Roll No.												

PRESIDENCY UNIVERSITY

BENGALURU

End - Term Examinations – MAY 2025

Date: 24-05-2025 **Time:** 09:30 am – 12:30 pm

School: SOE	**Program:** B.Tech-MEC	
Course Code : MEC3089	**Course Name:** Heat and Mass Transfer	
Semester: VI	**Max Marks**:100	**Weightage**: 50%

CO - Levels	CO1	CO2	CO3	CO4	CO5
Marks	14	14	24	24	24

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 2marks. **10Q x 2M=20M**

1.	Define heat transfer.	**2 Marks**	**L1**	**CO1**
2.	What is contact resistance	**2 Marks**	**L1**	**CO1**
3.	What is thermal conductivity?	**2 Marks**	**L1**	**CO2**
4.	What is steady state heat transfer?	**2 Marks**	**L1**	**CO2**
5.	State Newton's law of cooling.	**2 Marks**	**L1**	**CO3**
6.	What are non-dimensional numbers?	**2 Marks**	**L1**	**CO3**
7.	State Stefan Boltzmann Law of Radiation.	**2 Marks**	**L1**	**CO4**
8.	What is reflectivity?	**2 Marks**	**L1**	**CO4**
9.	Differentiate between condenser and evaporator.	**2 Marks**	**L1**	**CO5**
10.	How are the heat exchangers classified based on physical state?	**2 Marks**	**L1**	**CO5**

S

Part B

Answer the Questions. **Total Marks 80M**

11.	Derive the 3-D conduction equation in Cartesian coordinates.	**10 Marks**	**L2**	**CO1**
	Or			
12.	A metallic steam pipe (k= 45 W/m-K) 5 cm ID and 6.5 cm OD is lagged with a 2.75 cm radial thickness of high temperature insulation having thermal conductivity of 1.1 W/m-k. The surface heat transfer coefficient for inside and outside are 4650 and 11.5 W/m^2-k respectively. If the steam temperature is 200°C and the ambient temperature is 25°C, determine: (i) heat loss per meter length of pipe (ii) temperature at the interfaces.	**10 Marks**	**L3**	**CO1**
13.	Define and Classify fins with proper diagrams.	**10 Marks**	**L2**	**CO2**
	Or			
14.	A 1 m long and 5 cm diameter cylinder placed in an atmosphere of 40°C is provided with 12 longitudinal straight fins of 75 W/m-k, 0.75 mm thick. The fins protrude 2.5 cm from the cylinder surface. The heat transfer coefficient from the cylinder and fins to the ambient air is 23.3 W/m^2-k. Calculate, (i) increase in the rate of heat transfer due to fins if the surface temperature of the cylinder is 150°C and (ii) the temperature at the center of the fin.	**10 Marks**	**L3**	**CO2**
15.	Define and provide physical significance of Reynolds number, Prandltl number, Nusselt number and Grashoff Number.	**10 Marks**	**L2**	**CO3**
	Or			
16.	Define boundary layer and explain boundary layer formation with a neat diagram.	**10 Marks**	**L2**	**CO3**
17.	Water is heated in a tank by dipping a plate, 30 cm x 30 cm size. The temperature of plate surface is maintained at 140°C. Assuming the temperature of surrounding water at 20°C, find the heat loss from the plate per hour.	**10 Marks**	**L3**	**CO3**
	Or			
18.	Air at standard conditions of 760 mm Hg and 20°C flows over a flat plate at 180 m/min. The plate is (50 cm x 25 cm). Find out the heat lost per hour if the flow is parallel to 50 cm side of plate. If the 25 cm side is kept parallel to the air flow, what will be the effect on heat transfer? Temperature of the plate is 100°C.	**10 Marks**	**L3**	**CO3**
19.	State and explain Lambert's Cosine law, Planck's distribution law, Wein's Displacement law and Kirchhoff's law of radiation.	**10 Marks**	**L2**	**CO4**

	Or			
20.	Define Black body, Irradiation, Radiosity, radiation shield, radiation shape factor.	**10 Marks**	**L2**	**CO4**
21.	It is desired to calculate the net radiant heat exchange between the floor of a furnace 4m x 2m and a side wall 3m x 2m. The emissivity of the floor material is 0.63 and that of the side wall material is 0.2. If the temperature of the floor and side wall are at 600^{o}C and 400^{o}C, calculate the net heat exchange between them.	**10 Marks**	**L3**	**CO4**
	Or			
22.	A thin polished copper plate with an emissivity of 0.04 is inserted as radiation shield between two dull steel plates with emissivity of 0.8. Determine the percentage decrease in radiant energy transfer due to the presence of the shield. What will be the percentage reduction if the copper plate gets oxidized to an emissivity of 0.6.	**10 Marks**	**L3**	**CO4**
23.	Classify heat exchangers with proper diagrams.	**10 Marks**	**L2**	**CO5**
	Or			
24.	Define Mass transfer and its types. Explain Fick's law of Diffusion and define diffusion coefficient.	**10 Marks**	**L2**	**CO5**
25.	Calculate the outside tube area for a single pass steam condenser to handle 3500 kg/hr of dry saturated steam at 50^{o}C. the tube has 25 mm outer diameter and 22 mm inner diameter and the tube material has K= 105 W/m-K. The average water velocity in each tube is limited to 2 m/s. Assume steam side film coefficient as 3235 W/m2-K and inlet and outlet water temperatures as 15^{o}C and 25^{o}C respectively.	**10 Marks**	**L3**	**CO5**
	Or			
26.	It is desired to heat 230 kg/hr of water from 35^{o}C to 93^{o}C with oil C_p = 2.1 kJ/kg-K, having an initial temperature of 175^{o}C. The mass flow of oil is also 230 kg/hr. Two double-pipe heat exchangers are available with the data given below. Which heat exchanger would you recommend? Heat Exchanger 01: U = 570 W/m^{2}K, A = 0.47 m^2 Heat Exchanger 02: U = 370 W/m^{2}K, A = 0.94 m^2	**10 Marks**	**L3**	**CO5**