Seat No.: _____ Enrolment No._____

# GUJARAT TECHNOLOGICAL UNIVERSITY

**BE - SEMESTER–IV (NEW) EXAMINATION – SUMMER 2022**

**Subject Code:3143611 Date:29-06-2022**

**Subject Name:Basics 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 |
|---|---|---|---|
| **Q.1** | **(a)** | Define heat transfer coefficient and describe its dependence of various parameters. | **03** |
| | **(b)** | Write down difference between free and forced convection. | **04** |
| | **(c)** | A furnace is constructed with 225 mm thick of fire brick, 120 mm of insulating brick and 225 mm of the building brick. The inside temperature is 1200 K and the outside temperature is 330 K. Find the heat loss per unit area and the temperature at the junction of the fire brick and insulating brick. Data : k for fire brick = 1.4 W/(m·K), for insulating brick = 0.2 W/(m·K), for building brick = 0.7 W/(m·K) | **07** |
| **Q.2** | **(a)** | Give the physical significance of Prandtl Number | **03** |
| | **(b)** | Discuss concept of black body. | **04** |
| | **(c)** | Discuss Natural convection. Show the velocity and temperature profile for natural convection from heated vertical plate. | **07** |
| | | **OR** | |
| | **(c)** | Explain Reynolds analogy along with the significance. | **07** |
| **Q.3** | **(a)** | State and derive Kirchhoff's Law for radiation. | **03** |
| | **(b)** | Derive the expression for heat conduction in a hollow spherical vessel. | **04** |
| | **(c)** | Explain Black Body and Grey Body. | **07** |
| | | **OR** | |
| **Q.3** | **(a)** | Discuss Wien's Displacement law. | **03** |
| | **(b)** | Derive the expression for critical radius of insulated pipe. | **04** |
| | **(c)** | Difference between specular reflection and diffuse reflection. | **07** |
| **Q.4** | **(a)** | What is the reason for increasing the number of passes in a shell & tube heat exchanger? | **03** |
| | **(b)** | Discuss about concurrent and counter current flow arrangement in heat exchangers. | **04** |
| | **(c)** | Lubricating oil used in gear box of a 14000 rpm high speed blower is being recycled continuously through a double pipe counter current heat exchanger for cooling. The oil is cooled from 70 °C to 40 °C at the rate of 1000 kg/h using water entering at 28 °C. The water temperature at exit should not exceed 42 °C. The specific heat of oil is 2.05 kJ/kg °C and that of water is 4.17 kJ/kg °C. Calculate required rate of flow of water. If the heat exchanger area is 3.0 m2, calculate the overall heat transfer coefficient. | **07** |

**OR**

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| **Q.4** | **(a)** | Explain the significance of LMTD correction factor. | **03** |
| | **(b)** | What are the advantages of square pitch arrangement over the triangular pitch in case of heat exchanger tubes? | **04** |
| | **(c)** | In an oil cooler, 60 kg/s of hot oil enters a thin metal pipe of diameter 25 mm. An equal mass of cooling water flows through the annular space between the pipe and a larger concentric pipe; the oil and water moving in opposite directions. The oil enters at 420 K and is to be cooled to 320 K. If the water enters at 290 K, what length of pipe will be required? Take oil side and water side coefficients to be 1.6 $kW/m^2K$ and 3.6 $kW/m^2K$ respectively, and the specific heats to be 2.0 kJ/kg K and 4.18 kJ/kg K for oil and water, respectively. Neglect scale and metal wall resistance. | **07** |
| **Q.5** | **(a)** | Differentiate between film wise and drop wise condensation. | **03** |
| | **(b)** | Discuss with the help of diagram various regimes of pool boiling. | **04** |
| | **(c)** | Classify different types of evaporator. Explain any one evaporator with a neat sketch. | **07** |

**OR**

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|---|---|---|---|
| **Q.5** | **(a)** | Discuss the effect of non-condensable gases on condensation. | **03** |
| | **(b)** | Discuss Pool boiling of a saturated liquid. | **04** |
| | **(c)** | Differentiate between forward feed and backward feed in a multiple effect evaporator with a neat sketch. | **07** |

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