Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE – SEMESTER- V EXAMINATION-SUMMER 2023

Subject Code: 3151909 Date: 26/06/2023

Subject Name: 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)**	Give difference between free and forced convection.	**03**
	(b)	Explain the terms thermal diffusivity and thermal contact resistance.	**04**
	(c)	A mild steel tank of wall thickness 10 mm contains water at 90° C. The thermal conductivity of mild steel is 50 W/m°C , and the heat transfer coefficient for inside and outside of the tank area are 2800 and 11 W/m^2 °C, respectively. If the atmospheric temperature is 20°C , calculate (i) The rate of heat loss per m^2 of the tank surface area. (ii) The temperature of the outside surface tank.	**07**
Q.2	**(a)**	A spherical shaped vessel of 1.2 m diameter is 100 mm thick. Find the rate of heat leakage, if the temperature difference between the inner and outer surfaces is 200° C. Thermal conductivity of material is 0.3 kJ /mh°C.	**03**
	(b)	Write the general three dimensional heat conduction equation in i) Cylindrical coordinates ii) Spherical coordinates	**04**
	(c)	A 12 cm diameter long bar initially at a uniform temperature of 40°C is placed in a medium at 650°C with a convective co efficient of 22 W/m^2K. Calculate the time required for the bar to reach 255^{0}C. Take k = 20W/mK, ρ = 580 kg/m^3 and c = 1050 J/kg K.	**07**
		OR	
	(c)	A motor body is 360 mm in diameter (outside) and 240 mm long. Its surface temperature should not exceed 55 °C when dissipating 340 W. Longitudinal fins of 15 mm thickness and 40 mm height are proposed. The convection coefficient is 40W/m^2 °C. Determine the number of fins required. Atmospheric temperature is 30°C. Take thermal conductivity = 40 W/m°C.	**07**
Q.3	**(a)**	Explain Displacement thickness, Momentum thickness and Energy thickness.	**03**
	(b)	Differentiate between steady state and transient heat conduction and give some examples of unsteady state heat conduction.	**04**
	(c)	For natural convection heat transfer, show that Nu = C (Pr^n , Gr^m).	**07**
		OR	
Q.3	**(a)**	Define radiation. State the range of wavelengths for ultraviolet, visible and thermal radiations.	**03**
	(b)	Discuss the significance of Prandtl, Nusselt and Stanton numbers in convection.	**04**
	(c)	Define and discuss velocity boundary layer and thermal boundary layer over a flat plate. Show the thickness of thee layers for different Prandtl numbers.	**07**

Q.4 **(a)** Explain the terms absorptivity, reflectivity and transmissivity of radiant energy. **03**

(b) The filament of a 75 W light bulb may be considered as a black body radiating into a black enclosure at 70^0 C. the filament diameter is 0.10 mm and length is 5 cm. Considering the radiation, determine the filament temperature . **04**

(c) State and prove Kirchhoff's law. **07**

OR

Q.4 **(a)** Calculate the shape factor for cylindrical cavity shown in Fig. 1 with respect to itself. **03**

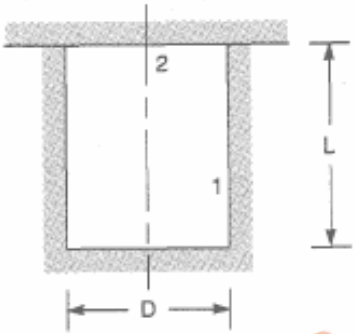

Fig. 1

(b) Define Heat exchanger. Give classification of heat exchangers. **04**

(c) Define intensity of radiation and show that for a unit surface the intensity of normal radiation is $1/\pi$ times the total emissive power. **07**

Q.5 **(a)** What do you understand by fouling factor in case of heat exchanger? List the causes of fouling. **03**

(b) Define and explain types of condensation. **04**

(c) What is boiling? Explain different regimes of boiling. **07**

OR

Q.5 **(a)** What do you understand by TEMA charts? How are they useful in the design of multi-pass heat exchangers. **03**

(b) Differentiate between pool boiling and forced convection boiling. **04**

(c) Derive LMTD formula for counter flow heat exchanger. **07**
