Enrollment No./Seat No.:

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering - SEMESTER - III EXAMINATION - WINTER 2025

Subject Code: BE03051041 **Date: 22-12-2025**

Subject Name: Engineering Properties of Biological Materials

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.**

			Marks
Q.1	**(a)**	Define engineering properties of biological materials. Discuss their importance in food processing.	**03**
	(b)	Explain the method to determine sphericity and roundness of grains with neat sketches.	**04**
	(c)	A batch of wheat grains has an average length = 6.5 mm, breadth = 4.2 mm, thickness = 3.8 mm. Calculate (i) Geometric mean diameter, (ii) Sphericity, (iii) Surface area.	**07**
Q.2	**(a)**	Define thermal conductivity and thermal diffusivity of foods with units.	**03**
	(b)	Write a short note on heat of respiration in biological materials.	**04**
	(c)	Derive the expression for determination of specific heat of food materials using the method of mixtures. Give suitable example.	**07**
		OR	
	(c)	A sample of potato (moisture content 80% w.b.) is cooled from 80 °C to 30 °C. Calculate the energy removed per kg using appropriate thermal property data.	**07**
Q.3	**(a)**	Define angle of repose. Explain its significance in design of storage bins.	**03**
	(b)	Differentiate between static friction, kinetic friction, and rolling resistance with examples.	**04**
	(c)	Explain the concept of terminal velocity and derive the equation for aerodynamic properties of grains.	**07**
		OR	
	(a)	List and explain applications of frictional properties in food engineering.	**03**
	(b)	Explain the role of drag coefficient in design of pneumatic conveyors.	**04**
	(c)	A grain of 2 mm equivalent diameter and density 1200 kg/m³ falls in air (ρ = 1.2 kg/m³, μ = 0.018 cP). Calculate its terminal velocity.	**07**
Q.4	**(a)**	Define Newtonian and Non-Newtonian fluids with examples.	**03**
	(b)	Explain the flow curve for pseudoplastic and dilatant foods with neat sketches.	**04**

	(c)	Describe rheological models of Bingham plastic and Thixotropic fluids. Explain their applications in food industries.	**07**

OR

	(a)	Write short notes on: (i) Viscoelasticity, (ii) Rheopectic fluids.	**03**
	(b)	Explain experimental determination of viscosity using Brookfield viscometer.	**04**
	(c)	Derive the powerlaw model equation for NonNewtonian fluids and explain each parameter.	**07**
Q.5	**(a)**	Define dielectric constant and loss tangent of food materials.	**03**
	(b)	Explain the applications of electrical properties in food processing equipment.	**04**
	(c)	Describe the methods of determination of electrical properties of food with suitable examples.	**07**

OR

	(a)	Define A.C. conductivity of food materials.	**03**
	(b)	Explain the role of electrical properties in microwave heating of foods.	**04**
	(c)	Discuss in detail the design considerations of food equipment based on thermal, electrical, and magnetic properties.	**07**

***