

GUJARAT TECHNOLOGICAL UNIVERSITY**BE- SEMESTER-V (NEW) EXAMINATION – WINTER 2024****Subject Code:3151404****Date:28-11-2024****Subject Name:Food Engineering Operation-1****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) Discuss in detail the What is Fick's law of diffusion.	03
	(b) Define the followings True density, Material density, Particle density, Bulk density	04
	(c) Define the angle of repose and briefly describe the factors affecting the angle of repose. Write a procedure to measure angle of repose of a grain with help of a labelled diagram and formula.	07
Q.2	(a) Enlist different cleaning and separation equipment for the food processing industry.	03
	(b) Calculate the terminal velocity of a particle of animal feed having an intermediate diameter of $22\mu\text{m}$ falling through standard air (density 1.20 kg/m^3). Assume the particle is spherical and that is a piece of corn endosperm at 15% moisture content (density 1300kg/m^3). The viscosity of standard air is $1.81 \times 10^{-5}\text{ kg/m s}$. Assume the flow is laminar when the particle will reach to its terminal velocity.	04
	(c) A cold storage wall of $3 \times 6\text{ m}$ in size is constructed of 15 cm thick concrete of thermal conductivity of $1.37\text{ W/m}^0\text{C}$. Insulation must be provided to maintain heat transfer rate through the wall at or below 500 W . If the thermal conductivity of the insulation is $0.04\text{W/m}^0\text{C}$, compute the required thickness of the insulation. The outside temperature of the wall is 38^0C and inside temperature is 5^0C .	07
	OR	
	(c) Discuss the importance of thermal properties in food processing.	07
Q.3	(a) What is meant by diffusion? Write short notes on diffusional mass transfer.	03
	(b) Derive the terminal velocity equations for spherical body.	04
	(c) Discuss the basic principle of radiation. A piece of guava is kept in a deep freezer maintained at -18^0C . Calculate the radiative heat transfer if the guava is at 25^0C and has an average area of 0.045 m^2 . The emissivity of guava is taken as 0.82 and Stefan-Boltzmann constant is $5.669 \times 10^{-8}\text{ W/m}^2\text{K}^4$	07
	OR	
Q.3	(a) What are different components of clean-o-grader?	03
	(b) Explain the working of indented cylinder separator in detail.	04
	(c) Draw the detailed diagram of Texture Profile Analysis (TPA). Also define Farcturability, Cohesiveness, Adhesiveness, Springiness, Gumminess	07

- Q.4 (a)** Write the Janssen's formula of lateral pressure exerted by granular materials against the wall in vertical deep bins. **03**
- (b)** Explain construction and working of belt conveyor with a sketch. **04**
- (c)** Give the application of diffusion in Food Processing. Derive an expression for heat flux through a cylindrical pipe. **07**

OR

- Q.4 (a)** Prove that sphericity is ; **03**

$$\Phi = \frac{(lbt)^{1/3}}{l}$$

- (b)** What is black body? How does it differ from a gray body? State the Stefan – Boltzmann law. **04**
- (c)** What is fineness modulus? Write the expression for mass mean diameter, volume surface mean diameter and volume mean diameter. **07**
- Find the fineness modulus from the given data and calculate the average particle size.

IS screen number	100	70	50	40	30	20	15	Pan
Mass retained (g)	0	1.8	20.4	40.4	108.3	114.7	4.6	9.8

- Q.5 (a)** Explain briefly direct and indirect damages by insects/pests of stored grain. **03**
- (b)** Describe the Gas displacement method used for the measurement of volume of food products. **04**
- (c)** What do you understand by convective mass transfer? Discuss Continuous phase and Dispersed phase. **07**

OR

- Q.5 (a)** Draw a neat schematic diagram of positive pressure pneumatic system. **03**
- (b)** Define thermal conductivity of food products. Discuss Parallel, Perpendicular and Krischer model for prediction of thermal conductivity. **04**
- (c)** A steel pipe with 50 mm outer diameter is covered with a 6.4 mm asbestos insulation ($k = 0.166 \text{ W/mK}$) followed by a 25 mm layer of fiber glass insulation ($k = 0.0485 \text{ W/mK}$). The pipe wall temperature is 393K and outside insulation temperature is 311K. Calculate the interface temperature between the asbestos and the fiber glass **07**
