Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV EXAMINATION – SUMMER 2025

Subject Code:3140503 Date:12-05-2025

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.**

			MARKS
Q.1	**(a)**	Explain thermal conductivity of gases, liquid and solids.	**03**
	(b)	Enlist the property of Insulating material.	**04**
	(c)	Explain in brief various laws of radiation.	**07**
Q.2	**(a)**	Enlist different types of fins with neat sketch.	**03**
	(b)	Derive an expression for heat flow through a cylinder.	**04**
	(c)	A furnace is constructed with a 24 cm thick layer of fire brick, 12 cm thick layer of insulating brick and followed by a 24 cm thick layer of building brick. The inside temperature of the furnace is 950 °C and the outside temperature is 55 °C. The thermal conductivities of fire brick, insulating brick and building brick are 6.05, 0.59 and 2.4 W/(m °C). Find the heat loss per unit area and the temperature at the interfaces.	**07**
		OR	
	(c)	Derive equation for heat transfer through a composite wall made up of 3 different materials in close thermal contact with each other, with no heat loss to surrounding.	**07**
Q.3	**(a)**	Give the physical significance of Prandlt No., Nusselt No. and Grashoff No.	**03**
	(b)	Explain natural convection phenomenon.	**04**
	(c)	Using Dimension analysis derive expression for forced convection for the fluid flowing inside tube in a turbulent flow.	**07**
		OR	
Q.3	**(a)**	Explain the terms absorptivity, emissivity, transmissivity and reflectivity for heat transfer by radiation.	**03**
	(b)	Define the black body and Give applications where this concept is used in heat transfer.	**04**
	(c)	Discuss with the help of diagram various regimes of pool boiling. What is the use of finding critical flux and critical temperature drop?	**07**
Q.4	**(a)**	Draw the temperature profiles of cold and hot fluids for true co-current and counter –current flow in double pipe heat exchanger.	**03**
	(b)	Discuss the Concept of fin Effectiveness.	**04**
	(c)	Derive the equation for LMTD and explain its importance.	**07**
		OR	
Q.4	**(a)**	When LMTD correction factor is used in heat exchanger calculation?	**03**
	(b)	Derive an equation for Overall heat transfer coefficient in double pipe heat exchanger.	**04**
	(c)	Explain in details with neat sketch: Shell & Tube heat exchangers.	**07**
Q.5	**(a)**	Define capacity and economy of evaporator.	**03**
	(b)	Explain working of Vertical Tube Evaporator.	**04**
	(c)	Derive the material and energy balances for multi effect evaporator.	**07**

OR

Q.5	**(a)**	Differentiate between forward feed and backward feed in a multiple effect evaporator with a neat sketch.	**03**
	(b)	Write short notes on Vapor recompression in evaporator.	**04**
	(c)	Write a short note on Multiple Effect Evaporator	**07**

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Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV (NEW) EXAMINATION – SUMMER 2024

Subject Code:3140503 Date:18-07-2024

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.**

			MARKS
Q.1	**(a)**	List out features of unit operations. Also Define Heat transfer.	**03**
	(b)	A furnace is constructed with 225 mm thick of fire brick,120 mm of insulating brick and 225 mm of building brick. The inside temperature is 1200 K and the outside temperature is 330 K. Find the heat loss per unit area and the temperature at the junction of the fire and insulating brick. **Data**: k for fire brick = 1.4 W/(m.K), k for insulating brick = 0.2 W/(m.K), k for building brick = 0.7 W/(m.K)	**04**
	(c)	Why Insulation is necessary for process equipment. Also Mention characteristics of insulating material & Derive equation for critical radius of insulation.	**07**
Q.2	**(a)**	Discuss the Physical significance of (i) Prandlt Number (ii) Peclet Number (iii) Biot Number.	**03**
	(b)	Explain Velocity boundary layer & Thermal boundary layer. Which dimensionless number is related to it? How?	**04**
	(c)	Determine the heat transfer coefficient for water flowing in a tube of 16 mm diameter at a velocity of 3 m/s. The temperature of the tube is 297 K and the water enters at 353 K and leaves at 309 K. Using Dittus-Boelter equation and Sieder-Tate equation. Data : Properties of water at 331 K at arithmetic mean-bulk temperature are: ϱ = 984.1 kg/m^3, C_p = 4187 J/(kg.K), μ=485*10^{-6} Pa.s, k = 0.657 W/(m.K), Viscosity of water at 297 K, μ_w = 920*10^{-6} Pa.s	**07**
		OR	
	(c)	Derive the equation of overall heat transfer co-efficient(U) from the individual heat transfer co-efficient(h) with neat sketch.	**07**
Q.3	**(a)**	Define: Thermal Conductivity. Enlist the factors on which thermal conductivity of a substance depends?	**03**
	(b)	Describe any two laws of black body radiation.	**04**
	(c)	What is boiling and when does it occurs? Explain Nucleate boiling.	**07**
		OR	

