Register Number: ……..

B.E. DEGREE EXAMINATIONS: NOV / DEC 2010

Sixth Semester

MECHANICAL ENGINEERING

U07ME602: Heat and Mass Transfer

Time: Three Hours **Maximum Marks: 100**

Answer ALL Questions:-

PART A (10 x 1 = 10 Marks)

1. The transmission of energy from one region to another due to temperature difference is called

   A) Mass Transfer B) Heat Transfer C) Pressure Transfer D) Power Transfer

2. Main application of fin is

   A) To get good look of the engine B) To get better life of the engine

   C) Cooling of Motor cycle Engine D) To get good performance.

3. The ratio of the momentum diffusivity to the thermal diffusivity is called

   A) Prandtl Number B) Reynolds number C) Nusselt Number D) Grashof Number

4. The ratio of Nusselt Number to the product of Reynolds number and Prandtl Number is called

   A) Pin number B) Fin Number C) Stanton number D) Standard Number

5. The change of phase from liquid to vapour state is known as

   A) Vapour B) Heating C) Boiling D) Cooling

6. An Equipment which transfer the heat from a hot fluid to a cold fluid is called

   A) Liquidator B) Evaporator C) Heat Exchange D) Water cooler

7. The ratio between radiation absorbed and incident radiation is

   A) Emissivity B) Absorptivity C) Reflectivity D) Transmissivity

8. Lambert's Law tells

   A) $E_b \alpha \cos\theta$ B) $E_b = \cos\theta$ C) $E_b > \cos\theta$ D) $E_b < \cos\theta$

9. The ratio of mass concentration of species to the total mass density of the mixture

   A) Mass fraction B) mole fraction C) Molar concentration D) Mass concentration

10. The ratio of the molecular diffusivity of momentum to the molecular diffusivity of mass

    A) Sherwood number B) Schmidt number C) Molar number D) Mass number

PART B (10 x 2 = 20 Marks)

11. Define heat transfer, and what are the modes of heat transfer.
12. State the applications of fins.
13. State Buckingham π theorem.
14. Indicate the concept or significance of boundary layer.

15. What are the types of heat exchangers?
16. What is meant by compact heat exchangers?
17. Define Emissivity.
18. What are the assumptions made to calculate radiation exchange between the surfaces?
19. What is mass transfer and give examples?
20. What is molecular diffusion?

PART C (5 x 14 = 70 Marks)

21. a) A furnace wall made up of 7.5 cm of fire plate and 0.65 cm of mild steel plate. Inside surface exposed to hot gas at 650^0 C and outside air temperature 27^0 C. The convective heat transfer co efficient for inner side is 60 W / m^2K. The convective heat transfer co efficient for out side is 8 W / m^2K. Calculate the heat lost per square meter area of the furnace wall and also find outside surface temperature.

(OR)

b) An aluminium cube 6 cm on a side is originally at a temperature of 500^0 C. It is suddenly immersed in a liquid at 10^0 C for which h is 120 W / m^2K. Estimate the time required for the cube to reach a temperature of 250^0 C. For aluminium ρ = 2700 kg / m^3, C_p = 900 J / kg K, k = 204 W / mK.

22. a) Air at atmospheric pressure and 200^0 C flows over a plate with a velocity of 5 m /s. The plate is 15 mm wide and is maintained at a temperature of 120^0 C. Calculate the thickness of hydrodynamic and thermal boundary layers and the local heat transfer coefficient at a distance of 0.5 m from the leading edge. Assume that the flow is on one side of the plate. ρ = 0.815 kg / m^3; $\mu = 24.5 \times 10^{-6}$ Ns / m^2; Pr = 0.7 ; k = 0.0364 W/ mK.

(OR)

b) A thin 80 cm long and 8 cm wide horizontal plate is maintained at a temperature of 130^0 C in large tank full of water at 70^0 C. Estimate the rate of heat input in to the plate necessary to maintain the temperature of 130^0 C.

23. a) Dry saturated steam at a pressure of 2.45 bar condenses on the surface of a vertical tube of height 1 m. The tube surface temperature is kept at 117^0 C. Estimate the thickness of the condensate film.

(OR)

b) A counter flow concentric heat tube exchanger is used to cool engine oil (C=2130J /kgK) from 160^0 C to 60^0 C with water available at 25^0 C as the cooling medium. The flow rate of cooling water through the inner tube of 0.5 m is 2 kg / s

while the flow rate of oil through the outer annulus, outer diameter = 0.7 m is also 2 kg / s. If U is 250 W/m^2K, how long must the heat exchanger be to meet its cooling requirement?

24. a) A furnace wall emits radiation at 2000 K. Treating it as black body radiation, calculate
    1. Monochromatic radiant flux density at 1μm wave length.
    2. Wave length at which emission is maximum and the corresponding emissive power.
    3. Total emissive power.

(OR)

b) Two black square plates of size 1 by 1 m are placed parallel to each other at a distance of 0.4 m. One plate is maintained at a temperature of 900^0 C and the other at 400^0 C. Find the net heat exchange of energy due to radiation between the two plates.

25. a) A mixture of O_2 and N_2 with their partial pressures in the ratio 0.21 to 0.79 is in a container at 25^0 C. Calculate the molar concentration, the mass density, and the mass fraction of each species for a total pressure of 1 bar. What would be the average molecular weight of the mixture?

(OR)

b) Air at 1 atm and 25^0 C containing small quantities of iodine flow with a velocity of 6.2 m /s inside a 35 mm diameter tube. Calculate mass transfer co efficient for iodine. The thermo physical properties of air are $\upsilon = 15.5 \times 10^{-6}$ m^2 / s; $D = 0.82 \times 10^{-5}$ m^2/ s.

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