

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-V • EXAMINATION – SUMMER 2013****Subject Code: 151404****Date: 14-05-2013****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) Explain the term Absorbivity, Reflectivity, Transmissivity, Emissivity. **07**

A loaf of bread is passing through a baking oven, the walls of which are maintained at a constant temperature of 220°C. The bread has an area of 0.09 m² and is at 100°C. The emissivity of bread may be taken as 0.52. Calculate radiative heat transfer rate.

(b) Give short notes on the followings: **07**

1. Nusselt number
2. Prandtl number
3. Peclet number
4. Graetz number

What is the expected percentage increase in convective heat transfer coefficient if the velocity of the fluid is doubled while all other parameters are kept the same for turbulent flow in pipe?

Q.2 (a) What is Fourier's law? What is its importance in food processing? **07**

Derive an expression for heat conductance for composite cylindrical tubes (in series).

(b) Differentiate between; **07**

1. Springiness and Gumminess
2. Bingham and Non- Bingham fluid
3. Pseudo plastic and Dilatant
4. Sphericity and Roundness
5. Boundary volume and Bulk volume

OR**(b)** What do you mean by diffusion? State the Fick's law of diffusion. Explain the process of mass transfer in gas liquid system. **07****Q.3 (a)** It is proposed that an air stream to be used to separate wheat kernels from oat kernels. What air velocity would you choose? Derive the following equation for spherical bodies; **07**

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

- (b) Mentions the purpose of screen motion. What do you mean by a ϕ Mesh and an ϕ Aperture? Calculate the opening size (Aperture) and the percentage open area in mm of a 150-mesh screen of Tyler standard screen series with a wire of 0.064 mm diameter. **07**

OR

- Q.3** (a) Derive the expression for screen effectiveness of a screen indicating each variable. **07**

- (b) Explain the construction and working of a grizzly screen. What would be the critical speed of rotation, in revolution per minute for wet grinding in viscous suspensions by a ball mill of 1600 mm diameter charged with 100 mm ball? **07**

- Q.4** (a) Explain briefly the Bond's law for energy requirement in size reduction. Define work index. How much power is required to crush 500 kg/h of a food material if 80% of the feed passes through IS sieve No. 340 (3.25 mm opening) and 80% of the product passes through IS sieve No. 50 (0.5 mm opening)? Given the work index of the material is 6.75. **07**

- (b) Define a plane of rupture. Differentiate shallow bin and deep bin on the basis of plane of rupture. With helps of diagrammatic representation briefly explain different types of flow patterns when emptying a vertical silo. **07**

OR

- Q.4** (a) Write the Janssen's formula of lateral pressure exerted by granular materials against the wall in vertical deep bins indicating each variable with proper units. **07**

A RCC cylindrical grain storage bin has internal diameter of 5 m and is 20 m deep. It is completely filled with wheat weighing 750 kg/m^3 . The angle of internal friction for wheat is 26° , while the angle of internal friction between the wheat and bin wall is 24° . The ratio of horizontal and vertical pressure intensity K is constant. Calculate the lateral pressure intensity at 2 m interval using Janssen's equation.

- (b) Define crushing efficiency and mechanical efficiency in size reduction. The screen analysis data for particle size determination of Sorghum (3.8 mm size) milled by a burr mill is shown in table given below. **07**

IS Sieve No	100	70	50	40	30	20	15	Pan
Weight of material retained, g	0.0	5.6	25.4	36.2	80.1	90.8	11.9	0

The power requirement was 10 kW at a feed rate of 300 kg/h. Calculate the power require to mill sorghum by the same mill to IS sieve 15 (0.157 mm opening) by using Kick's law.

- Q.5** (a) Explain the principle, construction and working of an indented cylinder separator. **07**

- (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**
- (i) Power required (in HP) of the motor
 - (ii) Load propagation rate
 - (iii) Total load per meter run

OR

- Q.5** (a) In a bucket elevator for lifting wheat, each bucket is 24 cm long and has a cross section which is a section of a circle having a radius of 16 cm and subtending an angle of 81° at the centre. The buckets are 40 cm apart, the lift is 25 m and the head wheel has a diameter of 60 cm. Calculate **07**
- (i) belt speed so that the discharge is centrifugal.
 - (ii) Capacity of lifting wheat weighing 750 kg/m^3 .
 - (iii) Horsepower required assuming an overall efficiency of 80%.
- (b) What is a squat silo? Explain briefly the infestation by Rats and rat control measures while designing warehouse for storing grains. **07**
