

Seat No.: \_\_\_\_\_

Enrolment No. \_\_\_\_\_

**GUJARAT TECHNOLOGICAL UNIVERSITY**

**BE - SEMESTER-IV(OLD) • EXAMINATION – WINTER 2016**

**Subject Code:140503**

**Date:23/11/2016**

**Subject Name: Process 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.

Q.1 (a) Explain all modes of heat transfer giving examples of each . 07

(b) Derive the equation for LMTD and explain its importance. 07

Q.2 (a) Give equations and significance of Prandtl, Nusselt and Grashof numbers. 07

(b) Write Fourier's law of conduction and derive equation for steady state heat conduction through composite wall. 07

**OR**

(b) Explain Reynolds and Colburn analogy along with the significance. 07

Q.3 (a) Discuss various regimes of Pool boiling with neat graph. 07

(b) Determine the overall conduction heat transfer rate per unit area occurring across a furnace wall made of fire clay. Furnace wall has a thickness of 12" or a foot. The wall is insulated from outside. Thermal conductivity values for the wall and insulation materials are  $0.1 \text{ W/m}\cdot\text{K}$  and  $0.01 \text{ W/m}\cdot\text{K}$ , respectively. The furnace operates at  $6500^\circ\text{C}$ . Average ambient temperature outside the furnace wall is  $300^\circ\text{C}$  and allowable temperature on the outer side of insulation is  $800^\circ\text{C}$ . If the air side heat transfer coefficient is  $0.4 \text{ W/m}^2\cdot\text{K}$ , calculate the minimum insulation thickness requirement. 07

**OR**

Q.3 (a) Explain Vapor recompression and Mechanical recompression for

evaporators.

07

(b) A single-effect evaporator is used to concentrate 7 kg/s of a solution from 10 to 50 per cent solids. Steam is available at 205 kN/m<sup>2</sup> and evaporation takes place at 13.5 kN/m<sup>2</sup>. If the overall coefficient of heat transfer is 3 kW/m<sup>2</sup> deg K, estimate the heating surface required and the amount of steam used if the feed to the evaporator is at 294 K and the condensate leaves the heating space at 352.7 K. The specific heats of 10 and 50 per cent solutions are 3.76 and 3.14 kJ/kg deg K respectively. Assume the steam is dry and saturated at 205 kN/m<sup>2</sup>.

07

Q.4 (a) Explain any three Radiation laws.

07

(b) Derive the expression for critical radius of insulation for a cylinder. 07

OR

Q.4 (a) Define : Black body, White body, Grey body, Transparent body, Transmittivity, Absorptivity, Reflectivity.

07

(b) Show different types of fins used in heat exchanger with help of

Diagram.

07

Q.5 (a) Compare drop wise condensation and film wise condensation.

07

(b) Discuss the concept of Boiling Point Elevation.

07

OR

Q.5 (a) With a neat sketch explain the various parts of shell & tube heat exchanger.

07

(b) Explain with sketch, the various method of feeding in multiple-effect evaporator.

07

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