

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-VII (NEW) EXAMINATION – WINTER 2023****Subject Code:2170102****Date:14-12-2023****Subject Name: Theory of 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

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|------------|--|-----------|
| Q.1 | (a) State and explain Fourier's law of heat conduction. | 03 |
| | (b) Distinguish between natural and forced convection heat transfer. | 04 |
| | (c) Discuss effect of temperature on thermal conductivity of metals, refractory and building materials. | 07 |
| Q.2 | (a) Define Critical thickness of insulation. | 03 |
| | (b) Discuss about types of Fin. | 04 |
| | (c) Derive an energy equation for thermal boundary layer over a flat plate? | 07 |
| OR | | |
| | (c) A small hemispherical oven is built of an inner layer of insulating fire brick 125 mm thick ($k = 0.31 \text{ W/mK}$) and an outer covering of 85% magnesia 40 mm thick ($k = 0.05 \text{ W/mK}$). The inner surface of the oven is at 1073 K and the heat transfer coefficient for the outer surface is $10 \text{ W/m}^2\text{K}$, the room temperature is 20°C . Calculate the rate of heat loss through the hemisphere if the inside radius is 0.6 m. | 07 |
| Q.3 | (a) Explain in brief about types of convection. | 03 |
| | (b) What is difference between conduction, convection and radiation mode of heat transfer. | 04 |
| | (c) What is transient heat transfer? How it is different from steady state heat transfer? Discuss it with suitable examples. | 07 |
| OR | | |
| Q.3 | (a) Explain film wise condensation. | 03 |
| | (b) Explain Boiling regimes with neat sketch. | 04 |
| | (c) Derive an expression for logarithmic mean temperature difference (LMTD) in the case of parallel flow heat exchanger. | 07 |
| Q.4 | (a) Define absorptivity, emissivity and monochromatic emissive power. | 03 |
| | (b) Explain shape factor for radiation. | 04 |
| | (c) State and prove Kirchof's law of radiation. Derive Wein's displacement law. | 07 |
| OR | | |
| Q.4 | (a) Justify that good absorber is also good emitter for radiation heat transfer. | 03 |
| | (b) Explain Lambert's cosine law. | 04 |
| | (c) Derive an expression for rate of radiation exchange, when a radiation shield is inserted between two large parallel plates. | 07 |
| Q.5 | (a) Explain working of heat pipe. | 03 |
| | (b) What is fouling? State the causes of fouling. | 04 |
| | (c) What do you mean by Dimensional analysis? What are the assumptions used in it? State suitable examples. | 07 |

OR

- Q.5**
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|------------|---|-----------|
| (a) | Distinguish between parallel flow and counter flow heat exchanger. | 03 |
| (b) | Discuss about compact heat exchanger. | 04 |
| (c) | The flow rates of hot and cold water streams running through a double pipe heat exchanger (inside and outside diameter of the tube 80 mm and 100 mm) are 2 kg/s and 4 kg/s. The hot fluid enters at 75°C and comes out at 45°C. The cold fluid enters at 20°C. If the convective heat transfer at the inside and outside surface of the tube is 150 and 180 W /m ² K, thermal conductivity of the tube material 40 W/mK, calculate the area of the heat exchanger assuming counter flow. | 07 |
