Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE – SEMESTER – V (NEW) EXAMINATION – WINTER 2015

Subject Code: 2151404 **Date:08/12/2015**

Subject Name: Food Engineering Operations-I

Time:10:30am to 1:00pm **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

1Q **a** A cold storage wall of 3x6m in size is constructed of 15cm thick concrete of thermal conductivity of 1.37 W/m^{0}C. Insulation must be provided to maintain heat transfer rate through the wall at or below 500W. If the thermal conductivity of the insulation is 0.04W/m^{0}C, compute the required thickness of the insulation. The outside temperature of the wall is 38^{0}C and inside temperature is 5^{0}C. **07**

b What are the sources of infestation during storage? Discuss direct and indirect damages of food during storage. Explain any two traditional storage structures in detail. **07**

2Q **a** What is the importance of terminal velocity? Derive the following equations for spherical body. **07**

$$V_t = \left[\frac{4g\, d_p\, (\rho_p - \rho_f)}{3\rho_f\, C} \right]^{1/2}$$

b What are the different criteria for selection of proper conveying system? Explain construction and working of bucket elevator. **07**

OR

b Briefly explain the Bond's law & work index. What rotational speed, in revolutions per minute, would you recommend for a ball mill 1200 mm in diameter charged with 75 mm balls?

3Q **a** Define the followings **07**

1. Roundness
2. Sphericity
3. Drag coefficient

4. Dynamic angle of repose
5. Thermal properties
6. Physical properties
7. Viscous fluids

b Sorghum (4.85 mm size) was milled by a burr mill at two different gaps between the burr stones. The flour was analyzed by IS sieves for particle determination as shown in Table given below. The power required to mill sorghum at first setting was 5.0 kW. Calculate the power requirement of the mill in second setting using (i) Rittinger's law and (ii) Kick's law. The capacity of mill was 1.5q/hr. **07**

IS Sieve No.	Mass Fraction of flour retained over sieve, g	
	I-Setting	II-Setting
100	--	0.0
70	10.1	1.5
50	16.7	13.3
40	36.0	36.1
30	83.2	74.8
20	96.0	104.6
15	8.0	8.4
pan	0.0	11.3

OR

3Q **a** List out the importance of engineering properties of food materials. Give the description of following shapes; **07**

(a) Round, (b) Oblate, (c) Oblong, (d) Conic, (e) Ovate, (f) Truncate

b A RCC cylindrical grain storage bin has internal diameter of 5 m and is 22 m deep. Its completely filled with wheat weighing 840 kg/m^3. The angle of internal friction for wheat is 35°, while the angle of internal friction between the wheat and bin wall is 30°. The ratio of horizontal and vertical pressure intensity 'K' is 0.4. Calculate the lateral pressure intensity at 2 m interval using Janssen's equation. **07**

4Q **a** Meat is roasted in a tandoori oven at a temperature 200^0C. The meat piece has an area of $0.05m^2$ and emissivity of 0.82, and its temperature is 85^0C. Calculate the heat transfer rate considering both convective and radiating heat. Consider that a meat piece a cube in a shape. **07**

b Describe the importance of radiation heat transfer. Explain absorbivity, reflectivity, transmissivity and emissivity. What is Kirchhoff's law and Stefan-Boltzmann law? **07**

OR

4Q **a** Explain the difference between ideal screen and actual screen by using graph. Define the effectiveness of Scree and derive an equation for effectiveness of screen. **07**

b Derive the following equations for conductive heat transfer. **07**

$$Q_x = \frac{T_1 - T_2}{\frac{x_2 - x_1}{KA}} \qquad (1)$$

$$Q_x = \frac{T_2 - T_1}{R_{tB} + R_{tC} + R_{tC}} \qquad (2)$$

5Q **a** Derive the equation for composite wall cylinder in series. **07**

A hollow cylinder 5 cm internal diameter and 10 cm outer diameter has an inner surface temperature of 200^0C and an outer surface temperature is 100^0C. Determine the temperature of the point half way between the inner and outer surfaces. The thermal conductivity of the material is 70W/mK. Determine the heat flow through the cylinder per linear meter.

b Explain principle, construction & working of ball mill. Also Explain the principle, construction & working of an indented cylinder separator **07**

OR

a Discuss different types of pores with diagram. Also explain True, Material and Particle density. **07**

b 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 labeled diagram and formula. **07**