G 1063 (Pages : 2) Reg. No.....

Name.....

B.TECH. DEGREE EXAMINATION, MAY 2016

Sixth Semester

Branch : Mechanical Engineering/Automobile Engineering

HEAT AND MASS TRANSFER (MU)

(Old Scheme—Prior to 2010 Admissions—Supplementary/Mercy Chance)

Time : Three Hours Maximum : 100 Marks

Part A

Answer **all** *questions.*
Each question carries 4 *marks.*

1. Explain the term over all heat transfer coefficient.
2. Explain critical radius of Insulation for cylindrical surface.
3. Explain Reynolds analogy.
4. Explain with a neat diagram development of laminar velocity profile inside a pipe.
5. Define the term Fouling factor.
6. What are compact heat exchangers ? Give an example.
7. Define : (a) Black body ; (b) white body ; (c) gray body.
8. Differentiate between Specular and Diffuse surfaces ?
9. Differentiate between film and drop wise condensation.
10. Define Fick's law of diffusion.

(10 × 4 = 40 marks)

Part B

Answer **all** *questions.*
Each full question carries 12 *marks.*

11. (a) Derive the one-dimensional heat conduction equation in a cylinder with density ρ, specific heat C and outer radius R.

Or

(b) A composite cylinder consist of 10 cm radius steel pipe of 25 mm thickness over which two layers of insulation 30 mm and 35 mm are laid. The conductivities are 25 W/m K, 0.25 W/m K and 0.65 W/m K. The inside is exposed to convection at 300°C with h = 65 W/m^{2}K. The outside is exposed to air at 30°C with h = 15W/m^{2}K. Determine the heat loss/m. Also find interface temperatures.

Turn over

12. (a) A solar concentrator causes a heat flux of 2000 W/m^2 on tube of 60 mm ID. Pressurized water flows through the tune at a rate of 0.01 kg/s. If the bulk temperature at inlet is 20°C, what will be the length required to heat the water to a bulk temperature of 80°C. Also find the wall temperature at exit.

Or

(b) A flat-plate solar collector contains a number of copper tubes that are painter black to enhance the absorptance of thermal radiation from the sun. Consider one such copper tube that is ½ standard type M and is 3 m long. It conveys ethylene glycol at a volume flow rate of 3.25×10^{-6} m^3/s. The liquid enters the tube at a (bulk) temperature of 20°C. Determine the fluid outlet temperature and the tube-wall temperature at the outlet. Take the incident heat flux to be 2200 W/m^2.

13. (a) The inlet and outlet temperature of hot and cold fluids in a double pipe heat exchanger are 220°C, 100°C and 80°C and 120°C. Determine whether the exchanger is parallel flow or counter flow. Also determine the LMTD and effectiveness of the exchanger and the capacity ratio.

Or

(b) Derive an expression for effectiveness for counter flow heat exchangers.

14. (a) Two circular disks of 1m diameter are placed coaxially, parallel and symmetrically at a distance of 1 m. The disks have an emissivity of 0.6 and are at 1000 K and 500 K. Determine the reduction in radiation in heat flow due to the introduction of a shield of equal diameter midway n = between the two. The shield of equal diameter midway between the two. The shield has an emissivity of 0.1 on both sides. (Neglect interactions to the outside pipe).

Or

(b) Two large parallel planes are at 1000 K and 600 K. Determine the heat exchange per unit area, (i) if surface are black ; (ii) if the hot one has an emissivity of 0.8 and the cooler one 0.5 ; (iii) if a large plate is inserted between these two, the plate having an emissivity of 0.2.

15. (a) The condenser of a steam power plant operates at a pressure of 7.38 kPa. Steam at this pressure condenses on the outer surface of horizontal tubes through which cooling water circulates. The outer diameter of the pipe is 3 cm, and the outer surfaces of tube are maintained at 30°C. Determine ; (i) rate of heat transfer to the cooling water circulating in the tubes and (ii) the rate of condensation of steam per length of horizontal tube.

Or

(b) A square plate of side 1m has one of its sides coated with naphthalene and stands vertically in still air at 53°C. Determine diffusion rate. M = 128, D = 6.11×10^{-6} m^2/s, kinematic viscosity = 18.8×10^{-6} m^2/s Sc = 3.077. The vapour pressure at 53°C is 1.333×10^{-3} bar, R_v = 8315/128 = 64.91 J/kg K, T = 326 K.

(5 × 12 = 60 marks)