Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE – SEMESTER – VI EXAMINATION – WINTER 2015

Subject Code:161403 **Date:08/12/ 2015**

Subject Name: Food Engineering Operations-II

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)** Raw whole milk at 7°C is to be pasteurized at 72°C in Plate Heat Exchanger at the rate of 5000 liter/hour and then cooled to 4.5°C. The hot water is supplied at 7500 liter/hour at 85°C. Chilled water inlet temperature is 2°C and outlet temperature is 4.5°C. Each heat exchanger plate has available area of 0.79 m². The overall Heat Transfer coefficients are calculated as 2890 W/m²K in the heating section; 2750 W/m²K in the cooling section; 2700 W/m²K in regeneration section. 75% of the heat exchange is required to take place in the regeneration section. Calculate the number of plates requires in heating, cooling and regeneration section. **07**

Assume that the density of milk is 1030 kg/m³. The density of water is 958 kg/m³ at 85°C and 1000 kg/m³ at 20°C. The specific heat of water is constant as 4.2 kJ/kg K and the specific heat of milk is 3.9 kJ/kg K.

(b) A continuous fractionating column is to be designed for separating 10,000 kg per hour of a liquid mixture containing 40 mole percent methanol and 60 mole percent water into an overhead product containing 97 mole percent methanol and a bottom product having 98 mole percent water. A mole reflux ratio of 3 is used. Calculate (i) moles of overhead product obtained per hour and (ii) number of ideal plates and location of the feed plate if the feed is at its bubble point. **07**

Equilibrium data:

x	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
y	0.417	0.579	0.669	0.729	0.78	0.825	0.871	0.915	0.959

Where x = mole fraction of methanol in liquid

And y = mole fraction of methanol in vapor

Q.2 **(a).1** What do you mean by fouling of heat exchangers? Briefly explain the types of fouling deposits in heat exchanger used in milk pasteurizer and their effects on performance. **04**

(a).2 Explain In-Bottle Sterilization. **03**

(b) Define homogenization and explain the mechanism of homogenization with diagram. Briefly explain the two stages of homogenization and effect of homogenization stages **07**

on viscosity of milk.

OR

	(b)	State the functions of ice-cream freezer and explain the continuous type freezer. What are the advantages of continuous freezer?	**07**
Q.3	**(a)**	Write short notes on (1) Crystal growth (2) Circulating magma vacuum crystallizer	**07**
	(b)	What are clarifiers and thickeners? Write a short note on Batch sedimentation.	**07**

OR

Q.3	**(a)**	Discuss mechanism of crystallization process in detail.	**07**
	(b)	Write in brief about cake filtration and its principle.	**07**
Q.4	**(a)**	Define centrifugation with principle. Explain the working of disc-bowl centrifuge with diagram.	**07**
	(b).1	If Q = 1000 liter/ hour, p = 250 kg/cm² then calculate the horse-power required for homogenization.	**03**
	(b).2	What are the factors affecting the separation efficiency of centrifugal separation?	**04**

OR

Q.4	**(a)**	Advantages and applications of liquid-liquid extraction in food industry. Draw and explain equilateral triangular diagram for Single-stage liquid-liquid extraction process.	**07**
	(b)	Explain extraction with example .Write a short note on rotocel extractor for leaching.	**07**
Q.5	**(a).1**	Give the equation of flow rate in centrifuge and Calculate the flow rate of milk through a centrifugal separator if; number of discs =105, discs angle of inclination is 55°, outer radius R_o= 0.13m; inner radius R_i=0.075m, limiting diameter of fat globules d = 1.6μm, rpm n = 6000, density difference of milk and fat globules $\Delta\rho$ = 116 kg/m³, absolute viscosity $\mu = 1.04 \times 10^{-3}$ kg/m.s Correction factor C=0.6.	**04**
	(a).2	Explain the Freeze Drying Process with phase diagram.	**03**
	(b)	What are the difference between the direct type and indirect type sterilization plants? Briefly Explain the types of Direct heating sterilization plant.	**07**

OR

Q.5	**(a)**	A solution containing 10g/lit of a valuable protein and 1g/lit of a protein impurity is extracted in a stirred vessel using an organic solvent. Distribution co-efficient K=8 for the valuable proteins and 0.5 for the impurity. The initial volume is 500 lit and 400 lit of solvent are used for the extraction. What are the final concentration in the two phases and what fraction of each protein is recovered in the solvent phase?	**07**
	(b)	Write and explain types of distillation. Derive operating line equation for rectifying section in distillation.	**07**

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