KERALA AGRICULTURAL UNIVERSITY

B.Tech (Agrl.Engg) Degree Programme 2015 Admission
IInd Semester-Final Examination-June/July-2016

Cat. No: Phpt.1201 **Marks: 50**
Title:Heat and Mass Transfer (1+1) **Time : 2 hours**

I. Answer all the questions

Give the SI units for the following (1 to 3) **(10 x 1=10)**

1. Thermal conductivity.
2. Heat transfer coefficient.
3. Thermal resistance.

State true or false (4 to 7)

4. Reynold's number is inversely proportional to viscosity.
5. In a counter flow heat exchanger the fluids will flow in the opposite direction.
6. For radiation heat transfer a source of circulating the air/fluid is required.
7. In a sphere the heat transfer rate does not change with the diameter.

Fill up the blanks (8-10)

8. Heat transfer from one surface to another surface in contact is by _____.
9. Plank's Law is related to the _____ heat transfer.
10. Forced convection in a liquid bath is caused by _____.

II **Answer the following any FIVE** **(5 x 2=10)**

1. Name the modes of heat transfer and give the application s of heat exchangers.
2. Define thermal conductivity and heat transfer coefficient.
3. Differentiate between film coefficient of heat transfer and overall heat transfer coefficient.
4. Differentiate between Reflectivity and transmissivity.
5. Differentiate between parallel flow and counter flow heat exchangers.
6. Explain the concept of black body
7. Explain the working principle of tube and plate type heat exchanger.

III. Write short notes on ANY FIVE of the following **(5 x 4=20)**

1. Derive an expression for heat transfer rate through a composite cylinder with 2 layers. Use usual notation.
2. Derive an expression for the Logarithmic Mean Temperature Difference for the flow in a counter flow heat exchanger.

3. Derive an expression for the determination of heat transfer coefficient by natural convection, using usual notations.

4. How much water can be heated per hour in a double tube heat exchanger with counter flow if super heated steam enters the inner tube at 250°C and leaves at 190° C with water entering the outer tube at 25° C and leaving at 140° C. The heat exchanger area is 0.2 sq.m. and the overall heat transfer coefficient from steam to water is 730 W/ m^2°K.

5. Exhaust gases flowing through the tubular heat exchanger at the rate of 20 kg/min are cooled from 450°C to 150°C by water initially at 20°C. The specific heat of gases may be taken as 1.13 kJ/kg °K, and overall heat transfer co-efficient may be taken as 140 W/m^2. Calculate the surface area needed if the water flow is 25 kg/min for (a) parallel flow (b) counter-flow.

6. Determine the radiation heat loss from each metre length of a 20 cm outer diameter heating pipe, when it is placed concentrically in a brick duct of square cross section of 30 cm side. The pipe surface temperature is 200°C and brick work is at 20°C. The emissivity of the pipe surface is 0.8 and that of brick work is 0.9. Assume only radiation heat transfer between the pipe and brick work.

7. The annular space between two thin concentric spherical shells having radii 10 cm and 15 cm is filled with bulk insulating powder. What electrical power is required from an electric heater located in the centre of the smaller sphere in order to maintain a temperature difference of 40°C. Assume the average thermal conductivity of the insulating material as 0.04 W/mK and neglect the thermal conductivity of the sphere material.

IV. Answer any one of the following (1 x 10 = 10)

1.a. A chemical plant produces 300 tonnes of H_2SO_4 per day, the acid is to be cooled from 60°C to 40°C by 500 tonnes of water per day which has an initial temperature of 15°C. The counter flow cooler consists of concentric cast iron pipes. The inner diameter of the inner pipe through which the acid flows is 7.5 cm and that of outer pipe is 12.5 cm. The wall thickness of the inner pipe is 1.25 cm. Find the length of the pipe required. The properties of H_2SO_4 and water at mean temperature are given below:

Property	H_2SO_4	Water	Units
ρ	1800	998.2	kg/m^3
C_p	0.35	1.0	kJ/kg K
K	0.26	0.515	W/m°C
μ	0.0126	1x10-3	kg/m.sec.
γ	7x10-6	1.006 x 10-6	m^2/sec.

K(pipe) = 40 W/m °C

(7)

1.b. Write a note on the applications of mass transfer in food and agricultural processing operations.

(3)

2.a. Dry steam at 300°C is flowing through a pipe of 12 cm outer diameter, and 10 cm inner diameter. The steel pipe is located in a large room and is covered with 5 cm asbestos insulation of 0.0625 W/m °C. The surroundings are at 20 °C. For the inner pipe surface, convective heat transfer coefficient is 500 W/m^2 °C and the outer surface it is 7 W/m^2 °C which includes radiation and convection. The emissivity of the surface is 0.88. Find (a) heat transferred per meter length of the pipe, (b) equivalent radiation film co efficient, (c) convective heat transfer co-efficient for outer surfaces.

(7)

2.b. Explain the modes of heat transfer and the applications of heat transfer in food processing operations with appropriate examples.

(3)