Seat No./Enrollment No.: _____

GUJARAT TECHNOLOGICAL UNIVERSITY
BACHELOR OF ENGINEERING – SEMESTER 7 – EXAMINATION – SUMMER 2026

Subject Code: 3170102 **Date: 08/06/2026**

Subject Name: Theory of 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.**

Q.1	**(a)**	Explain the modes of heat transfer.	**03**
	(b)	What is 'Fourier Law of Conduction'? What is its application?	**04**
	(c)	What do you mean by critical radius of insulation? Derive its expression for hollow cylinder.	**07**
Q.2	**(a)**	Define: thermal conductivity, heat transfer coefficient and thermal resistance.	**03**
	(b)	Write and explain Stefan Boltzmann law in brief.	**04**
	(c)	Derive the expression of fin effectiveness for an infinitely long fin.	**07**
		OR	
Q.2	**(c)**	Derive the heat conduction equation for the one dimensional steady sate heat conduction through hollow sphere.	**07**
Q.3	**(a)**	What is Biot number? What is its physical significance?	**03**
	(b)	What is Wien's Displacement Law? Explain in brief.	**04**
	(c)	Derive the expression of the overall heat transfer coefficient for a conduction through hollow cylinder.	**07**
		OR	
Q.3	**(a)**	Define a geometrical or shape factor and its importance in radiation between two surfaces.	**03**
	(b)	What is Lumped Capacity? Derive its expression for unsteady state heat transfer.	**04**
	(c)	Derive the general expression for the conductive heat transfer in cartesian coordiantes.	**07**
Q.4	**(a)**	Explain Newton's law of cooling.	**03**
	(b)	What is fouling factor? How it is calculated?	**04**
	(c)	Derive the formula of LMTD for counter flow heat exchanger.	**07**
		OR	
Q.4	**(a)**	Explain in brief Kirchoff's law of radiation.	**03**
	(b)	Explain the process of filmwise and dropwise condensation with neat sketches.	**04**

(c) A spherical container of negligible thickness holding a hot fluid at 1400 and having an outer diameter of 0.4 m is insulated with three layers of each 50 mm thick insulation of k1 = 0.02: k2 = 0.06 and k3 = 0.16 W/mK. (Starting from inside). The outside surface temperature is 300C. Determine (i) the heat loss, and (ii) Interface temperatures of insulating layers. **07**

Q.5 **(a)** Which materials are said an insulating materials. Give examples of insulating materials. **03**

(b) Explain in brief Lambert's cosine law. **04**

(c) A motor body is 360 mm in diameter (outside) and 240 mm long. Its surface temperature should not exceed 55ºC when dissipating 340W. Longitudinal fins of 15 mm thickness and 40 mm height are proposed. The convection coefficient is $40 W/m^2{}^oC$. **07**

determine the number of fins required. Atmospheric temperature is 30^oC. thermal conductivity = 40 W/mºC.

OR

Q.5 **(a)** Explain the need of extended surfaces. Which are the conventional shapes used as external surfaces in heat transfer. **03**

(b) Classify the heat exchangers in brief. **04**

(c) When 0.6 kg of water per minute is passed through a tube of 2 cm diameter, it is found to be heated from 20^oC to 60^oC. the heating is achieved by condensing steam on **07**
the surface of the tube and subsequently the surface temperature of the tube is maintained at 90^o C. Determine the length of the tube required for fully developed flow. Take Nu as 3.66.Properties of water at 40oC: $\rho = 995 kg/m^3$, $\nu = 0.657x10\text{-}6$ m2/s Pr = 4.340 K = 0.628W/mK Cp = 4178J/kgK

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