KERALA AGRICULTURAL UNIVERSITY

B.Tech.(Food Engg.) 2016 Admission

II[nd] Semester Final Examination – July - 2017

Cat. No: Fden 1202 **Marks: 50**

Title: Heat and Mass Transfer (1+1) **Time : 2 hours**

I. State True or False/Fill up the blanks /Define: **(10 x 1=10)**

1. Convective heat transfer coefficient is a property of fluids (True /False)
2. In metals for heat to transfer in positive direction the thermal gradient should also be positive (True /False)
3. The heat flow rate decreases when the thickness of insulation on a pipe exceeds the critical value (True /False)
4. A material medium is always necessary for heat transmission (True /False)
5. The unit of mass transfer coefficient is m/s (True /False)
6. The unit of thermal conductivity is _____
7. The thermal diffusivity of substance is given by _____
8. Natural convection takes place in the presence of _____
9. State Fourier Law of conduction
10. Define Reynolds Number

II. Write State short notes on ANY FIVE: **(5x 2=10)**

1. Reynolds Analogy
2. Overall heat transfer coefficient
3. Concept of black body
4. Equimolal diffusion
5. Critical thickness of insulation
6. Radiation shape factor
7. Electrical network analogy

III Write answers on ANY FIVE: **(5 x 4=20)**

1. A storage chamber of interior dimensions 10m X 8m X2.5 m high has its inside maintained at a temperature of – 20 degree C, while the outside is at 25 degree C. The walls and ceiling of the chamber have three layers made of

   a. 60 mm thick board (k= 0.2 W/m deg) on the inside

   b. 90 mm thick insulation (k=0.04 W/m deg) at the mid

   c. 240 mm thick concrete (k=0.18 W /m deg) on the outside.

   Neglecting flow of heat through the floor, determine the rate at which heat can flow towards inside of the chamber.

2. Establish a relation for the shape factor of a cavity with respect to itself. The cavity is closed on its outer surface with a flat surface.
3. A spherical heater of 20 cm diameter and at 60 degree C is immersed in a tank of water at 20 degree C. Determine the value of convective heat transfer coefficient.
4. How is the Reynolds number defined? What is its physical interpretation? What role is played by the critical Reynolds Number?
5. What is the effectiveness of a heat exchanger? What is its range of possible values?
6. Differentiate between a diffuse and specular reflector.
7. A cylindrical cement tube of inner radii 0.05 cm and outer radius 1 cm, has a wire embedded into it along its axis. To maintain a steady temperature difference of 120 degree C between the inner and outer surfaces, a current of 5 ampere is made to flow in the wire. Make calculations for the amount of heat generated per meter length and the thermal conductivity of cement. (resistance of wire equal to 0.1 ohm per cm of length)

IV. Write essay on any ONE **(1 x 10=10)**

1. Derive an equation to determine the heat transfer through a composite cylindrical wall made of three layers.
2. Air at 2 bar pressure and 200 degree C temperature gets heated as it flows through 2.5 cm diameter tube with a velocity of 10 m/s. A constant heat flux condition is maintained at the wall and wall temperature is 20 degree C above the air temperature all along the length of the tube. Make calculations for the heat transfer per unit length of the tube.

   Use the following empirical correlation for convection coefficient

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

   Where the different thermo physical properties of air are

   $\mu = 2.57 \times 10^{-5}\ Ns/m^2$

   k=0.0385 w/m deg C

   Cp=1025J/kgK

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