Reg. No. | | | | | | | | | |

M.E. / M.TECH. DEGREE EXAMINATIONS, MAY/JUNE 2017
FIRST SEMESTER
INTERNAL COMBUSTION ENGINEERING
IC16101 ADVANCED HEAT TRANSFER

(Regulation 2016)

Q. Code: 325210

(Heat and mass transfer data book allowed)

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

Answer **ALL** questions

PART A - (10 X 2 = 20 marks)

1. Define overall heat transfer co-efficient.
2. Define “shape factor”.
3. State Buckingham π theorem.
4. Write a short note on laminar flow and turbulent flow.
5. List the types of compact heat exchanger.
6. Define “Drop wise condensation”.
7. State the limitations of the analytical solution method.
8. Define “thermal diffusivity”.
9. Enumerate application of mass transfer.
10. What do you mean by equimolar counter diffusion?

PART B - (5 X16 = 80 marks)

11. (a) Derive an expression for generalised heat conduction equation in cylindrical coordinates. **(16)**

(OR)

(b) Two parallel plates of size 3 m × 2 m are placed parallel to each other at a distance of 1 m. One plate is maintained at a temperature of 550°C and the other at 250°C and the emissivities are 0.35 and 0.55 respectively. The plates are located in a large room whose walls are at 35°C. If the plates located exchange heat with each other and with the room, calculate heat lost by the plates. **(16)**

12. (a) Derive an expression for Von Karman momentum equation. **(16)**

(OR)

(b) Air at 40°C flows over a flat plate, 0.8 m long at a velocity of 50 m/s. The plate surface is maintained at 300°C. Determine the heat transferred from the entire plate length to air taking into consideration both laminar and turbulent portion of the boundary layer. Also calculate the percentage error if the boundary layer is assumed to be turbulent nature from the very leading edge of the plate. **(16)**

13. (a) (i) Derive LMTD for counter flow heat exchanger. **(10)**

(ii) Compare LMTD and NTU analysis of heat exchangers. **(6)**

(OR)

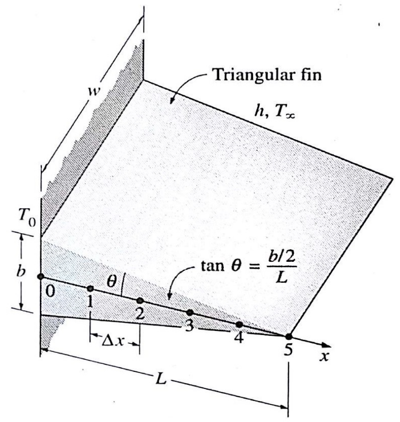
(b) In a counter flow heat exchanger water at 20°C flowing at the rate of 1200 kg/h it is heated by oil of specific heat 2100 J/kg K flowing at the rate of 520 kg/h at inlet temperature of 95°C. Determine the following. **(16)**
1. Total heat transfer
2. Outlet temperature of water
3. Outlet temperature of oil

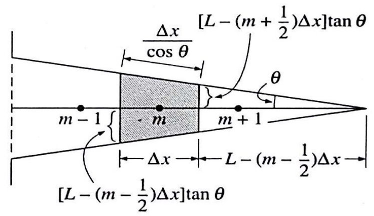
Take, Overall heat transfer coefficient is 1000 W/m^2 K. Heat exchanger area is 1m^2.

14. (a) Explain in detail about the finite difference form of a heat conduction problem is obtained by the energy balance method. **(16)**

(OR)

(b) Consider an aluminium alloy fin (k= 180 W/m°C) of a triangular cross section with length L = 5 cm, base thickness b = 1 cm, and very large width w, as shown in fig. The base of the fin is maintained at a temperature of T_o = 200°C. The fin is losing heat to the surrounding medium at t_∞ = 25°C with a heat transfer coefficient of h = 15 W/m^2°C. Using the finite difference method with six equally spaced nodes along the fin in the x-direction. Determine (a) the temperature at the nodes, (b) the rate of heat transfer from the fin for w = 1 m, and (c) the fin efficiency. **(16)**





15. (a) (i) A mixture of O_2 and N_2 with their partial pressures in a ratio 0.21 to 0.79 is in a container at 25°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? **(10)**

(ii) Explain steady diffusion through a plane membrane. **(6)**

(OR)

(b) (i) Dry air at 30°C and one atmospheric pressure flows over a flat plate of 600 mm long at a velocity of 55 m/s. Calculate the mass transfer coefficient at the end of the plate. **(12)**

(ii) Explain fick's law of diffusion. **(4)**