Seat No.: Enrolment No. **GUJARAT TECHNOLOGICAL UNIVERSITY BE - SEMESTER-IV (NEW) - EXAMINATION - SUMMER 2017** Subject Code: 2140503 Date: 08/06/2017 **Subject Name: Process 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. **Q.1 Short Questions** 14 1 Enlist various modes of heat transfer. Write down SI unit of thermal conductivity. 2 3 What is heat flux? Define thermal diffusivity. 4 5 What is critical thickness of insulation? 6 Maximum heat transfer rate is obtained in (a)laminar flow (b)turbulent flow (c)creeping flow (d)transition region 7 Define Grey body. Write down Kirchoff `s law. 8 Define tube pitch of heat exchanger. 9 What is Subcooled boiling? 10 11 Define: Angle of vision 12 State Durhing's rule. What is Fouling factor? 13 14 Define: Fin efficiency **O.2** Explain how does thermal conductivity of gases, liquid and solids depend 03 (a) upon temperature? Discuss the fourier's law of conduction. 04 **(b)** Write a short note on significance of various dimensionless numbers in 07 (c) heat transfer. OR A pipe carrying steam having an outside diameter of 30 cm runs in a (c) 07 large room and is exposed to air at a temperature of 35°C. The pipe surface temperature is 405°C. Calculate the loss of heat to surrounding per meter length of pipe due to thermal radiation. The emissivity of the pipe surface is 0.8. What would be the loss of heat by thermal radiation if the pipe is enclosed in a 50 cm diameter brick conduit of emissivity 0.91? Value of Stefan Boltzmann constant is $5.67 \times 10^{-8} \text{ W/(m^2K^4)}$ Discuss Planck's law of radiation. 03 Q.3 (a) Distinguish between filmwise and dropwise condensation. **(b)** 04 Derive an expression for heat flow through a cylinder. State all the 07 (c) necessary assumptions.

OR

Q.3	(a)	Discuss: Capacity and Economy of evaporators.									03	
	(b)	What	are	the	advantages	of	square	pitch	arrangement	over	the	04
	triangular pitch in case of heat exchanger tubes?											

Discuss with the help of diagram various regimes of pool boiling. What is 07 (c) the use of finding critical flux and critical temperature drop?

- Q.4 (a) Write short note on condensation of superheated vapors.
 - (b) Explain the terms absorptivity, emissivity, transmissivity and 04 reflectivity for heat transfer by radiation.
 - (c) A single effect evaporator is to be fed with 6000 Kg/hr of 10% sugar solution by weight. The feed at 40°C is to be concentrated to a solution containing 40% by wt of solute under an absolute pressure of 101.325 kPa. Steam is available at an absolute pressure of 303.975 kPa (Saturation temp of 134°C). The overall heat transfer coefficient is 1750 W/m².°C. Calculate heat transfer area required and the steam economy of evaporator. Cp of feed is 4.187 kJ/(kg.°C)

reduction as pure water for the purpose of eared autom of entitalples.								
Temperature °C	Enthalpy, kJ/kg							
	Vapour	Liquid						
40	-	170						
100	2676	419						
134	2725	563						
OR								

Treat solution as pure water for the purpose of calculation of enthalpies.

- Q.4 (a) Draw the sketch of various methods of feeding the multiple effect 03 evaporators.
 - (b) When LMTD correction factor is used in heat exchanger calculation? 04
 - (c) Explain in details neat sketch: Shell & Tube heat exchanger.
- Q.5 (a) Explain Reynolds analogy along with the significance.
 - (b) Discuss the effect of noncondensable gases on condensation.
 - (c) A furnace is constructed with a 24 cm thick layer of fire brick, 12 cm thick layer of insulating brick and followed by a 24 cm thick layer of building brick. The inside temperature of the furnace is 950 °C and the outside temperature is 55 °C. The thermal conductivities of fire brick, insulating brick and building brick are 6.05, 0.59 and 2.4 W/(m.°C). Find the heat loss per unit area and the temperature at the interfaces.

OR

- Q.5 (a) What is black body? Give applications where this concept is used in 03 heat transfer.
 - (b) Define convection and write down difference between free and forced 04 convection.
 - (c) Hot oil at a rate of 1.3 kg/s having Cp of 2083 J/(kg.K) flows through a double pipe heat exchanger. It enters at 643 K and leaves at 583 K. cold fluid enters at 313 K and leaves at 410 k. If the overall heat transfer co-efficient is 500 W/(m².K), calculate the heat transfer area for (i) parallel flow (ii) countercurrent flow.

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