Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject Code:3151404 Date:06-01-2023

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.**

Q.1	**(a)**	Enlist the engineering properties of food materials. What are physical properties?	**03**
	(b)	What are the laws for calculation of energy requirements in size reduction?	**04**
	(c)	What is Fourier's law for heat conduction? 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).	**07**
Q.2	**(a)**	Write three features of air screen cleaner.	**03**
	(b)	A composite wall of a furnace has 2 layers of equal thickness having thermal conductivities in the ratio of 3:2. What is the ratio of the temperature drop across the two layers?	**04**
	(c)	A cold storage is used to store eight tones of apple having specific heat 3.347 kJ kg^{-1} $^0C^{-1}$. The apples are to be cooled from 25 to 14 ^0C in 24 hours. The heat of respiration per 24 hours is 0.129 kJ kg^{-1}. Calculate the product load of storage plant in ton of refrigeration (TR) (Given 1 ton of refrigeration = 3.517 kilowatt).	**07**
		OR	
	(c)	Write the followings; a. Equation of Nusselt Number when flow is laminar b. Applications of diffusion in food processing c. Define absorbivity, transmissivity, reflectivity and explain Stefan-Boltzmann law	**07**
Q.3	**(a)**	Describe in brief the boundary layer theory of mass transfer.	**03**
	(b)	In a wheat milling experiment, it was found that to grind 4 mm sized grains to IS sieve 35 (0.351 mm opening), the power requirement was 10 kW. Calculate the power requirement for milling wheat by the same mill to IS sieve 15 (0.157 mm opening) using Rittingers' law. Feed rate of milling is 180 kg/h.	**04**
	(c)	Differentiate shallow and deep bin with suitable diagram. Mention the features of modern storage structures for grains.	**07**
		OR	
Q.3	**(a)**	What are ideal and actual screen?	**03**
	(b)	Write two features each of: a. Revolving screen b. Vibratory screen	**04**
	(c)	Enlist different types of improved storage structures for grains. Describe the important features of any two of them.	**07**
Q.4	**(a)**	What is meant by natural and forced convection?	**03**

	(b)	Describe the concept of overall heat transfer coefficient.	**04**
	(c)	A 2.5 cm inside diameter pipe is being used to convey a liquid food at 80°C. The inside convective heat transfer coefficient is 10 W/(m 2 °C). The pipe (0.5 cm thick) is made of steel (thermal conductivity = 43 W/[m °C]). The outside ambient temperature is 20°C. The outside convective heat-transfer coefficient is 100 W/(m 2 °C). Calculate the overall heat transfer coefficient and the heat loss from 1 m length of the pipe.	**07**

OR

Q.4	**(a)**	Define: a. Rheological properties b. Power law fluids c. Viscosity	**03**
	(b)	Predict the specific heat for a model food with the following composition: carbohydrate 40%, protein 20%, fat 10%, ash 5%, moisture 25%.	**04**
	(c)	Discuss the principle and theory of diffusion. Explain the diffusion of oxygen from air into water through gas liquid interphase.	**07**
Q.5	**(a)**	What are various parameters measured through Texture Profile Analysis. Define any two of them.	**03**
	(b)	Mention different sources of infestation in food grains with their control measures.	**04**
	(c)	Describe the use of controlled and modified atmospheric storage for perishable food products.	**07**

OR

Q.5	**(a)**	Draw a suitable sketch of bucket elevator.	**03**
	(b)	Describe the design parameters of belt conveyor.	**04**
	(c)	Describe in detail with suitable diagram various pneumatic conveying systems used for handling of food grains.	**07**

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