Enrolment No./Seat No_____

# GUJARAT TECHNOLOGICAL UNIVERSITY

**BE- SEMESTER–VII (NEW) EXAMINATION – WINTER 2024**

**Subject Code:3170102 Date:16-12-2024**

**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.**
5. **Tables for properties of air and water are permitted.**

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| **Q.1** | **(a)** | Define heat transfer and explain different modes of heat transfer in brief. | **03** |
| | **(b)** | Write eight day to day life applications of fins. | **04** |
| | **(c)** | Derive equations of temperature distribution and heat dissipation for infinite fin. | **07** |
| **Q.2** | **(a)** | What do you understand by thermal insulation? Explain required properties of insulating materials. | **03** |
| | **(b)** | Define unsteady state conduction heat transfer? Write suitable examples of transient heat conduction? | **04** |
| | **(c)** | A plane brick wall 25 cm thick, is faced with 15 cm thick concrete layer. If the temperature of exposed brick face is $70^0$C and that of the concrete is $25^0$C, find out heat lost per hour through a wall of 15 m x 10 m. Also, determine the interface temperature. Thermal conductivity of brick and concrete are 0.7 W/mK and 0.95 W/mK respectively. | **07** |
| | | **OR** | |
| | **(c)** | A copper rod 0.5 cm diameter and 50 cm long protrudes from a wall maintained at a temperature of $500^0$C. The surrounding temperature is $30^0$C. Convective heat transfer coefficient is 40 W/m$^2$K and thermal conductivity of material is 300 W/mK. Determine:<br>(1) Total heat transfer rate from rod<br>(2) Temperature of the rod at 20 cm from wall. | **07** |
| **Q.3** | **(a)** | Define thermal diffusivity? Also provide significance of thermal diffusivity? | **03** |
| | **(b)** | Write a short note on lumped system analysis? Also provide suitable assumptions? | **04** |
| | **(c)** | Explain the significance of the following terms:<br>(1) Prandtl Number (2) Nusselt Number (3) Grashoff Number (4) Reynolds Numbers. | **07** |
| | | **OR** | |
| **Q.3** | **(a)** | Differentiate between free and forced convection. | **03** |
| | **(b)** | What is thermal and hydrodynamics boundary layers with neat diagram. | **04** |

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| | **(c)** | Derive the momentum equation for hydrodynamic boundary in differential form with neat sketch. Write equation for stretching factor? State its significance for solving momentum equation. | **07** |
| **Q.4** | **(a)** | Compare parallel flow and counter flow heat exchanger. | **03** |
| | **(b)** | Write the advantages of the effectiveness-NTU method over the LMTD method. | **04** |
| | **(c)** | Differentiate between Film and drop-wise condensation. | **07** |

**OR**

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| **Q.4** | **(a)** | State & explain Lambert's cosine law. | **03** |
| | **(b)** | Explain Effectiveness and NTU with reference to the heat exchanger. | **04** |
| | **(c)** | Prove that the effectiveness of parallel flow heat exchanger is given by $\varepsilon = \frac{1-\exp[-NTU(1+C)]}{1+C}$ | **07** |
| **Q.5** | **(a)** | What do you understand by absorptivity? How can it be improved for an opaque body? | **03** |
| | **(b)** | Making use of Plank's law of distribution, establish the relation for Wien's displacement law. | **04** |
| | **(c)** | Derive the Stefan-Boltzmann law from the Plank's law of thermal radiation. What is the value of Stefan-Boltzmann constant? | **07** |

**OR**

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| **Q.5** | **(a)** | Explain fouling factor in heat exchanger. | **03** |
| | **(b)** | Define a black body. Give examples of some surfaces which don't appear black but have high value of absorptivity. | **04** |
| | **(c)** | Explain boiling curve which shows all the boiling regimes in details. | **07** |

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