PVP 14

Code: ME5T3

III B.Tech - I Semester – Regular/Supplementary Examinations March 2021

HEAT TRANSFER
(MECHANICAL ENGINEERING)

Duration: 3 hours Max. Marks: 70

Note: 1. Heat Transfer Data Books are permitted.
2. Assume suitable data wherever necessary.

PART – A

Answer ***all*** the questions. All questions carry equal marks

11x 2 = 22 M

1.

a) Define Thermal Diffusivity. What are its units.
b) Define Fourier's Law. Write its equation. Why there is a negative sign? What is the reason for it?
c) What is the purpose of fins? Give two examples where fins are used.
d) What are the assumptions made in Lumped Parameter Analysis.
e) What is the importance of Heislar charts?
f) Differentiate between free and forced convection. List out the examples.
g) Draw temperature and velocity profile for thermal boundary layer over a flat plate. Indicate maximum and minimum points clearly.
h) Define NTU. What does it signify?
i) Define fouling. What is its effect on heat exchanger.

j) State Kirchhoff's law of black body radiation.

k) Define Emissivity. What are its units.

PART – B

Answer any ***THREE*** questions. All questions carry equal marks. 3 x 16 = 48 M

2. a) Derive general heat conduction equation in cylindrical coordinate system. 10 M

b) Compare various modes of heat transfer with suitable examples and governing laws. 6 M

3. a) A carbon steel (K=54 W/mk) rod with cross section of an equilateral triangle (each side 5mm) is 80 mm long. It is attached to a plane wall which is maintained at a temperature of 400°C. The surrounding temperature is at 50°C. Calculate the heat dissipated by the rod. Take $h=90W/m^2K$. Consider fin is insulated at tip. 8 M

b) A long cylinder of 12 cm in diameter, initially at 20°C is placed into a furnace at 800 °C. Calculate the time required for the center of the rod to reach 760°C. Also calculate the temperature at a radius of 5.4cm at the same time. Take $h= 140W/m^2K$, $\alpha =6.11 \times 10^{-6}\ m^2/s$, k= 21 w/mk. 8 M

4. a) Liquid sodium potassium alloy (25% Na+75% K) at 200°C flows across a cylinder of 0.020 mm diameter with a velocity of 2 m/s, the pipe wall is being maintained at 500°C. Determine the rate of heat transfer. 8 M

b) Air flows over a plate with a velocity of 2m/s. Temperature of air is 10°C. If the width of the plate is 30cm and it is at temperature of 65°C. Find the following parameters at a distance of 25cm from the leading edge. 8 M
i) Boundary layer thickness ii) total drag force
iii) total heat transfer rate from the surface.

5. a) What is meant by Nucleate Boiling. What are the factors effecting Nucleate Boiling. 8 M

b) Derive LMTD equation for parallel flow heat exchanger. List out the assumptions made. 8 M

6. a) Prove that Emissive power is π times the Intensity of radiation. 8 M

b) Calculate the heat exchange by radiation between the surfaces of two long cylinders having radii 120mm and 60mm respectively. The axis of the cylinder is parallel to each other. The inner cylinder is maintained at a temperature of 130ºC and emissivity of 0.6. Outer cylinder is maintained at a temperature of 30ºC and emissivity of 0.5. 8 M