

Seat No.: _____

Enrolment No. _____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- VIth SEMESTER-EXAMINATION – MAY- 2012

Subject code: 161403

Date: 15/05/2012

Subject Name: Food engineering operations -II

Time: 10:30 am – 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**
- (a) 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/m³
 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
- (b) The F value at 121.1 °C equivalent to 99.999% inactivation of a strain of *C. botulinum* is 1.5 minutes. **03**
 (i) Calculate the D₀ value of this organism.
 (ii) Calculate F₀ based on the 12D concept using the D₀ value of *C. botulinum* and a most likely spore load in the product of 100.
- (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

Where x = mole fraction of methanol in liquid

And y = mole fraction of methanol in vapor

- Q.2**
- (a) Write short notes on **07**
 (1) Crystal growth
 (2) Circulating magma vacuum crystallizer
- (b) Discuss mechanism of crystallization process in detail. **07**
- OR**
- (b) What are clarifiers and thickeners? Write a short note on Batch sedimentation. **07**

- Q.3 (a)** Write in brief about cake filtration and its principle. **07**
- (b)** Advantages and applications of liquid-liquid extraction in food industry. Draw and explain equilateral triangular diagram for Single-stage liquid-liquid extraction process. **07**
- OR**
- Q.3 (a)** Explain extraction with example .Write a short note on rotocel extractor for leaching. **07**
- (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 for the extraction. What are the final concentration in the two phases and what fraction of each proteins is recovered in the solvent phase? **07**
- Q.4 (a)** A food product with 80% moisture content is being frozen in a 6 cm-diameter can. The product density is 1000 kg/m^3 , the thermal conductivity is 1.0 W/(m K) , and the initial freezing temperature is -2°C . After 10 h in the -15°C freezing medium, the product temperature is -10°C . Estimate the convective heat-transfer coefficient for the freezing medium. Assume the can has infinite height.
[Take Latent heat of fusion of water = 333.3 kJ/kg and the geometric parameters as $P = \frac{1}{4}$ and $Q = \frac{1}{16}$] **06**
- (b)** What are the advantages and difficulties with UHT processing? **04**
- (c)** Describe the function of a regenerator in a HTST pasteurizer. Draw the line diagram of a HTST pasteurizer labeling each component. **04**
- OR**
- Q.4 (a)** 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? **06**
- (b)** Define D- value, Z- Value and represent them graphically. **04**
- (c)** Define F value. For cans of pea puree, the $F_0 = 2.45 \text{ min}$ at 121.1°C and $z = 10^\circ\text{C}$. Neglecting heat-up time, determine the process time for adequate sterilization at 110°C at the centre of the can. **04**
- Q.5 (a)** Differentiate between pasteurization and Sterilization. List out the advantages of Heat Exchangers over in-bottle processing in pasteurization. **03**
- (b)** Briefly explain the influence of freezing process on the thermal properties of the food products. **04**
- (c)** How does homogenization of milk increases its stability? What are the effects of homogenization on properties of milk? **07**
- Determine the rising velocity (in mm/h) of the fat globule of diameter $5\mu\text{m}$ at a radial position of 0.15 m in a centrifuge, rotating at a speed of 5500 rpm. The density of skim milk and fat is 1035 and 930 kg/m^3 , respectively and absolute viscosity is 1.35 centipoises.
- OR**
- Q.5 (a)** 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**
- (b)** 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**
