Reg. No.												

Question Paper Code	12167

B.E. / B.Tech. - DEGREE EXAMINATIONS, NOV / DEC 2023

Sixth Semester

Mechanical Engineering

20MEPC602 - HEAT TRANSFER

(Use of Standard HMT Data book is permitted)

(Regulations 2020)

Duration: 3 Hours Max. Marks: 100

PART - A (10 × 2 = 20 Marks)

Answer ALL Questions

		Marks, K-Level, CO
1.	State Fourier's law of heat conduction.	*2,K2,CO1*
2.	What is the main difference between steady state and unsteady state heat transfer?	*2,K1,CO1*
3.	Define emissive power of a black surface.	*2,K1,CO2*
4.	Sketch the electrical analogue circuit for thermal radiation.	*2,K2,CO2*
5.	Describe the importance of Prandtl number in the convection heat transfer.	*2,K2,CO3*
6.	Sketch the velocity and temperature profiles in free convection on a vertical wall.	*2,K2,CO3*
7.	Define dropwise condensation.	*2,K1,CO4*
8.	Define excess temperature in boiling.	*2,K1,CO4*
9.	State the key factors to be considered in designing a heat exchanger.	*2,K1,CO5*
10.	Sketch temperature distribution graph for condensers and evaporators.	*2,K2,CO5*

PART - B (5 × 13 = 65 Marks)

Answer ALL Questions

11. a) A 3 cm OD steam pipe is to be covered with two layers of insulation each having a thickness of 2.5 cm. The average thermal conductivity of one insulation is 5 times that of the other. Determine the percentage decrease in heat transfer if better insulating material is next to pipe than it is the outer layer. Assume that the outside and inside temperatures of composite insulation are fixed. *13,K3,CO1*

OR

b) Derive generalized steady state heat conduction equation for a plane wall. *13,K2,CO1*

12. a) For an industrial furnace in the form of a black body at 3000 K emits radiation. Calculate the followings: *13,K3,CO2*

(i) Monochromatic emissive power at 1μm wave length,

(ii) Wave length at which the emission is maximum,
(iii) Maximum emissive power,
(iv) Total emissive power,
(v) Total emissive power of the furnace if it is assumed as a real surface having emissivity equal to 0.85.

OR

b) Two large parallel planes with emissivities of 0.35 and 0.85 exchange heat by radiation. The temperatures of the planes are respectively 1073K and 773K. A radiation shield having the emissivity of 0.04 is placed between them. Find the percentage reduction in radiation heat exchange and temperature of the shield. *13,K3,CO2*

13. a) Ethylene glycol is cooled from 60°C to 40°C in a 30 mm diameter tube, the tube wall temperature being maintained constant at 20°C. The average velocity at entry is 10 m/s. Determine the length required. *13,K3,CO3*

OR

b) Air at 25°C, flows over a flat plate at a velocity of 5m/s and heated to 135°C. The plate is 3 m long and 1.5 m wide. Calculate the local heat transfer coefficient at x = 0.5 m and the heat transferred from the first 0.5 m of the plate. *13,K3,CO3*

14. a) Demonstrate the Nusselt's theory of condensation. *13,K2,CO4*

OR

b) Illustrate the various regimes of pool boiling. *13,K2,CO4*

15. a) Explain the different types of heat exchangers with neat sketches. *13,K2,CO5*

OR

b) Derive an expression for the effectiveness of counter flow heat exchanger stating the assumptions involved in it. *13,K2,CO5*

PART - C (1 × 15 = 15 Marks)

16. a) Sketch the hydrodynamic and thermal boundary layer development for a flow over a flat plate, and explain the Velocity distribution and temperature distribution in the boundary layers. *15,K2,CO6*

OR

b) In a heat exchanger, hot fluid enters at 180°C and leaves at 120°C while the cold fluid enters at 100°C and leaves at 120°C. Estimate the LMTD and effectiveness in the following cases. Also find the NTU values. *15,K3,CO6*
1. Counter flow.
2. One shell pass and multiple tube passes.
3. Cross flow, both fluids unmixed.