Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V EXAMINATION – SUMMER 2025

Subject Code:3151909 Date:15-05-2025

Subject Name:Heat Transfer

Time:02:30 PM TO 05:00 PM Total Marks:70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**
5. **Assume suitable data if required**

			MARKS
Q.1	**(a)**	Define steady-state heat conduction. How does it differ from transient heat conduction?	**03**
	(b)	Explain Fourier's law of heat conduction. How does the temperature dependency of thermal conductivity vary for gases compared to solids?	**04**
	(c)	With usual notations derive general heat conduction equation in Cartesian coordinates and explain its significance.	**07**
Q.2	**(a)**	Derive the formula for the critical radius of insulation for a spherical object. Why does the rate of heat transfer initially decrease with insulation and then increase?	**03**
	(b)	What applications of heat exchangers? Classify heat exchangers	**04**
	(c)	What are compact heat exchangers, Discuss the design and construction features of compact heat exchangers.	**07**
		OR	
	(c)	With usual notations derive the expression for effectiveness for a parallel flow heat exchanger.	**07**
Q.3	**(a)**	Define the Biot number and explain its significance in determining the applicability of the lumped capacitance method.	**03**
	(b)	What are fins, and why are they used in heat transfer applications? What are the advantages and limitations of using fins for heat transfer enhancement?	**04**
	(c)	Derive the expression for temperature distribution and heat transfer rate for a fin insulated at the tip.	**07**
		OR	
Q.3	**(a)**	Derive the governing equation for one-dimensional transient heat conduction in a plane wall with finite conduction and convective resistances.	**03**
	(b)	What is a thermometer well, and why are errors introduced during temperature measurements?	**04**
	(c)	With usual notations derive the generalized heat conduction equation in spherical coordinates and explain its specific applications.	**07**
Q.4	**(a)**	What are radiation shields, and how do they reduce heat transfer?	**03**
	(b)	What is the Von-Karman integral momentum equation, Explain the physical significance of the terms in the Von-Karman equation.	**04**
	(c)	Define the following dimensionless numbers and explain their physical significance: Reynolds number (Re), Nusselt number (Nu),	**07**

Prandtl number (Pr), Grashof number (Gr), Peclet number (Pe), Biot number (Bi)

OR

Q.4	**(a)**	Explain the physical significance of the momentum equation in fluid flow.	**03**
	(b)	Outline the assumptions made in deriving the Blasius solution for a laminar boundary layer and describe the steps involved in solving the Blasius equation for boundary layer thickness.	**04**
	(c)	Define the following terms : Reflectivity, transmissivity, Emissivity, Kirchhoff's law, Planck's law, Wien's law, Stefan-Boltzmann law.	**07**
Q.5	**(a)**	What is a shape factor, and why is it important in radiation heat exchange?	**03**
	(b)	Explain the significance of the overall heat transfer coefficient in heat exchanger analysis.	**04**
	(c)	Derive the expression for radiation heat exchange between two black bodies.	**07**

OR

Q.5	**(a)**	Distinguish between the hydrodynamic and thermal boundary layers..	**03**
	(b)	What is the fouling factor, and how does it affect the performance of a heat exchanger?	**04**
	(c)	Define the overall heat transfer coefficient and derive its expression for a heat exchanger. How does the overall heat transfer coefficient vary for single-phase and two-phase heat transfer?	**07**

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