

PRN No.	
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PAPER	0314-2112 (ESE)
CODE	

**(AY:2024-25) December 2024 (ENDSEM) EXAM
TY (SEMESTER - I)**

COURSE NAME: Heat Transfer Branch: Mechanical COURSE CODE: MEUA31202

(T.Y PATTERN 2020)

Time: [1Hr 30 Min]

[Max. Marks: 40]

(* Instructions to candidates:

- 1) **Figures to the right indicate full marks. Use of scientific calculator is allowed**
- 2) **Use suitable data wherever required**
- 3) **All questions are compulsory. Solve any two sub question each from Questions 1 and 2**
- 4) **Solve any one sub question (2 marks) from Questions 3, 4, 5 and 6 and sub question of 4 marks is compulsory from questions 3,4,5, and 6**

Q. No.	Question Description	Max. Marks	CO mapped	BT Level
Q.1	a) Apply fourier law of heat conduction to a plane wall and draw electric circuit for composite wall.	[4]	01	Apply
	b) A refrigerated container in the form of a cube with 2 meter sides and 5 mm thick aluminium walls ($k=204$ W/mK) is insulated with a 0.1 m layer of cork ($k=0.043$ W/mK) and the surface temperatures are $T_i=5$ C and $T_o=20$ C. Find heat transfer rate.	[4]	01	Apply
	c) Steam at 350 C flowing in a pipe ($k=80$ W/mK) 5 cm ID and 5.6 cm OD is covered with 3 cm thick insulation ($k=0.05$ W/mK). Heat is lost to the surrounding at 5 C by natural convection $h=20$ W/m ² K. Find total resistance for the heat transfer.	[4]	01	Apply
Q2	a) A stainless steel fin ($k = 20$ W/m K) having a diameter of 20 mm and a length of 0.1 m is attached to a wall at 300°C. The ambient temperature is 50°C and the heat transfer coefficient is 10 W/m ² K. The fin tip is insulated. Determine the rate of heat dissipation from the fin.	[4]	02	Apply
	b) Fins 12 in number, having $k = 75$ W / m * K and 0.75 mm thickness protrude 25 mm from a cylindrical surface of 50 mm diameter and 1 m length placed in an atmosphere of 40°C. If the cylindrical surface is maintained at 150°C and the heat transfer coefficient is 23W / (m ^ 2) K, calculate the rate of heat transfer.	[4]	02	Apply

	c) The cooling system of an electronic package has to dissipate 0.153 kW from the surface of an aluminium plate 100 mm x 150mm. It is proposed to use eight fins, each 150 mm long and 1 mm thick. The temperature difference between the plate and the surroundings is 50 K, the thermal conductivity of plate and fins is 0.15 kW/m K and the heat transfer coefficient is 0.04 kW/m ² K. Calculate the heat transfer from unfinned surface.	[4]	02	Apply
Q3	a) Illustrate lumped parameter approach to solve unsteady state heat transfer problems.	[2]	03	Understand
	OR			
	b) Illustrate Biot number to solve unsteady state problems.	[2]	03	Understand
	c) A solid copper ball of 100 mm diameter and $\rho = 8954$ kg/m ³ , $c_p = 383$ J/kg K, $k = 386$ W/mK uniform temperature of 250°C. It is suddenly immersed in a well-stirred fluid which is maintained at a uniform temperature of 50°C. The heat transfer coefficient between the ball and the fluid is $h = 200$ W/m ² K. Estimate Biot and Fourier number.	[4]	03	Apply
Q4	a) Sketch the boundary layer formed along the horizontal pipe in natural convection mode and state its importance.	[2]	04	Understand
	OR			
	b) Illustrate importance of Nusselt number in convective heat transfer.	[2]	04	Understand
	c) Water is heated while flowing through a 1.5 cm x 3.5 cm rectangular cross-section tube at a velocity of 1.2 m/s. The entering temperature of the water is 40°C, and the tube wall is maintained at 85°C. Determine the Reynolds number and sketch the boundary layer formed within duct. Properties of water at the mean bulk temperature of 55°C are: $\rho = 985.5$ kg/m ³ ; $c_p = 4.18$ kJ/kg K, $\nu = 0.517 \times 10^{-6}$ m ² /s, $k = 0.654$ W/m K and $Pr = 3.26$.	[4]	04	Apply
Q.5	a) Illustrate the significance of shape factor in radiative heat transfer.	[2]	05	Understand
	OR			
	b) Elaborate usage of radiation shield in nuclear power plant.	[2]	05	Understand

	c) Assuming the sun to be a black body having a surface temperature of 5800 K, calculate (a) the total emissive power, (b) the wavelength at which the maximum spectral intensity occurs.	[4]	05	Apply
Q.6	a) Justify the radiator used for cooling of Internal combustion engine.	[2]	06	Understand
	OR			
	b) Illustrate sizing and rating problems of heat exchangers.	[2]	06	Understand
	c) Water ($C_p = 4.187 \text{ kJ/kg K}$) is heated at the rate of 1.4 kg/s from 40°C to 70°C by an oil ($C_p = 2 \text{ kJ/kg K}$) entering at 110°C and leaving at 60°C in a counterflow heat exchanger. If $U = 350 \text{ W/m}^2 \text{ K}$, calculate surface area required.	[4]	06	Apply

