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

B.E (FULL TIME) DEGREE END SEMESTER EXAMINATIONS, OCT / NOV 2013

MECHANICAL ENGINEERING BRANCH

Sixth Semester

ME 9355 HEAT & MASS TRANSFER
(Regulation 2008)

Time: 3 Hours | Answer ALL Questions | Max. Marks 100

PART- A (10 x 2 = 20 Marks)

1 What do you understand by critical radius of insulation?

2 What is lumped analysis

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 State Newton's law of cooling

6 Differentiate free and forced convection.

7 What are the effects of non-condensable gases during condensation?

8 What are fouling factors in heat exchangers?

9 What are the analogy between Heat and Mass Transfer

10 Define Schmidt and Sherwood numbers.

Part – B (5 x 16 = 80 marks)

11. Two square plates, each of 5 m^2 area, are separated by a gap of 6 mm. One plate, whose surface emissivity is 0.7, is at a temperature of 900 K. The other plate has surface emissivity of 0.95 and a temperature of 300 K. Assuming the plates to be much larger than the gap, calculate the net radiation heat exchange between the plates. If a thin polished metal sheet of surface emissivity 0.15 on both sides is interposed between two plates, calculate the steady state temperature and new net radiation exchange through the system. Calculate how many times the heat loss by radiation will be reduced.

(16)

12. a) A 5-cm-thick iron plate [k = 60 W /m °C), c_p = 460 J/(kg °C), ρ = 7850 kg/m^3, and α = 1.6 x 10^{-5} m^2/s] is initially at T_i = 225°C. Suddenly, both surfaces are exposed to an ambient at T_∞ = 25 °C with a heat transfer coefficient h = 500 W/m^2 °C. Calculate the center temperature at t = 2 min after the start of the cooling. Calculate the energy removed from the plate per square meter during this time.

(16)

OR

b) A steel rod of diameter D = 2cm, length L = 25 cm, and thermal conductivity k = 50 W/(m °C) is exposed to ambient air at T_∞ = 200C with a heat transfer coefficient, h = 64 W/(m^2 °C). If one end of the rod is maintained at a temperature of 120 °C, calculate the heat loss from the rod.

(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) Air at 80 kg/h flows through a 10 cm internal diameter tube. At a particular point, the pressure and temperature of air are 1.5 bar and 333 K respectively. Whilst the surface temperature of the tube is maintained at 380 K. Find heat transfer coefficient and rate from 1m length of the tube in this region.

(16)

14. 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 °C. Estimate the thickness of the condensate film. (16)

OR

b) A parallel flow heat exchanger has hot and cold water stream running through it. the flow rates are 10 and 25 kg/min respectively. Inlet temperatures are 75 °C and 25 °C on hot and cold sides. The exit temperature on the hot side should not exceed 50 °C. Assume $h_i = h_o$ = 600 W/m^2K. Calculate the area of heat exchanger using ε - NTU approach. (16)

15. 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 ^{o}C. Calculate the molar concentration, the mass density, the mole fraction and the mass fraction of each species for a total pressure of 1 bar. What would be the average molecular weight of the mixture?

(16)

OR

b) Air at 25^{0}C and atmospheric pressure flows with a velocity of 3 m/s inside a 10 mm diameter tube of 1 m length. The inside surface of the tube contains a deposit of naphthalene. Determine the average mass transfer coefficient for the transfer of naphthalene from the pipe surface into the air. (16)