Q.3	**(a)**	Explain basic law for heat conduction.	**03**
	(b)	Explain Kirchhoff's law and Total emissive power for radiation.	**04**
	(c)	Define Condensation. Explain filmwise condensation & Dropwise condensation.	**07**
Q.4	**(a)**	Define: Tube Pitch, Baffle Spacing & Range.	**03**
	(b)	What do you mean by "fouling" in heat exchangers? What is the effect of it on performance of heat exchangers?	**04**
	(c)	Explain design steps for Shell &Tube heat exchanger in detail. Draw neat sketch of 2-4 pass shell & tube heat exchanger.	**07**

OR

Q.4	**(a)**	Define Fin. Enlist different types of it. Differ Transverse fin with longitudinal fin.	**03**
	(b)	What are the advantages of square pitch arrangement over the triangular pitch in case of heat exchanger tubes?	**04**
	(c)	With neat diagram explain construction and working of falling film evaporator.	**07**
Q.5	**(a)**	Explain the significance of LMTD correction factor.	**03**
	(b)	Explain Boiling Point Elevation (BPE).	**04**
	(c)	What is importance of LMTD? Derive the equation for parallel flow arrangement.	**07**

OR

Q.5	**(a)**	Define Capacity and Economy of evaporator.	**03**
	(b)	Calculate rate of heat loss from a thermoflask if the polished silvered surfaces have emissivities of 0.05,the liquid in the flask is at 368 K and the casing is at 293 K. Calculate loss if both surfaces were black. Stefan Boltzmann constant = $5.67*10^{-8}$ $W/(m^2.K^4)$	**04**
	(c)	Write a short note on Multiple Effect Evaporator.	**07**

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Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER– IV(NEW) EXAMINATION – SUMMER 2023

Subject Code:3140503 Date:11-07-2023

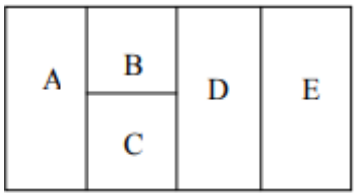
Subject Name:Heat Transfer

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.**

			Mark
Q.1	**(a)**	Distinguish between Heat transfer and Thermodynamics.	**03**
	(b)	Derive an expression for critical radius of insulation for Sphere.	**04**
	(c)	Determine the heat transfer through the composite wall shown in the figure below. Take the conductives of A, B, C, D & E as 50, 10, 6.67, 20& 30 W/mK respectively and assume one dimensional heat transfer.Take area of A=D=E=1m^2 and B=C=0.5 m^2. Temperature entering at wall A is 800^{0}C and leaving at wall E is 100^{0}C.	**07**

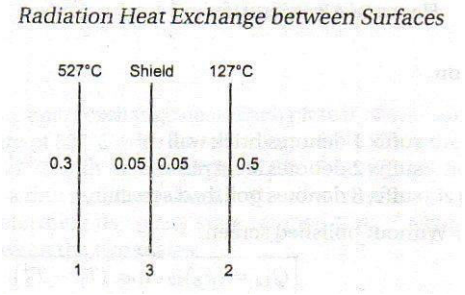


Q.2	**(a)**	Write Dittus-Boeltier equation and Sieder-Tate equation explaining each term and highlight the difference.	**03**
	(b)	Explain Reynold analogy for heat transfer.	**04**
	(c)	Define fin effectiveness and derive an expression for Temperature profile for Insulated Fin at the tip.	**07**
		OR	
	(c)	Derive equation for LMTD with suitable assumptions. Why correction factor is necessary to include with LMTD?	**07**
Q.3	**(a)**	Give Comparision about Conductors and insulators.	**03**
	(b)	Explain the terms absorptivity, emissivity, transmissivity and reflectivity for heat transfer by radiation.	**04**
	(c)	Explain different regimes of pool boiling of saturated liquid with neat sketch.	**07**
		OR	

Q.3 **(a)** Explain how does thermal conductivity of gases, liquid and solids depend upon temperature? **03**

(b) Two large parallel planes with emissivities of 0.3 and 0.5 are maintained at temperatures of 527^0C and 127^0C respectively.A radiation shield having emissivities of 0.05 on both sides is placed between them. Calculate(i) Heat transfer rate between them without shield. (ii) Heat transfer rate between them with shield. **04**

$Q_{w/t\ shield}$ and $Q_{with\ shield}$



(c) Compare drop wise condensation and film wise condensation. **07**

Q.4 **(a)** Define : Segmental baffle, Tie rods, Passes **03**

(b) Differentiate Square and Triangular pitch. List out drawbacks of double pipe heat exchanger. **04**

(c) A counter flow double pipe heat exchanger using super heated steam is used to heat water at the rate of 10500 kg/hr. The steam enters the heat exchanger at 180°C and leaves at 130°C. The inlet and exit temperature of water are 30°C and 80°C respectively. If theoverall heat transfer coefficient from steam to water is 814 W/m^{2}K, calculate the heat transfer area. What would be the increase in area if the fluid flow were parallel? **07**

OR

Q.4 **(a)** Draw a neat sketch of 1-2 shell and tube heat exchanger and label its parts. **03**

(b) State advantages and disadvantages of a floating head heat exchanger. Why floating tube bundle head arrangement is used in shell and tubeheat exchanger? **04**

(c) A counter flow heat exchanger is employed to cool 0.55 kg/s (Cp = 2.45 kj/kg°C) of oil from 115°C to 40°C by the use of water.The inlet and outlet temperature of cooling water are 15°C and 75°C respectively. The overall heat transfer coefficient is expected to be 1450 W/m^2 °C. Using NTU method, calculate the following: **07**

(i) The mass flow rate of water. (ii) The effectiveness of heat exchanger. (iii) The surface area required.

