Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV(New) • EXAMINATION – WINTER 2016

Subject Code:2140503 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.**

			MARK
Q.1		**Short Questions:**	**14**
	1	Which are the different modes of heat transfer?	
	2	Give examples of some heat insulators.	
	3	Write SI unit of thermal conductivity.	
	4	What is monochromatic radiation?	
	5	Write the formula for thermal diffusivity of solids and its unit.	
	6	List different types of baffles.	
	7	What is a radiation shield?	
	8	External cleaning of tubes is easy in case of _____ pitch arrangement in shell & tube heat exchanger.	
	9	What is a 1-4 shell & tube heat exchanger?	
	10	What are the different feed arrangements in a multiple effect evaporator?	
	11	Which type of heat exchangers is used for heat exchange between multiple fluids at a time?	
	12	Give examples of different types of boiling equipments.	
	13	List the different types of fins used in fin type heat exchanger.	
	14	Define evaporator economy.	
Q.2	**(a)**	Explain Fouriers law for heat conduction.	**03**
	(b)	A steel pipe of ID 120 mm has a wall 10 mm thick and is carrying steam at 150^0C. It is covered with insulation 20 mm thick. The thermal conductivity of steel is 60 W/mK and for insulation is 0.09 W/mK. The ambient temperature is 25^0C. Calculate the heat loss per metre length.	**04**
	(c)	Derive the expression for critical radius of insulated pipe. Explain its significance.	**07**
		OR	
	(c)	Derive the expression for heat conduction in a hollow spherical vessel. State the necessary assumptions.	**07**
Q.3	**(a)**	Explain natural convection phenomenon.	**03**
	(b)	A hot metallic ball having surface temperature 800^0C behaves as a gray body with emissivity of 0.8. Calculate (i) the emissive power, (ii) the wavelength corresponding to the maximum spectral intensity of radiation.	**04**
	(c)	Describe all the radiation laws in detail.	**07**
		OR	

Q.3	**(a)**	Define: i) emissivity, ii) black body, iii) grey body.	**03**
	(b)	Explain the significance of different dimensionless numbers in heat transfer.	**04**
	(c)	A vertical cylindrical body 20mm in diameter and 2m height is maintained at a constant temperature of 42 ^{0}C. The surrounding temperature is 19 ^{0}C. Properties of air is as follows: density = 1.165 kg/m^3, specific heat = 1005 J/kgK, thermal conductivity = 0.0267 W/mK, viscosity = 1.866×10^{-5} Ns/m^2. Calculate the amount of heat lost by the cylindrical body by natural convection. For natural convection, use the equation, $Nu = 0.12 (Gr \times Pr)^{1/3}$.	**07**
Q.4	**(a)**	What is the reason for increasing the number of passes in a shell & tube heat exchanger?	**03**
	(b)	Write Dittus-Boeltier equation and Sieder-Tate equation explaining each term and highlight the difference.	**04**
	(c)	A shell & tube heat exchanger has brass tubes (k = 128 W/mK) of internal diameter of 27mm and thickness 2mm. It is used for heating water from 22^{0}C to 45^{0}C using steam at 120^{0}C on the shell side. Water flows at 10 kg/s. Heat transfer coefficient on the steam side and water side is 6000 W/m^{2}K and 850 W/m^{2}K respectively. Calculate the number of tubes required. Data: Specific heat for water = 4.187 kJ/kgK.	**07**
		OR	
Q4	**(a)**	Explain the significance of LMTD correction factor.	**03**
	(b)	Describe different analogy between heat and mass transfer.	**04**
	(c)	With a neat sketch explain the construction and working of a fin tube heat exchangers and its application.	**07**
Q5	**(a)**	Explain the concept of weighted LMTD.	**03**
	(b)	Differentiate between film wise and drop wise condensation.	**04**
	(c)	Classify different types of evaporator. Explain any one evaporator with a neat sketch.	**07**
		OR	
Q5	**(a)**	Explain Duhrings rule.	**03**
	(b)	Differentiate between forward feed and backward feed in a multiple effect evaporator with a neat sketch.	**04**
	(c)	It is desired to concentrate 8000 kg/hr of a solution from 12% to 20% solids using a single effect evaporator. Feed enters at 25^{0}C. Saturated steam at 110^{0}C (latent heat = 2260 kJ/kg) is available. The condensate leaves at the condensing temperature. Saturation temperature of vapor to the condenser is 40^{0}C (latent heat = 2428 kJ/kg). Specific heat of all solutions may be taken as 4.186 kJ/kg^{0}C. Assume boiling point rise to be 5^{0}C. The overall heat transfer coefficient of evaporator is 2210 W/m^{2}K. Calculate: i) evaporator capacity, ii) evaporator economy, iii) the area of heating surface required.	**07**