Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII (NEW) EXAMINATION – WINTER 2022

Subject Code:3170102 Date:12-01-2023

Subject Name:Theory of Heat 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.**
4. **Simple and non-programmable scientific calculators are allowed.**

			Marks
Q.1	**(a)**	State the fourier's law of conduction with suitable example.	**03**
	(b)	Derive expression for temperature distribution under 1D steady state heat conduction for composite cylinder.	**04**
	(c)	Distinguish between conduction, convection and radiation modes of heat transfer with suitable examples.	**07**
Q.2	**(a)**	What is Biot number? Write its significance.	**03**
	(b)	What do you understand by fin effectiveness and fin efficiency?	**04**
	(c)	Derive general heat conduction equation in Cartesian coordinates.	**07**
		OR	
	(c)	Using dimensional analysis, obtain a general form of equation for free Convective heat transfer.	**07**
Q.3	**(a)**	Define: Thermal Boundary layer, Hydrodynamic Boundary layer.	**03**
	(b)	Distinguish between natural and forced convection heat transfer.	**04**
	(c)	What is the "critical radius" of insulation? Derive an expression for the same for cylinders.	**07**
		OR	
Q.3	**(a)**	State limitations of LMTD method.	**03**
	(b)	Write down expression of effectiveness of following heat exchangers: (a) Parallel Flow (b) Counter flow (c) Condenser (d) Evaporator.	**04**
	(c)	In a food processing plant, a brine solution is heated from -12^0C to -65^0C in double pipe parallel flow heat exchanger by water entering at 35^0C & leaving at 20.5^0C at the rate of 9 kg/min. Determine the heat exchanger area for an overall heat transfer coefficient of 850 W/m^{2}K. For water C_p= 4.186×10^3 J/kgK.	**07**
Q.4	**(a)**	Define heat exchanger and classify in detail.	**03**
	(b)	Write a note on Nucleate boiling?	**04**
	(c)	Derive expression for logarithmic mean temperature difference (LMTD) in the case of counter-flow-heat exchanger.	**07**
		OR	
Q.4	**(a)**	Define condensation process.	**03**
	(b)	What are the fouling factors? Explain their effect in Heat Exchanger design.	**04**
	(c)	Derive a general relation for the radiation shape factor in case of radiation between two surfaces. Explain Wein's displacement law of radiation.	**07**
Q.5	**(a)**	State and Prove Kirchoff's law of radiation?	**03**
	(b)	Define: Total Emissive Power, Emissivity	**04**

	(c)	A pipe with a surface temperature of 480 K is kept within a large enclosure whose walls are at 380 K. Presuming the pipe surface to be black, calculate the coefficient of radiant heat transfer. If the heat transfer coefficient including the effect of radiation and convection is 34.9 W/m^2-deg, find the convective heat transfer coefficient.	**07**

OR

Q.5	**(a)**	Define: Black body, White body.	**03**
	(b)	Differentiate between dropwise and filmwise condensation.	**04**
	(c)	Define Radiation Intensity? Prove that the intensity of radiation is given by $Ib = Eb / \pi$.	**07**