Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V • EXAMINATION – SUMMER • 2014

Subject Code: 151404 **Date: 11-06-2014**

Subject Name: Food Engineering Operations-I

Time: 10.30 am - 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.**

Q.1 **(a)** A square silo of side 2.5m and height 20m of reinforced concrete is filled with paddy. Calculate the load on the bottom of silo and the lateral thrust at every 2m of depth on the wall. The characteristics of stored paddy are: **07**

Minimum bulk density 576kg/m^3
Maximum bulk density 656kg/m^3
Minimum angle of internal friction 36^0
Maximum angle of internal friction 40^0
Minimum angle of friction on smooth sheeting 36^0
Angle of repose 36^0

(b) Write down the importance of heat transfer operations in agricultural processing. Explain the various modes of heat transfer. Derive the equation for conduction heat flow through pipe. **07**

Q.2 **(a)** A 5m high and 12m long composite wall of cold storage is made up of 100m thick brick wall as a outside wall. The inner wall surface is of fiber glass of 60mm thick. In between two walls a insulating board 20mm thick is placed. The coefficient of thermal conductivity for three layers is 1.15, 0.04 and 0.06 W/mK for bricks, fiber and insulating board respectively. If the outside temperature is 27^0C and cold room temperature is 8^0C, calculate the heat loss per hour through the wall. Also determine the interface temperature. **07**

(b) A cylindrical silo of 2.5m diameter and 20m height is filled with wheat. Calculate the load on the bottom and the lateral thrust at every 2m depth on the walls. The silo is made of steel with smooth wall. The characteristics of stored wheat are as follows. **07**

Minimum bulk density 720kg/m^3
Maximum bulk density 830kg/m^3
Minimum angle of internal friction 25^0
Maximum angle of internal friction 30^0
. Minimum angle of friction on smooth sheeting 18^0
. Angle of repose 25^0

OR

(b) Discuss direct and indirect damages of food during storage. Explain any two traditional storage structures in detail. **07**

Q.3 **(a)** Discuss the importance of terminal velocity. Derive the following equation for spherical bodies; **07**

$$V_i = \frac{\left[4gd_p\left(\rho_p - \rho_f\right)\right]^{1/2}}{\left[3\rho_f C\right]^{1/2}}$$

(b) Make the statements TRUE or FALSE **07**

1. The Genus of rice is sativa.
2. Reasons to study the chemical compositions are for canning processing.
3. Negative force area in TPA does not represent adhesiveness.
4. Paint, ink in ball pen, concentrated juice, pulp are the example of dilatants.
5. Chewiness is the product of hardness and cohesiveness.
6. Roundness is the ratio of radius of curvature of sharpest corner to mean radius of the particle.
7. When an object attains a terminal velocity, the net gravitational accelerating force equal to upward drag force.

OR

Q.3 **(a)** Define an ideal screen. How is it different from an actual screen? Explain the Difference with help of suitable diagram. **07**

(b) Calculate the convective heat transfer coefficient when air is at 90^0C is passed through a deep bed of green peas. Assume surface temperature of a pea to be 30^0C. The diameter of each pea is 0.5cm. The velocity of air through the bed is 0.3m/s. Given; **07**

ρ = 1.025kg/m^3, Cp = 1.017KJ/kg^{0}C, K = 0.0279 W/m^{0}C, μ = 19.907x10^{-6} PaS, Npr = 0.71

Q.4 **(a)** Define the followings **07**

1. Volume surface mean diameter
2. Bond's law
3. Kick's law
4. Angle of repose
5. Aperture
6. Mesh
7. grizzly

(b) Define an ideal screen. How is it different from an actual screen? Explain the difference with help of suitable diagram. Discuss briefly CAP storage. **07**

OR

Q.4 **(a)** What is work index? Define crushing efficiency and mechanical efficiency in size reduction. What is the power required to crush 100 ton/h of limestone if 80% of the feed pass a 2-in screen and 80% of the product a 1/8 in screen? The work index for limestone is 12.74. **07**

(b) Discuss the followings; **07**

1. Ovate, Elliptical, Ribbed and Irregular shape
2. Particle density and Bulk density
3. Newtonian and Non-Newtonian fluids
4. Static and Dynamic angle of repose
5. Thermal diffusivity and Specific heat.

Q.5 **(a)** Give the graphical representation of textural profile analyzer. Also discuss Brittleness, Hardness, Gumminess, Adhesiveness and cohesiveness. **07**

(b) What are common methods used for size reduction? Explain ball mill in detail. **07**

OR

Q.5 **(a)** Derive the expression of screen effectiveness of a screen indicating each variable. **07**

$$E = \frac{m_o(1-m_u)(m_u-m_f)(m_f-m_o)}{m_f(1-m_f)(m_o-m_u)^2}$$

(b) A horizontal screw conveyor mounted on a 6 cm diameter shaft has a screw pitch and diameter both equal to 45 cm. Estimate its actual capacity of conveying wheat weighing 750 kg/m^3 while operating at 160 rpm. Assume loading efficiency of 50 %, screw length of 10 m and coefficient of resistance as 2. Calculate **07**

1. Power required (in HP) of the motor
2. Load propagation rate
3. Total load per meter run

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