Q.5 **(a)** How we can choose steam pressure for evaporators? **03**

(b) Draw schematic temperature profile of evaporator. List out material of construction for evaporators. Enlist disadvantages of thermal recompression and Calendria type evaporator. **04**

(c) Explain Material and enthalpy balances for single effect evaporator. **07**

OR

Q.5 **(a)** 1.Single effect evaporator has low economy though it is used in industries. Why? 2.State applications of falling film evaporator. **03**

(b) Explain Boiling Point Elevation (BPE). **04**

(c) A single effect evaporator is to concentrate 15000 kg/h of a solution having a concentration of 7% salt to a concentration of 14% salt by weight. Steam is fed to the evaporator at a pressure corresponding to the saturation temperature of 399 K. The evaporator is operating at atmospheric pressure and the boiling point rise is 7 K. Calculate heat load and steam economy. **07**

Data : Feed temperature=298K, Specific heat of feed=4.0 kj/kg.K
Latent heat of condensation of steam at 399 K=2185 kj/kg,
Latent heat of vaporization of water at 373 K=2257 kj/kg

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Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV (NEW) EXAMINATION – SUMMER 2022

Subject Code:3140503 Date:27-06-2022

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.**

			MARKS
Q.1	**(a)**	Define: Heat & Temperature. How it can be differ from each other.	**03**
	(b)	The temperature at the inner and outer surfaces of a boiler wall made of 20 mm thick steel and covered with an insulating material of 5 mm thickness are 3000^0C and 500^0C respectively. If the thermal conductivities of steel and insulating material are 58W/m^{0}C and 0.116 W/m^{0}C respectively, determine the rate of flow through the boiler wall.	**04**
	(c)	Derive equation for heat transfer by conduction through composite wall. Also mention assumptions made for it.	**07**
Q.2	**(a)**	Discuss the Physical significance of (i) Nusselt Number (ii) Grashoff Number (iii) Biot Number.	**03**
	(b)	Explain Velocity boundary layer & Thermal boundary layer. Which dimensionless number is related to it? How?	**04**
	(c)	A vertical pipe 80 mm diameter and 2 m height is maintained at a constant temperature of 120^{o}C.The pipe is surrounded by still atmospheric air at 30^{o}C.Find heat loss by natural convection.	**07**
		OR	
	(c)	Derive the equation of overall heat transfer co-efficient(U) from the individual heat transfer co-efficient(h) with neat sketch.	**07**
Q.3	**(a)**	Define: Thermal Conductivity. Enlist the factors on which thermal conductivity of a substance would be dependent.	**03**
	(b)	How would you distinguish between the following: black body, white body, transparent body and opaque body.	**04**
	(c)	What is boiling and when does it occurs? Explain Nucleate boiling.	**07**
		OR	
Q.3	**(a)**	Explain basic law for heat conduction.	**03**
	(b)	State and prove Stefan Boltzmann law relating to thermal radiation and temperature of a radiating body.	**04**
	(c)	Define Condensation. Explain filmwise condensation & Dropwise condensation.	**07**
Q.4	**(a)**	Define: Tube Pitch, Baffle Spacing & Range.	**03**
	(b)	What do you mean by “fouling” in heat exchangers? What is the effect of it on performance of heat exchangers?	**04**
	(c)	Explain design steps for Shell &Tube heat exchanger in detail. Draw neat sketch of 2-4 pass shell & tube heat exchanger.	**07**
		OR	
Q.4	**(a)**	Define Fin. Enlist different types of it. Differ Transverse fin with longitudinal fin.	**03**

	(b)	Explain Heat transfer effectiveness and number of transfer units (NTU).	**04**
	(c)	What is LMTD? List out its assumptions. Derive the equation for LMTD for counter current flow.	**07**
Q.5	**(a)**	How can you measure performance of evaporators?	**03**
	(b)	What is Evaporation? Distinguish Natural circulation & forced circulation evaporators.	**04**
	(c)	Discuss various methods of feeding in multiple effect evaporators with their relative merits and demerits.	**07**

OR

Q.5	**(a)**	Explain Duhring rule & Boiling point Elevation.	**03**
	(b)	What are the Properties of evaporating liquids that influence the process of evaporation?	**04**
	(c)	What are the various types of evaporators? Draw neat sketch of falling film evaporator and briefly explain its construction and working.	**07**

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