KERALA AGRICULTURAL UNIVERSITY
B.Tech.(Food Engg. & Technology)
VIII Semester Final Re- Examination – July 2023
2019 Admission

Fden.1202 **Heat and Mass Transfer (1+1)** **Marks: 50**
Time: 2 hours

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

1. The rate equation for conduction is known as .....
2. The unit of momentum diffusivity is .....
3. Heat transfer in vacuum is essentially due to .....
4. The unit of convective mass transfer coefficientis .....

State True or False

5. Thermal conductivity of insulators decreases with increase in temperature.
6. The Nusselt number in free convection is a function of Reynolds number and Grashof's number.
7. The effectiveness of parallel flow heat exchanger is less than counter- flow heat exchanger.
8. The parallel flow heat exchanger is preferred for short length.

Define the following

9. Newton's law of cooling
10. Emmissivity

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

1. Reynolds number
2. Effectiveness of heat exchanger
3. Kirchoffs law of radiation
4. Film wise and drop wise condensation
5. Ficks law of diffusion
6. Mechanism of conduction in gases
7. Nusselt number

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

1. Derive an expression for steady state heat transfer through a plane wall.
2. Give the classification of heat exchangers.
3. Explain Reynolds- Colburn analogy.
4. Differentiate between heat and mass transfer.
5. An immersion heater of surface area 0.2 m^2 and rating 1 kW is designed to operate fully submerged in water. Estimate the surface temperature of the heater when the water is at 40°C and the heat transfer coefficient is 300 W/m^2K. If this heater by mistake used in air at 40°C with convective heat transfer coefficient of 9 W/m^2 K, what will be its surface temperature.
6. Application of mass transfer phenomena in food processing
7. Discuss the advantage of NTU method over the LMTD method of heat exchanger design.

IV **Write an essay on ANY ONE of the following** **(1x10=10)**

1. A steam pipeof inner diameter 100 mm and outer diameter 110 mm is covered with an insulating material of conductivity 1 W/mK. The steam temperature and the ambient temperature are 200°C and 20°C respectively. If the convective heat transfer coefficient between the insulation surface and air is 8 W/m^2K, find the critical radius of insulation. For this value of r_o, calculate heat loss per meter of pipe and the surface temperature. Neglect resistance of pipe material.

2. Water at 50°C enters a 1.5 cm diameter and 3 m long tube with a velocity of 10 m/s. The tube wall is maintained at a constant temperature of 90°C. Calculate the heat transfer coefficient and the total amount of heat transferred if the exit temperature is 64°C.The properties of water are Density = 990 kg/m^3, kinematic viscosity = 0.517 x 10^{-6} m^2/s, conductivity = 0.65 W/mK, Prandtl number = 3.15,
Use the following correlation for heat transfer coefficient.

$$Nu = 0.023\, Re^{0.8} Pr^{0.4}$$

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