Hall Ticket Number :										

Code: 5G555

R-15

III B.Tech. I Semester Supplementary Examinations March/April 2023

Heat Transfer

(Mechanical Engineering)

Max. Marks: 70 Time: 3 Hours

Answer *all five* units by choosing one question from each unit (5 x 14 = 70 Marks)

****

UNIT–I

1. a) Derive the Fourier equation in 3D by Cartesian co-ordinate system.

   b) Asbestos layer of 10mm thickness (k=0.116W/mK) is used as insulation over a boiler wall. Consider an area of $0.5m^2$ and find out the rate of heat flow as well as the heat flux over this area if the temperatures on either side of the insulation are 300^0C and 30^0C.

OR

2. a) Explain the concept of thermal resistance and thermal contact resistance.

   b) A hollow cylinder of inner radius r1 and outer radius r2 has temperature variation along the radius gives by T(r)=400-400. In (r/r1). Thermal conductivity of the material, k=45W/(mC). If r1=5cm and r2=10cm, determine the direction and rate of flow of heat at the two surfaces for 1m length of pipe.

UNIT–II

3. a) A motor body is 360 mm in diameter (outside) and 240 mm long. Its surface temperature should not exceed 55^oC when dissipating 340W. Longitudinal fins of 15 mm thickness and 40 mm height are proposed. The convection coefficient is $40W/m^2\,^oC$.

   Determine the number of fins required.

   Atmospheric temperature is 30^oC. Thermal conductivity = 40 W/m^oC.

   b) Discuss about Infinite bodies in transient heat conduction.

OR

4. a) A 10cm diameter steel rod of k=50 W/m K is to be annealed by slowly cooling it from 800^0C to 100^0C in an ambient air at 30^0C. If the heat transfer coefficient is $15W/m^2K$, determine the time required for annealing. Take $\rho=7800kg/m^3$, C=0.5kJ/kg K.

   b) Define fin. List out various types of fin configurations and its applications.

UNIT–III

5. a) Explain the method of Buckingham π-theorem and its limitations.

   b) Derive the equation for heat transfer at critical valve of thickness for cylindrical pipe.

OR

6. a) Derive the governing equation and its solution by integral method in free convection.

   b) Air at 27^0C and 1 atm flows over a flat plate at a speed of 2m/s. calculate the boundary layer thickness at a distance of 20cm and 40 cm from the leading edge of the plate.

UNIT–IV

7. a) Draw the flux plot and explain different regimes in it.

   b) Differentiate between Film wise and Drop wise Condensation. Why the heat transfer coefficients are larger in film wise than drop wise condensation?

OR

8. a) Obtain the relation between intensity of radiation and emissive power.

   b) Water at atmospheric pressure is to be boiled in polished copper pan. The diameter of the pan is 380 mm and is kept at 115^0C. calculate the following:

   (i) Power required to boil the water. (ii) Rate of evaporation. (iii) Critical heat flux.

UNIT–V

9. a) Derive an equation for LMTD for counter flow heat exchanger.

   b) In a food processing plant, a brine solution is heated from 8^0C to 14^0C in a double pipe heat exchanger by water entering at 55^0C and leaving at 40^0C at the rate of 0.18kg/s. if the overall heat transfer coefficient is 800 W/m^2K, determine the area of heat exchanger required i) For a parallel flow arrangement, and ii) For counter flow arrangement. Take C_p for water = 4.18kJ/kgK

OR

10. a) Derive NTU-Effectiveness relation for counter flow heat exchanger.

    b) Consider a heat exchanger for cooling oil which enters at 180^0C, and cooling water enters at 25^0C. Mass flow rates of oil and water are: 2.5 kg/s and 1.2 kg/s, respectively. Area for heat transfer =16m^2. Specific heat data for oil and water and overall heat transfer coefficient are given: Cpoil=1900J/kgK; Cp water=4184J/kgK; U=285 W/m^2K. Calculate outlet temperatures of oil and water for parallel flow heat exchanger

***