Roll No.												

PRESIDENCY UNIVERSITY

BENGALURU

School of Engineering

Mid - Term Examinations - November 2024

Semester: III — **Date**: 7-11-2024

Course Code: PET2008 — **Time**: 02:00pm – 03:30pm

Course Name: Heat and Mass Transfer for Petroleum Engineering — **Max Marks**: 50

Program: B.Tech. (Petroleum Engineering) — **Weightage**: 25%

Instructions:

(i) Read all questions carefully and answer accordingly.

(ii) Do not write anything on the question paper other than roll number.

Part A

Answer ALL the Questions. Each question carries 2 marks. **5Qx2M =10M**

1	Define convection. Write down one example.	2 Marks	L1	CO1
2	Describe radiation and list one example.	2 Marks	L1	CO1
3	Define boiling and condensation.	2 Marks	L1	CO1
4	Describe “Fins”. Give its two practical applications.	2 Marks	L1	CO2
5	State general heat conduction equation for cylindrical co-ordinate.	2 Marks	L1	CO2

Part B

Answer ALL the Questions. Each question carries 10 marks. **4Qx10M =40M**

6	Estimate the following in the given scenario: A steel rod, 1 cm in diameter and 5 cm in length, functions as a fin with one end insulated, exposed to surroundings at 65 °C with a heat transfer coefficient of 50 W/m^2K. The base temperature is 98 °C. (a) Temperature at the tip of the fin (b) Fin effectiveness	10Marks	L2	CO
	or			
7	Estimate the following in the given scenario: A steel rod, 1 cm in diameter and 5 cm in length, functions as a fin with one end insulated, exposed to surroundings at 65 °C with a heat transfer coefficient of 50 W/m^2K. The base temperature is 98 °C. (a) Heat Loss from the Fin (b) Fin effectiveness	10Marks	L2	CO1

8	The classic pool boiling curve represents a graph that displays the relationship between heat flux (q) and excess temperature ($\Delta T_{excess} = T_w - T_{sat}$). As the magnitude of the excess temperature rises, the curve progresses through four distinct phases: (1) natural or free convection, (2) nucleate boiling, (3) transition boiling, and (4) film boiling. Elucidate the statement.	10Marks	L2	CO1

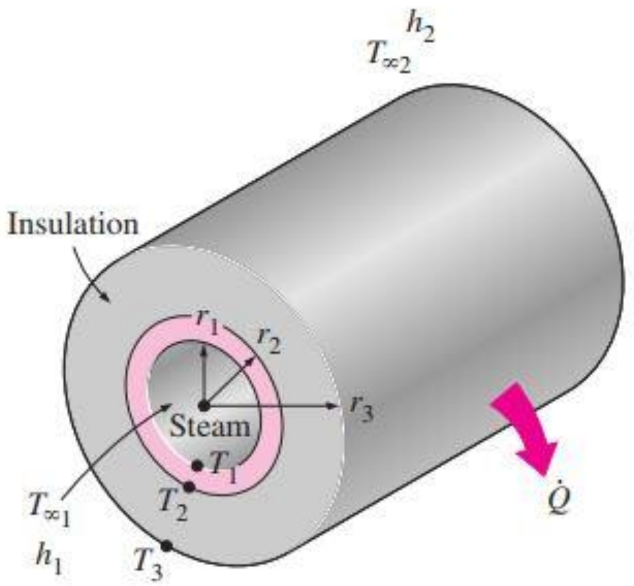
or

9	Elucidate the following dimensionless numbers with its significance in context of heat transfer: 1. Prandtl Number (Pr) 2. Grashof's Number (Gr)	10Marks	L2	CO1
10	A 2-m-long, 0.3-cm-diameter electrical wire extends across a room at 15°C, as shown in Fig. Heat is generated in the wire as a result of resistance heating, and the surface temperature of the wire is measured to be 152°C in steady operation. In addition, the voltage drop and electric current through the wire are measured to be 60 V and 1.5 A, respectively. Disregarding any heat transfer by radiation, determine the convection heat transfer coefficient for heat transfer between the outer surface of the wire and the air in the room.	10Marks	L3	CO2

or

11	The roof of an electrically heated home is 6m long, 8m wide and 0.25 m thick and is made of a flat layer of concrete whose thermal conductivity is k = 0.8 W/mK. The temperature of the inner and outer surfaces of the roof on eight are measured to be 15 °C and 4 °C, respectively, for a period of 10 hours. Determine (a) the rate of heat loss through the roof that night and (b) the cost of that heat loss to the home owner if the cost of the electricity is $0.08/KWh.	10Marks	L3	CO2

12	Steam at T = 320°C flows in a cast iron pipe (k = 80 W/m · °C) whose inner and outer diameters are $D1$ = 5 cm and $D2$ = 5.5 cm, respectively. The pipe covered with 3-cm-thick glass wool insulation with k = 0.05 W/m · °C. Heat is lost to the surroundings at $T2$ = 5°C by natural convection and radiation, with a combined heat transfer coefficient of h2 = 18 W/m2 · °C. Taking the heat transfer coefficient inside the pipe to be h1 = 60 W/m2 · °C, determine the rate of heat loss from the steam per unit length of the pipe.	10Marks	L3	CO2



or

13	Consider a steam pipe of length L = 20 m, inner radius r1 = 6 cm, outer radius r2 = 8 cm, and thermal conductivity k = 20 W/m · °C, as shown in Figure. The inner and outer surfaces of the pipe are maintained at average temperatures of T1 = 150°C and T2 = 60°C, respectively. Obtain a general relation for the temperature distribution inside the pipe under steady conditions.	10Marks	L3	CO2