Roll No. | | | | | | | | | | |

B.E (FULL TIME) DEGREE END SEMESTER EXAMINATIONS, APRIL / MAY 2013

MECHANICAL ENGINEERING BRANCH

16

Sixth Semester

ME 9355 HEAT & MASS TRANSFER
(Regulation 2008)

Time: 3 Hours Answer ALL Questions Max. Marks 100

(Approved Heat and Mass Transfer Data Book permitted)

PART-A (10 x 2 = 20 Marks)

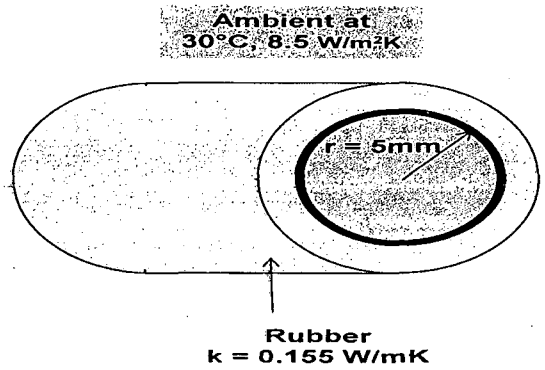
1. When do you recommend fin ?
2. What are Heislers Charts ?
3. What is the reciprocity relation for view factor ?
4. What is a radiation shield and how is net radiation transfer between two surfaces affected by an intervening shield ?
5. Draw the free convection boundary layer on a heated vertical plate.
6. Define Prandtl number. How does its value affect relative growth of the velocity and thermal boundary layers for laminar flow over a surface?
7. What are the promoters used to increase the effect of dropwise condensation?
8. Define effectiveness of a heat exchanger.
9. What are the analogy between Heat and Mass Transfer ?
10. Define Schmidt and Sherwood numbers.

Part – B (5 x 16 = 80 marks)

11. (i) Derive the expression for LMTD for a parallel-flow heat exchanger *(8)*

(ii) A 2 shell pass, 4 tube pass heat exchanger of flow arrangement is used to cool processed water from $t_1 = 75°C$ to $t_2 = 25°C$ on the tube side at a rate of $m_h = 5$ kg/s with cold water entering the shell side at $T_1 = 10°C$ at the rate of $m_c = 6$ kg/s. The overall heat transfer coefficient is $U_m = 750$ W/m^2 °C. Calculate the heat transfer surface and the outlet temperature of the coolant water. *(8)*

12. a) For the electrical conductor as shown in figue, calculate, the critical thickness of rubber and the maximum heat transfer rate per metre length of conductor. The temperature of rubber is not to exceed 65 °C (due to heat generated within the conductor). ***(16)***



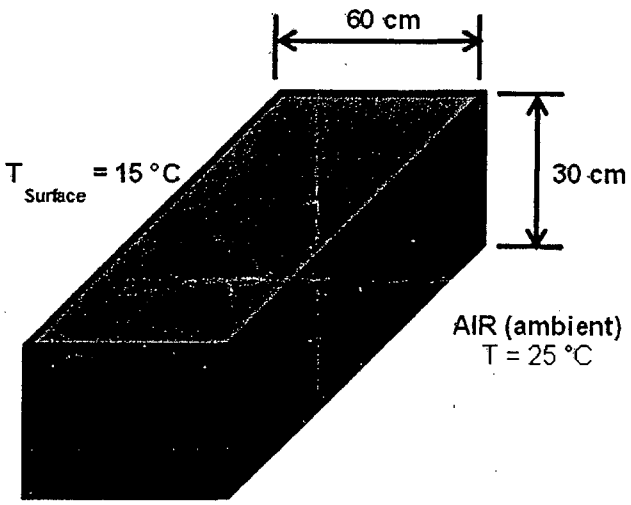
OR

b) A water pipe is to be buried in soil at sufficient depth from the surface to prevent freezing in winter. What minimum depth is required to prevent the freezing of pipe when soil is at uniform temperature of T_i = 10 °C, the surface is subjected to a uniform temperature of T_0 = -15 °C continuously for 50 days. Also the pipe surface temperature should not fall below 0 °C ***(16)***

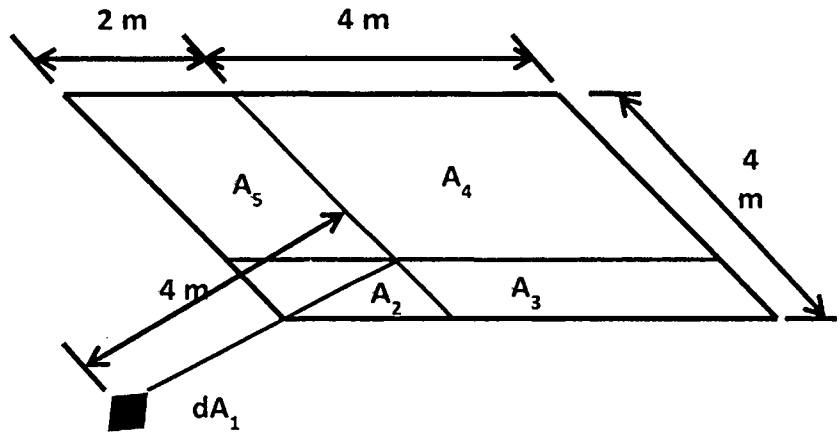
13. a) Air at 2 m/s, 27 °C, and 1 atm flows over a flat plate, Calculate
(i) Boundary Layer Thickness at x = 20 cm & 40 cm
(ii) Mass flow which enters the boundary layer between x=20 cm and x = 40 cm.
Assume unit depth in z direction. ***(16)***

OR

b) A horizontal un-insulated Air Conditioning duct as show in Fig, dissipate the energy to the ambient by natural convection. Determine the heat gained by duct / metre length ? ***(16)***



14. a) Brick wall (ε=0.8) 6m x 4m is located at a distance of 4m from an opening of size 20 cm x 20 cm in a furnace wall. Center line of opening lies 1m lower and 1m left of wall center. If T_{furnce} = 1523°C and T_{wall} = 37°C, calculate radiant heat exchange between opening and the wall. ***(16)***



OR

b) (i) A black body is kept at 727°C. Estimate the fraction of thermal radiation emitted by the surface in the wavelength band of 1.0 and 5.0 μ. ***(8)***

(ii) Intensity of the radiation emitted by the sun is maximum at a wavelength of 0.5 μ. Assuming sun to be a black body, estimate its surface temperature and emissive power. ***(8)***

15. a) Benzene (M = 87) is stored in an open tank of 5m in diameter and forms a 1 mm deep layer at its bottom. The vapour pressure of benezone in the tank is 0.14 bar. Diffusion of benzene takes place only through a stagnant air film 3mm thick. The operating pressure and temperature of the system are 1 atm and 20°C and at this condition, the diffusivity of the benezene is 8.5 x 10^{-6} m^2/s. Calculate the time taken for the entire benzene to evaporate. Take the density of benzene 880 kg/m^3. ***(16)***

OR

b) A system as show in Fig, has the Total Pressure = 1 atm, Temperature of 25 °C and the partial pressure of CO_2 in both the container is given in the Fig. Estimate the mass transfer rate of CO_2 and air through tube

D_{AB} = 0.16 x 10^{-4} m^2/s (for CO_2 – air combination) ***(16)***