

**GUJARAT TECHNOLOGICAL UNIVERSITY****BE - SEMESTER-VI (NEW) EXAMINATION – SUMMER 2023****Subject Code:3161403****Date:14-07-2023****Subject Name:Food Engineering Operations-II****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.
4. Simple and non-programmable scientific calculators are allowed.

- Q.1**
- (a) Mention the purpose of pasteurization in acid and low acid food. **03**
- (b) With a schematic diagram explain a typical sterilization process suitable for low-viscosity liquids. **04**
- (c) Describe continuous distillation with reflux with a suitable diagram. Derive the operating line equation for rectifying section. **07**

- Q.2**
- (a) What is homogenization? Show it through diagram. **03**
- (b) Write the construction and working of centrifugal separator. **04**
- (c) Find the final number of microorganism surviving in the food product, which has  $10^7$  number of microorganism per g at the initial stage and is being sterilized. During sterilization food is heated from  $30^{\circ}\text{C}$  to  $130^{\circ}\text{C}$  in 80 seconds and is held for 60 seconds and finally cooled to  $20^{\circ}\text{C}$  in 70 seconds. Use the D value obtained at  $121^{\circ}\text{C}$  if the D value of the microorganism at  $126.6^{\circ}\text{C}$  is 0.25 minutes and the slope of thermal resistance curve is 0.1. **07**

**OR**

- (c) What is probability of spoilage? A canned food prior to processing contains 1000 spores per can. The spores have a D value of 1.5 minutes at  $121.1^{\circ}\text{C}$ . If the process is carried out at an equivalent process time of 10 minutes at  $121.1^{\circ}\text{C}$ , what would be the probability of spoilage? **07**
- Q.3**
- (a) What are mixer settler? **03**
- (b) Name different types of liquid-liquid extraction equipments. Explain the working of spray extraction tower. **04**
- (c) The 'tabling process' is a traditional rural method for the separation of starch from its suspensions in water. The slurry is fed to a long horizontal settling tank. Starch granules settle to the bottom and the clear supernatant flows out over a weir at the opposite end of the table. If the table is 1.6 m wide and starch granules are assumed to be spheres with a diameter of  $30\text{ }\mu\text{m}$  and a density of  $1220\text{ kg.m}^{-3}$ , what is the minimal length of a table required for treating 4300 liters of slurry per hour? **07**

**OR**

- Q.3 (a)** Draw a typical VLE diagram indicating different regions in it. **03**
- (b)** What is flash distillation? Explain it with diagram. A liquid mixture containing 40 mole % benzene and 60 mole % toluene is subjected to flash distillation at a separator pressure of 101.325 kPa to vaporize 50 mole % of the feed. What will be the equilibrium composition of the vapour and liquid? Data for equilibrium curve is: **04**

|   |   |      |      |      |     |     |     |      |      |     |      |     |
|---|---|------|------|------|-----|-----|-----|------|------|-----|------|-----|
| x | 0 | 0.05 | 0.1  | 0.2  | 0.3 | 0.4 | 0.5 | 0.6  | 0.7  | 0.8 | 0.9  | 1.0 |
| y | 0 | 0.13 | 0.21 | 0.37 | 0.5 | 0.6 | 0.7 | 0.77 | 0.83 | 0.9 | 0.95 | 1.0 |

- (c)** Describe differential distillation process with a suitable diagram. Derive the Rayleigh equation for differential distillation. **07**
- Q.4 (a)** Write two differences between homogeneous and heterogeneous nucleation. **03**
- (b)** Enlist the leaching equipment based on percolation. Describe in detail the working of Bollmann Extractor. **04**
- (c)** What is nucleation? Mention the basic difference between primary and secondary nucleation? **07**

What is the size of a nucleus of a sugar crystal in equilibrium at 30 ° C with mother liquor at supersaturation ratio 1.20? The surface tension at the crystal–liquid interphase is estimated to be 0.003 J/m<sup>2</sup>. The density of the sugar crystal is 1500 kg/m<sup>3</sup>. The molecular weight of sucrose is 342. Take R as 8.314 J mol<sup>-1</sup>K<sup>-1</sup>.

**OR**

- Q.4 (a)** What is Stokes law? **03**
- (b)** Explain the mechanism of fouling in heat exchanger. **04**
- (c)** Write short note on: **07**
- Dead end filtration
  - McCabe Thiele method

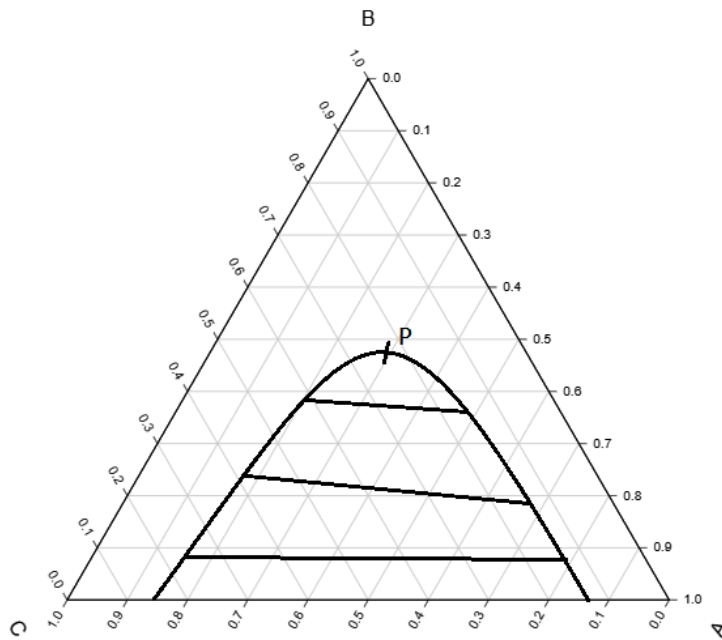
- Q.5 (a)** Write in brief about ammonia freezer. **03**
- (b)** Write the principle of cake filtration. Derive the equation for constant rate filtration. **04**
- (c)** Write the meaning of D, F and Z value. **07**
- The following survivor data were obtained when heat was used to kill a microorganism. Determine the D-value.

| Time (min) | Number of survivors (N) |
|------------|-------------------------|
| 0          | 160000                  |
| 10         | 25000                   |
| 20         | 8000                    |
| 30         | 1600                    |
| 40         | 200                     |

OR

- Q.5 (a) What is UHT processing? 03
- (b) Write different methods of freezing. Explain any one in detail. 04
- (c) Explain different aspects of ternary phase diagram. 07

For the given ternary phase diagram, A, B and C are water, ethylene glycol and furfural respectively. Calculate the amount of extract and raffinate obtained if a feed of 100 kg 40% ethylene glycol in water is mixed with 100 kg of pure furfural solvent.



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