Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject Code:3151404 Date:07-12-2023

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)** Differentiate between true density and bulk density **03**

(b) Name different types of screen used for cleaning of grains. Explain in detail any one of them. **04**

(c) A steel pipe with 50 mm outer diameter is covered with a 6.4 mm asbestos insulation (k = 0.166 W/m K) followed by a 25 mm layer of fiber glass insulation (k = 0.0485 W/m K). The pipe wall temperature is 393 K and outside insulation temperature is 311 K. Calculate the interface temperature between the asbestos and the fiber glass. **07**

Q.2 **(a)** Calculate Prandtl Number when air at 100^0C **03**

$$\mu = \frac{1.46x10^{-6}.T^{3/2}}{110+T} \text{ Kg/ms}$$

$C_p = 0.917 + 2.58x10^{-4}T - 3.98x10^{-8}T^2$ kJ/kg K (where T is the absolute temperature in Kelvin), k = 0.03186 w/mK

(b) Define thermal conductivity of food products. Discuss parallel, perpendicular and Krischer model for prediction of thermal conductivity. **04**

(c) What is fineness modulus? 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. **07**

IS Sieve No	Weight retained (g)
100	0
70	1.4
50	16.7
40	36.7
30	82.2
20	96
15	8
Pan	8.7

OR

(c) Describe the construction and working of: **07**

i. Indented cylinder separator

ii. Specific gravity separator

Q.3 **(a)** Differentiate between open pore and closed pore with diagram **03**

	(b)	A 2 cm thick steel pipe (thermal conductivity =43 W/[m °C]) with 6 cm inside diameter is being used to convey steam from a boiler to process equipment for a distance of 40 m. The inside pipe surface temperature is 115°C, and the outside pipe surface temperature is 90°C. Calculate the total heat loss to the surroundings under steady-state conditions.	**04**
	(c)	Derive an expression for conduction heat transfer when the slabs are in series.	**07**
		OR	
Q.3	**(a)**	What are silos? Write their advantages.	**03**
	(b)	Write short notes on controlled and modified atmosphere storage.	**04**
	(c)	Enlist different types of improved storage structures for grains. Describe the important features of any two of them.	**07**
Q.4	**(a)**	Calculate the rate of heat energy emitted by 100 m^2 of a polished iron surface (emissivity = 0.06) having temperature of the surface 37°C	**03**
	(b)	Describe the gas displacement method used for the measurement of volume of food products.	**04**
	(c)	What are air screen cleaners? Describe construction and working of rotary air screen cleaner.	**07**
		OR	
Q.4	**(a)**	What is Bond's law of size reduction? Define work index.	**03**
	(b)	Define: geometric mean diameter, arithmetic mean diameter, sphericity and roundness	**04**
	(c)	Derive the equation of Rittinger's law. 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 Rittinger's law. Feed rate of milling is 180 kg/h.	**07**
Q.5	**(a)**	Explain static and dynamic angle of repose with diagram.	**03**
	(b)	Write the use of Schimdt number and Sherwood number in mass transfer	**04**
	(c)	Explain film and boundary theory for mass transfer.	**07**
		OR	
Q.5	**(a)**	How does screw conveyor works?	**03**
	(b)	What are different source of infestation during storage? Mention their control measures.	**04**
	(c)	What are bucket elevators? Describe their working with a neat diagram.	**07**

****