Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V(NEW) EXAMINATION – SUMMER 2022

Subject Code:3151404 Date:04/06/2022

Subject Name:Food Engineering Operation-1

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.**

			MARKS
Q.1	**(a)**	Explain the forces involved in size reduction.	**03**
	(b)	Water flowing at a rate of 0.02 kg/s is heated from 20 to 60°C in a horizontal pipe (inside diameter = 2.5 cm). The inside pipe surface temperature is 90°C. Estimate the convective heat-transfer coefficient if the pipe is 1 m long.	**04**
	(c)	Enlist the engineering properties of agricultural materials. Explain in detail the rheological properties.	**07**
Q.2	**(a)**	Explain briefly Rittinger's law of size reduction.	**03**
	(b)	Explain different models for the prediction of thermal conductivity.	**04**
	(c)	One face of a stainless-steel plate 1 cm thick is maintained at 110°C, and the other face is at 90°C. Assuming steady-state conditions, calculate the rate of heat transfer per unit area through the plate. The thermal conductivity of stainless steel is 17 W/(m °C). Determine the temperature at 0.5 cm from the 110°C temperature face.	**07**
		OR	
	(c)	Derive the equation for conductive heat transfer in a rectangular slab. Explain the concept of thermal resistance.	**07**
Q.3	**(a)**	Explain the working of specific gravity separator.	**03**
	(b)	Discuss the use of dimensionless number in convective mass transfer.	**04**
	(c)	Determine the rate of water evaporated from a tray full of water. Air at a velocity of 2 m/s is flowing over the tray. The temperature of water and air is 25 ^{0}C. The width of the tray is 45 cm and its length along the direction of air flow is 20 cm. The diffusivity of water vapor in air is D = 0.26 x 10^{-4} m^2/s. The relative humidity of air is 50%.	**07**
		OR	
Q.3	**(a)**	What are advantages of controlled atmosphere storage?	**03**
	(b)	Describe the features of pusa bin.	**04**
	(c)	Enlist the traditional storage structures. Describe in detail Morai type storage structure.	**07**
Q.4	**(a)**	Differentiate between direct and indirect damage during storage of grains.	**03**
	(b)	Calculate the sphericity of a cylindrical object of diameter 1.0 cm and height 1.7 cm.	**04**

(c) What are different forms in which density of agricultural materials can be expressed? Give the definition of each of them. **07**

OR

Q.4 **(a)** What are different types of screens? **03**

(b) The mass retained over the IS set of sieves during sieve analysis is given below in the table. Calculate fineness modulus and average particle diameter **04**

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

(c) Wheat is milled in burr mill. The ground product was later on analysed in as set of IS sieve. The screen analysis data is given below in table. Calculate the screen effectiveness of (i) IS 40 mesh (ii) IS 20 mesh **07**

IS screen number		100	70	50	40	30	20	15	Pan
% material retained over each screen	Feed	--	2	10	29	36	16	4	3
	Overflow	--	12	48	19	15	4	2	--
	Underflow	--	--	5	9	51	20	7	8

Q.5 **(a)** What are modern storage structures for grains? **03**

(b) It is desired to crush 12 tonne/hour of an iron hematite. The size of feed is such that 80% passes through 76.2 mm screen and 80% of the product pass a3.17 mm screen. Calculate the gross power requirement. Use a work index of the material as 15. **04**

(c) What are the design features of air screen cleaners? **07**

OR

Q.5 **(a)** Draw a suitable diagram of bucket elevator. **03**

(b) Explain the application of screw conveyor in food industry. **04**

(c) Explain the construction and working of pneumatic conveying system **07**

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