

Seat No.: _____

Enrolment No. _____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER-VI (NEW) EXAMINATION – WINTER 2023

Subject Code:3161403

Date:13-12-2023

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.
4. Simple and non-programmable scientific calculators are allowed.

- Q.1**
- (a) What is aseptic processing? **03**
 - (b) What is sterilization? How it is different from pasteurization? **04**
 - (c) Derive Rayleigh equation for simple batch distillation. **07**

- Q.2**
- (a) Draw the cooling curves for pure water and aqueous solution. **03**
 - (b) Blocks of filleted fish, 5 cm thick are to be frozen in a plate freezer (by contact with a cold surface on both sides). Estimate the time for complete freezing of the blocks. Assume perfect contact between the fish blocks and the plate surface. **04**

Data:

Temperature of the plates: -28°C, constant; Average freezing temperature: -5°C

Density of the fish: 1100 kg/m³; Water content of the fish: 70% w/w

Thermal conductivity of frozen fish: 1.7 W/m.K; Latent heat of freezing of water: 334 kJ/kg. Sensible heat effects and heat loss will be neglected.

- (c) Derive the equation for the kinetics of thermal inactivation of microorganisms and enzymes **07**

OR

- (c) In a laboratory experiment it was found that heating a suspension of spores at 120 °C for 100 seconds results in a 9-log killing of the spores. To achieve the same reduction at 110 °C, 27.5 seconds are needed. Calculate the decimal reduction time at the two temperatures, the z value, the energy of activation and the Q₁₀ of the thermal inactivation process at these temperatures. **07**

- Q.3**
- (a) What depth filtration? **03**
 - (b) Explain the mechanism of surface/barrier filtration. **04**
 - (c) Discuss with diagram flow through feed plate for various feed condition for a continuous distillation process. **07**

OR

- Q.3**
- (a) Explain the working of disc bowl centrifuge. **03**

- (b) A laboratory procedure specifies centrifugation of a liquid at 10000 g. A centrifuge with an effective bowl diameter of 12 cm is available. What should be the speed of rotation of a centrifuge to meet the specification? **04**
- (c) What is leaching? Explain multistage leaching process through suitable diagram **07**
- Q.4** (a) Write the major steps in extraction process. **03**
- (b) Draw and explain ternary phase diagrams/equilateral triangular diagram. **04**
- (c) Explain the crystallization kinetics discussing nucleation and crystal growth. **07**
- OR**
- Q.4** (a) Draw a diagram of hydrostatic sterilizers **03**
- (b) Explain the continuous flash pasteurization of milk. **04**
- (c) Explain the typical sequence of operations during one cycle of batch sterilization in metal cans. **07**
- Q.5** (a) Write in brief about immersion freezer. **03**
- (b) What is the principle of operation of pressure homogenizer? **04**
- (c) The F_0 for *Clostridium botulinum* is 1.1 minutes for 99.999% inactivation. What would be the F_0 for a 12 D inactivation, if $Z=18^\circ\text{F}$. What would be D and F value at 275°F ? **07**
- OR**
- Q.5** (a) Draw a vapour liquid equilibrium diagram. **03**
- (b) Design the inlet and discharge for a centrifugal separation of cream from whole milk. The density of the skim milk is 1025 kg/m^3 . Illustrate the discharge conditions necessary if the cream outlet has a 2.5-cm radius and the skim milk outlet has a 5-cm radius. Suggest a desirable radius for the inlet. Cream density is 865 kg/m^3 . **04**
- (c) An air filter is used to remove small particles from an air supply to a quality control laboratory. The air is supplied at a rate of $0.5 \text{ m}^3/\text{s}$ through an air filter with a 0.5 m^2 cross-section. If the pressure drop across the filter is 0.25 cm water after one hour of use, determine the life of the filter if a filter change is required when the pressure drop is 2.5 cm of water. **07**
