

Seat No./Enrollment No.: _____

GUJARAT TECHNOLOGICAL UNIVERSITY
BACHELOR OF ENGINEERING – SEMESTER 4 – EXAMINATION – SUMMER 2026

Subject Code: BE04005021

Date: 25/05/2026

Subject Name: 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.**

- Q.1**
- (a) Explain different modes of heat transfer along with their basic laws. **03**
 - (b) Explain how does thermal conductivity of gases, liquid and solids depend upon temperature? **04**
 - (c) Write Fourier's law of conduction and derive equation for steady state heat conduction through composite wall. **07**
- Q.2**
- (a) Write the expression for critical radius of insulated pipe. Explain its significance. **03**
 - (b) Discuss Efficiency and effectiveness of Fins. **04**
 - (c) Calculate the critical radius of insulation for asbestos with $k=0.17 \text{ W/m } ^\circ\text{C}$ surrounding a pipe and exposed to room air at 30°C with $h=3 \text{ W/m}^2 \text{ } ^\circ\text{C}$. Calculate the heat loss from a 210°C , 5 cm diameter pipe when covered with the critical radius of insulation and without insulation. **07**
- OR
- Q.2**
- (c) A furnace wall is made up of 23 cm of fire brick, 7.5 cm of insulating brick and 8.9 cm of red brick. The temperature at the inner surface of wall is 800°C and that of the outer surface is 60°C . Average thermal conductivity values of the three types of bricks, i.e. fire brick, insulating brick and red brick are 1.04, 0.104 and 0.744 W/m K respectively. Neglecting resistance of points, calculate the rate of heat flow and temperature at the interfaces between different kinds of bricks. **07**
- Q.3**
- (a) Explain Reynolds analogy along with the significance. **03**
 - (b) Define convection and write down difference between free and forced convection. **04**
 - (c) Determine the conductivity of a test panel 15 cm by 16 cm and 1.25 cm thick, if during a two hour test 8.35 KJ heat is conducted through the panel having temperature of 35°C and 25°C at the two faces. **07**
- OR
- Q.3**
- (a) Write significance of Prandtl, Nusselt and Grashof numbers. **03**
 - (b) Using Dimension analysis derive expression for forced convection. **04**

	(c) Find the overall coefficient of heat transfer between water and oil if the water flows through a copper pipe 1.8 cm ID and 2.1 cm OD while the oil flows through the annulus between this pipe and a steel pipe. The water and oil side film coefficients are 4650 and 1280 W/m K. the fouling factors on the water and oil sides may be taken to be 0.000344 and 0.00086 respectively. The thermal conductivity of the tube wall is 349 W/m K.	07
Q.4	(a) Define: Black body, White body, Grey body	03
	(b) State laws of radiation. Explain Black body.	04
	(c) Describe Regimes of Pool Boiling.	07
	OR	
Q.4	(a) Determine the thermal radiation exchanged between black bodies at 150 °C and 1500 °C	03
	(b) Discuss Stefan-Boltzmann law of radiation.	04
	(c) Discuss Planck's law of radiation.	07
Q.5	(a) Discuss the classification of heat exchanger briefly.	03
	(b) Draw the sketch of various methods of feeding the multiple effect evaporators.	04
	(c) Listing the assumption derive the equation for logarithmic mean temperature difference (LMTD) for counter flow heat transfer.	07
	OR	
Q.5	(a) Define capacity and economy of evaporator.	03
	(b) Explain Boiling Point Elevation (BPE).	04
	(c) Water flowing at rate 0.15 Kg/sec is heated from 40 °C to 80 °C in a counter current double pipe heat exchanger. The hot fluid is oil and enters exchanger at 105 °C and leaves at 70 °C. Calculate heat transfer area if overall heat transfer coefficient is 300 w/m ² °C. Sp. heat of water is 4.186 kJ/kg k.	07
