KERALA AGRICULTURAL UNIVERSITY

B.Tech (Food. Engg) Programme

II[nd] Semester Re-Examination- June -2014

Cat. No: Fden.1202 **Marks: 80**

Title: Heat and Mass Transfer (1+1) **Time: 3 hours**

I. Answer the following :- **[10x1]**

1. Define quantum theory
2. Thermal conductivity
3. Heat exchanger
4. Define emissivity
5. Fourier law
6. Define Stefan Boltzmann's law
7. Differentiate gray body and blackbody
8. Differentiate reflectivity and absorptivity
9. Define Flick's law of diffusion
10. Define critical thickness

II. Write short notes/answer on ANY TEN. **[10x3=30]**

1. Classification of heat exchangers
2. Analogy between heat transfer and mass transfer
3. Give the application of forced convection
4. Derive the expression for mean area of cylinder.
5. Derive the expression for heat transfer through a sphere.
6. Discuss the concept of black body
7. Differentiate steady state and quasi state flow of heat conduction.
8. Overall heat transfer coefficient.
9. What do you mean by scaling of heat exchangers?
10. Explain the electromagnetic spectrum.
11. Absorbtivity, reflectivity and transmissivity.
12. The heat transfer through insulation materials is affected by inside convection compared with inside conduction-comment.

III. Answer ANY SIX **[6x5=30]**

1. Obtain the expression for log mean temperature difference (LMTD) equation for a single pipe double pass counter flow heat exchanger.

2. Prove that heat lost per square meter with reference to outer surface of a hollow

cylinder is 2K(T1- T2)D2 log (D2/D1) where T1and T2 are temperatures and D1 and D2 are inner and outer diameter.

3. Derive the formula for heat transfer between two fluids through a composite wall.

4. 45kg of oil flows through a 25mm internal diameter copper tube in one second. The oil - at the flow condition are
specific heat = 0.49 kcl/ kg*c , Thermal conductivity = 0.125kcl /hr m *c
Kinematic viscosity = 0.901x10 3 , Density = 880kg/m3
calculate the convection heat transfer coefficient using Nnu =0.023NRe Npr

5. Fruit juice having a specific heat of 3.85 kj/kg*K is being pre heated from 5°c to 45°C in a counter flow double pipe heat exchanger. Heating agent is hot water entering at 75°C and leaving at 65°C. The flow rate of fruit juice is 1.5kg?sec and the area of the heat exchanger is 10.0square metre. Calculate the overall heat transfer coefficient.

6. A cold storage room wall 3mx6m is constructed of 150 mm thick concrete K=1.37 W/m *C. Insulation must be provided to maintain a heat transfer rate through the wall at or below 500 W. If the thermal conductivity of insulation is 0.04 W/m *C, compute the required thickness of insulation, The outside surface temperature of the wall is 38°C, and the inside wall temperature is 5°C.

7. Derive the formula for optimum thickness of lagging for a pipe of inside diameter d1.

8. A hollow sphere with inner radius Ri, outer radius Ro, inner and outer surface temperature ti and to is made of a material whose thermal conductivity is K. Derive the expression for the conducted heat loss based on the outer area. If Ri=75mm, Ro=125mm,K=52 W/m*K, heat conducted out from the sphere is 118500w and inside temperature is 400°C ,determine outside surface temperature.

iv. Answer ANY ONE only. [1x10=10]

1. Derive the general heat conduction equation in spherical co-ordinates.

2. A furnace wall is composed of 22cm fire brick,15cm common brick,5cm of 85% magnesia and 3mm steel plate on the outside. If the inside surface temperature is 1500*C and the outside surface temperature is 90*C. Estimate the temperature between the layers and calculate the heat loss. K for fire brick 1.0W/m*K, common brick 0.7W/M*K, magnesia -0.06W/m*K and for steel 45 w/m*K.
