?

7 Give the different classifications of heat exchangers.

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

1 A rectangular plate is 120 cm long in the direction of flow and 200 cm wide. The plate is maintained at 80^0C when placed in air that has a velocity of 2.5m/s and has a temperature of 0^0C. Calculae the Reynolds number and state whether the flow is laminar or turbulent at the end of the plate. Determine the average heat transfer coefficient and total heat transfer from the plate. The properties of Nitrogen at the average temperature of 40^0C are: kinematic viscosity = 15.63x10^{-6}m^2/s, Prandtl Number = 0.708 and thermal conductivity = 0.0262W/mK. Use the correlation $Nu_{avg}=0.664Re^{0.5}Pr^{0.33}$

2 Two very large parallel surfaces having emissivity 0.8 and 0.6 are maintained at temperatures 600 K and 300 K respectively. If a radiation shield is placed between the surfaces, calculate the heat transfer rate per unit area between the surfaces with and without the radiation shields. Assume emissivity of radiation shield to be 0.1. Stefan-Boltzmann constant = 5.67x10^{-8} W/m^2/K^4

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