Seat No.: Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V (NEW) EXAMINATION – SUMMER 2019

Subject Code: 2151404 Date: 03/06/2019

Subject Name: Food Engineering Operations - I

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.**

Q.1 **(a)** What is screening? Write the purpose of screen motion. **03**

(b) Describe the different types of idlers used for belt conveyor. **04**

(c) What is Fourier's law of heat conduction? Derive an expression for heat conductance when the walls are in series (composite wall). **07**

Q.2 **(a)** State the principles of diffusion when two fluids are miscible. **03**

(b) Define plane of rupture. How shallow and deep bins are differentiated on basis of plane of rupture and angle of rupture? **04**

(c) Enlist the traditional and improved storage structures used in India. Describe in detail cover and plinth storage structure with suitable diagram. **07**

OR

(c) Discuss the stepwise design procedure to calculate the convective heat transfer coefficient. **07**

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?

Q.3 **(a)** Show diagrammatically the vertical and lateral pressure variation in a bin. **03**

(b) Define the followings **04**

1. Open pore porosity and Closed pore porosity
2. Thermal diffusivity and Thermal conductivity

(c) Derive an expression of conduction heat transfer when the pipes of different materials are in series. **07**

OR

Q.3 **(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) Derive an expression of terminal velocity for spherical body. **04**

(c) A steel pipe with 50 mm outer diameter is covered with a 6.4 mm asbestos insulation (k = 0.166 W/mK) followed by a 25 mm layer of fiber glass insulation (k = 0.0485 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**

Q.4 **(a)** What are the different sources of infestation for stored grain? **03**

(b) Discuss variety of pores are available in food grains with diagram. **04**

(c) (i) Write Bond's law for size reduction. **07**
(ii) 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 (1) Rittingers' law (2) Kicks' law. Feed rate of milling is 180 kg/h.

OR

Q.4 **(a)** Write a procedure to measure angle of repose of a grain with help of a labeled diagram and formula. **03**

(b) Differentiate between continuous phase and dispersed phase. List out the application of diffusion in food industry. **04**

(c) (i) Define belt tension. **07**
(ii) The capacity of toughened belt conveyor of 70 m length is 60 m^3/hr. Width of the belt is 61 cm and cross sectional area of the belt is 0.0309 m^2. Calculate belt speed and horse power for given belt conveyor. Given the constant A and B for the belt is 0.36 and 0.00298 respectively.

Q.5 **(a)** Describe the process of mass transfer in gas-liquid system with graph. **03**

(b) Define the followings and represents with graph **04**
1. Shear thinning
2. Shear thickening
3. Newtonian fluid
4. Non-Newtonian fluid

(c) List out the importance of engineering properties of food materials. Give the description of following shapes with diagram **07**
(a) Round, (b) Oblate, (c) Oblong, (d) Conic, (e) Ovate, (f) Truncate

OR

Q.5 **(a)** Draw the flow pattern of grain while emptying through a vertical silo. **03**

(b) Discuss the importance of angle of repose, internal and external friction in design of modern silo. **04**

(c) (i) Define effectiveness of screen. **07**
(ii) 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

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