Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER– VI (New) EXAMINATION – WINTER 2019

Subject Code: 2161403 Date: 06/12/2019

Subject Name: Food Engineering Operations - II

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)** How does homogenization of milk increases its stability? What are the effects of homogenization on properties of milk? **03**

(b) Differentiate between pasteurization and Sterilization. List out the advantages of Heat Exchangers over in-bottle processing in pasteurization. **04**

(c) Write short notes on: Crystal growth and Circulating magma vacuum crystallizer **07**

Q.2 **(a)** The F value at 121.1 ^{0}C equivalent to 99.999% inactivation of a strain of *C. botulinum* is 1.5 minutes. **03**

(i) Calculate the D_0 value of this organism.

(ii) Calculate F_0 based on the 12D concept using the D_0 value of *C. botulinum* and a most likely spore load in the product of 100

(b) What are the main components of a homogenizer? Calculate the power (in kW) required to start up a centrifugal separator with the following data: **04**

Density of bowl = 7850 kg/m^3

Speed of rotation = 6000 rpm

Outer radius of disc = 0.25 m and inner radius of disc = 0.225 m

Length where the mass is concentrated = 0.325 m

Time to reach the running speed = 3 minutes

(c) Describe the function of a regenerator in a HTST pasteurizer. Draw the line diagram of a HTST pasteurizer labeling each component. **07**

OR

(c) 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 effect on performance. How descaling of heat exchanger is done? **07**

Q.3 **(a)** Explain flash distillation with figure. **03**

(b) What are the advantages and difficulties with UHT processing? **04**

(c) What do you mean by bactofugation and how is it done? Derive an expression for rising velocity of milk in a centrifugal disc bowl centrifuge indicating each variable with proper units. **07**

OR

Q.3 **(a)** Define D- value, Z- Value and represent them graphically. **03**

(b) Briefly explain the influence of freezing process on the thermal properties of the food products. **04**

(c) List out different types of food freezing systems. Describe briefly the fluidized bed IQF freezing system. Mention two most common refrigerants used for immersion freezing system. **07**

Q.4 **(a)** Differentiate between distillation and liquid-liquid extraction. **03**

(b) Explain mechanism of crystallization in detail. **04**

(c) Derive an equation of rectifying section operating line for fractional distillation column. **07**

OR

Q.4 **(a)** What is the principle of clarifying filters? **03**

(b) Explain in detail about cake filters. **04**

(c) Advantages and applications of liquid-liquid extraction in food industry. Draw and explain equilateral triangular diagram for Single-stage liquid-liquid extraction process. **07**

Q.5 **(a)** Explain significance of relative volatility in distillation. **03**

(b) Describe in brief about batch sedimentation and draw the neat diagram indicating the same. **04**

(c) An equimolar mixture of benzene and toluene is subjected to flash distillation at a pressure of 1 bar in the separator. Determine the compositions (in mole fraction benzene) of the liquid and vapour leaving the separator when the feed is 25% vaporized. Equilibrium data for benzene-toluene system at 1 bar is given in Table: **07**

Temperature °C	80.1	85	90	95	100	105	110.6
Mole fraction Benzene in liquid	1	0.78	0.581	0.411	0.258	0.13	0
Mole fraction Benzene in vapor	1	0.9	0.777	0.632	0.456	0.261	0

OR

Q.5 **(a)** Write a short note on filter aids. **03**

(b) 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 **04**

for the extraction. What are the final concentration in the two phases and what fraction of each proteins is recovered in the solvent phase?

(c) 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

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