

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/m²°C, respectively. If the atmospheric temperature is 20°C , calculate **07**
- (i) The rate of heat loss per m² of the tank surface area.
- (ii) The temperature of the outside surface tank.
- 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 **04**
- i) Cylindrical coordinates
- ii) Spherical coordinates
- (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/m²K. Calculate the time required for the bar to reach 255°C. Take k = 20W/mK, ρ = 580 kg/m³ 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/m²°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°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 Kirchoff's law. **07**

OR

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

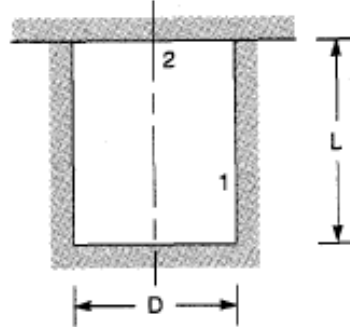


Fig. 1

- (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**
