Seat No.: _____ **Enrolment No._____**

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VI (OLD) - EXAMINATION – SUMMER 2017

Subject Code: 161906 **Date: 15/05/2017**

Subject Name: Heat and Mass Transfer

Time: 10:30 AM to 01:00 PM **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1	**(a)**	Distinguish between the conduction, convection and radiation modes of heat transfer.	**07**
	(b)	Establish the general differential equation in Cartesian co-ordinates for 3-D unsteady heat conduction by considering an infinitesimal volume element. Deduce there from the conduction equations for unsteady state 2-D flow with heat generation at uniform rate within material and steady 1-D flow without heat generation.	**07**
Q.2	**(a)**	What is critical thickness of insulation on a small diameter wire or pipe, Explain its physical significance and derive an expression for the same	**07**
	(b)	What is lumped capacity? What are the assumptions for lumped capacity analysis?	**07**
		OR	
	(b)	Derive equations of temperature distribution and heat dissipation for infinite long fin.	**07**
Q.3	**(a)**	Define Following: (i) Critical Reynolds Number (ii) Prandtl Number (iii) Grashof Number (iv) Nusselt Number (v) Stanton Number (vi) Peclet Number (vii) Graetz Number.	**07**
	(b)	Derive the integral momentum equation for the boundary layer over a flat plate.	**07**
		OR	
Q.3	**(a)**	Distinguish between natural and forced convection heat transfer.	**07**
	(b)	The inside and outside surfaces of a hollow sphere of radii r_1 and r_2 are maintained at constant temperatures T_1 and T_2 respectively. The thermal conductivity of insulating material varies with temperature as $k = k_o\left(1+\alpha T+\beta T^2\right)$, where k_o is constant. Derive an expression for heat flow through the sphere.	**07**
Q.4	**(a)**	Enumerate the applications of boiling heat transfer. Explain briefly the physical mechanism of boiling.	**07**
	(b)	Introducing Nusselt's simplification, obtain an expression for the heat transfer coefficient in filmwise condensation over a vertical plate.	**07**
		OR	
Q.4	**(a)**	Derive an expression for the Logarithmic Mean Temperature Difference for the flow in a counter flow heat exchanger	**07**
	(b)	Describe the phenomenon of radiation from real surfaces.	**07**
Q.5	**(a)**	State and explain Wien's displacement law and define Lambert's cosine law of radiation.	**07**
	(b)	What is the Stephen-Boltzmann Law? Explain the concept of total emissive power of a surface	**07**
		OR	
Q.5	**(a)**	State and explain Fick's law of diffusion. Express Fick's law in terms of partial pressures of gases.	**07**
	(b)	By dimensional analysis show that for forced convection heat transfer the Nusselt number can be expressed as a function of Prandtl number and Reynolds number.	**07**

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