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# B.M.S. College of Engineering, Bengaluru-560019

**Autonomous Institute Affiliated to VTU**

## January / February 2025 Semester End Main Examinations

**Programme: B.E.** **Semester: VII**
**Branch: Mechanical Engineering** **Duration: 3 hrs.**
**Course Code: 22ME7PEFBH** **Max Marks: 100**
**Course: Fundamentals of Boiling Heat Transfer**

**Instructions**: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

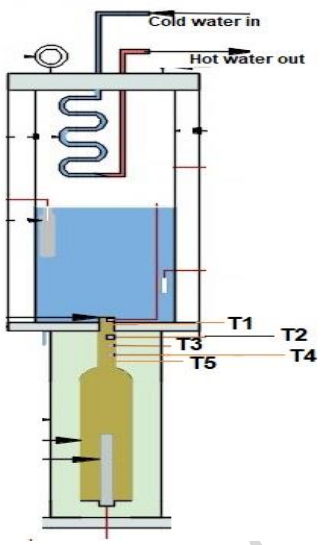
**Important Note:** Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

| | | | UNIT – I | *CO* | *PO* | Marks |
|---|---|---|---|---|---|---|
| 1 | a) | | Describe the significance of minimum boiling azeotropic mixtures in refrigeration industry. | *CO1* | *PO1* | **05** |
| | b) | | What role does wettability play in enhancing or hindering boiling heat transfer? | *CO1* | *PO1* | **05** |
| | c) | | What do positive and negative deviations from Raoult's law signify in a mixture? Explain these deviations using appropriate graphs. | *CO1* | *PO1* | **10** |
| | | | **OR** | | | |
| 2 | a) | | How do Zeotropic mixtures differ from ideal mixtures? Illustrate this with relevant graphs. | *CO1* | *PO1* | **10** |
| | b) | | Explain how are heat pipes utilized in: (i) Cooling satellite transponders and (ii) Preventing icing on airplane wings. | *CO1* | *PO1* | **10** |
| | | | **UNIT-II** | | | |
| 3 | a) | | Which coolants are commonly used in cooling heat-dissipating devices? | *CO2* | *PO1* | **05** |
| | b) | | How can boiling heat transfer be classified based on its mechanisms? | *CO2* | *PO1* | **05** |
| | c) | | What dimensionless numbers are crucial in boiling heat transfer, and what is their significance? | *CO2* | *PO1* | **10** |
| | | | **OR** | | | |
| 4 | a) | | In an experimental setup, the various temperatures recorded are tabulated in Table-1, where, $T_1$ is wall temperature (°C), $T_2$, $T_3$, $T_4$ and $T_5$ are the temperature (°C) of copper block at different vertical position and $T_f$ is water temperature (°C). The thermal conductivity of copper is 400 W/m-°C. Distance | *CO2* | *PO2* | **08** |

between each thermocouple is 5 mm. Determine the heat fluxes and heat transfer coefficients.

Table-1

| Sl.No | $T_f$ | $T_1$ | $T_2$ | $T_3$ | $T_4$ | $T_5$ |
|---|---|---|---|---|---|---|
| 1 | 85 | 100 | 102 | 103 | 104 | 106 |
| 2 | 100 | 112 | 114 | 116 | 118 | 120 |

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|---|---|---|---|---|---|
| | b) | Explain the pool boiling regime and its associated stages using a well-labeled graph. | *CO2* | *PO1* | **12** |
| | | **UNIT – III** | | | |
| 5 | a) | How does boiling in horizontal flow occur and which are the heat transfer mechanisms involved in it? | *CO2* | *PO1* | **10** |
| | b) | What are the different techniques used to augment heat transfer during flow boiling? | *CO2* | *PO1* | **04** |
| | c) | How does microgravity affect boiling in flow boiling heat transfer systems? | *CO2* | *PO1* | **06** |
| | | **OR** | | | |
| 6 | a) | What are the distinct boiling regimes in vertical flow boiling? Explain them with illustrative sketches. | *CO2* | *PO1* | **10** |
| | b) | With the help of neat sketches explain the structure of deep drilled, formed, and machine channel cold plates. | *CO2* | *PO1* | **10** |
| | | **UNIT-IV** | | | |
| 7 | a) | With the help of neat sketch describe the adiabatic vertical flow. | *CO3* | *PO1* | **10** |
| | b) | Why do homogeneous and heterogeneous nucleation occur during flow boiling? | *CO3* | *PO1* | **10** |
| | | **OR** | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 8 | a) | What are the concepts of nucleation site density, bubble release frequency and bubble departure diameter in boiling heat transfer? | *CO3* | *PO1* | **10** |
| | | b) | Describe an experimental setup for studying flow boiling with detailed and labelled diagrams. | *CO3* | *PO1* | **10** |
| | | | **UNIT - V** | | | |
| | 9 | a) | Derive the continuity equation from the scalar transport equation and explain the concept of bubble void fraction in boiling. | *CO4* | *PO1* | **10** |
| | | b) | Derive the energy equation with reference to scalar transport equation. | *CO4* | *PO1* | **10** |
| | | | **OR** | | | |
| | 10 | a) | Derive the momentum equation in partial differential form by considering the scalar transportation. | *CO4* | *PO1* | **10** |
| | | b) | What are some practical applications of boiling heat transfer across various industries? | *CO4* | *PO1* | **10** |

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