

**GUJARAT TECHNOLOGICAL UNIVERSITY**  
**BE - SEMESTER-IV (New) EXAMINATION – WINTER 2015**

**Subject Code:2140503****Date:01/01/2016****Subject Name: Process Heat Transfer****Time: 2:30pm to 5:00pm****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)** Derive the expression for heat transfer through composite wall made of materials A, B and C, with thermal conductivities  $k_A$ ,  $k_B$  and  $k_C$ , placed adjacent to each other in close thermal contact in one direction and insulated in other two. **07**

**(b)** A flat furnace wall is constructed of a 114 mm layer of refractory brick, with a thermal conductivity of 0.138 w/m k, backed by a 229 mm layer of common brick with a thermal conductivity of 1.3 w/m k. The temperature of inner surface of wall is 760°C and that of the outer surface 76.6°C. Calculate net heat loss per unit area and temperature of interface between refractory and common brick. **07**

**Q.2 (a)** Draw temperature profiles of fluids moving counter currently in a double pipe heat exchanger. Derive expression for mean temperature difference (LMTD). **07**

**(b)** Crude oil flows at the rate of 1000kg./hr through inside of a double pipe heat exchanger and is heated from 30°C to 90°C. In the outer pipe kerosene enters at 200°C and leaves at 105°C. Find the mass flow rate of kerosene, overall heat transfer co-efficient and rate of heat transfer. **07**

$C_p$  for crude oil = 2.093 Kj/Kg °C,  $C_p$  for Kerosene = 2.512 Kj/Kg °C

H.T Area=1.85mt<sup>2</sup>

**OR**

**(b)** Write short notes on Natural Convection. **07**

**Q.3 (a)** Draw neat sketch of Shell & Tube heat exchanger showing various parts. **07**

**(b)** Discuss various types of extended surface provided in heat exchangers. Explain when fins are provided. **07**

**OR**

**Q.3 (a)** Discuss Pool boiling of a saturated liquid. **07**

**(b)** Freon-12 at 60 °C condenses on the surface of a vertical tube 90 cm long & 2.5 cm diameter held at 57 °C. Calculate the rate of condensation per hour assuming the following properties. **07**

$\rho = 1280 \text{ kg/m}^3$ ,  $\mu = 0.9 \text{ kg/m hr.}$ ,  $\lambda = 130 \text{ kj/kg}$ ,  $k = 0.72 \text{ w/m}^\circ\text{k}$   $T_{\text{sat}} = 24.9^\circ\text{C}$

**Q.4 (a)** Discuss with diagram construction of any one Evaporator. **07**

**(b)** Explain various method of feeding the multiple effect evaporators with advantages and disadvantages. **07**

**OR**

- Q.4 (a)** An Evaporator is to be fed with 5000kg/hr of solution containing 10% solute by weight. The feed at 40°C is to be concentrated to a solution containing 40 % by weight of the solute under an absolute pressure of 1.03 kg/cm<sup>2</sup>. Steam is available at an absolute pressure of 3 atm (saturation temperature 134°C). The overall heat transfer coefficient is 1744 watt/ m<sup>2</sup> °C. Calculate the heat transfer area and Steam required. **07**

Data.

Temperature	Enthalpy(KJ/Kg)	
	Vapor	Liquid
40	2568	169.53
100	2675.7	418.6
134	2726.7	562.6

- (b)** Write short notes on Vapor recompression in evaporator. **07**

- Q.5 (a)** State and explain Stefan-Boltzmann Law of radiation. **07**

- (b)** Determine the net radiant interchange between two parallel oxidized iron plates, placed at a distance of 25 mm, having sides of 3 m × 3 m. The surface temperatures of the two plates are 100 °C and 40 °C respectively. Emissivity of the plates are equal (0.736) **07**

**OR**

- Q.5 (a)** With neat diagram explain construction and working of Box type furnace. **07**

- (b)** Explain Black Body and Grey Body. **07**

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