

**GUJARAT TECHNOLOGICAL UNIVERSITY**B.E. Sem-V<sup>th</sup> Examination December 2010**Subject code:151404****Subject Name: Food Engineering Operations-I****Date: 13/12 /2010****Time: 03.00 pm - 05.30 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 furnace is made out of steel wall followed by a brick wall followed by a sil-o-cel brick wall. Inside temperature of the furnace is 400<sup>o</sup>C and outside temperature is 40<sup>o</sup>C. Find the rate of heat per m<sup>2</sup> and temperature at the junction of the steel and bricks wall and at the junction of the brick and sil-o-cel brick wall. Properties of the materials are as follows **07**

Material	Thickness (cm)	Thermal conductivity (W/m <sup>o</sup> C)
Steel (A)	1.2	16.3
Brick (B)	20	0.72
sil-o-cel (C)	12	0.14

- (b)** What is Texture Profile Analysis (TPA). State its application in food. Also explain Fracturability, Hardness, Cohesiveness, Adhesiveness, Springiness, Gumminess, Chewiness and Stringiness with the help of generalized texture profile. **07**
- Q.2 (a)** Groundnut was procured for the study. The samples were selected and cleaned to ensure that grains were free of dirt, broken and other foreign materials. The moisture content during the experiment was found to be 7.9% (w.b.). Calculate the followings; **07**
- (i) Arithmetic mean diameter (ii) Geometric mean diameter  
 (iii) Open pore porosity (iv) Closed pore porosity  
 (v) Apparent porosity (vi) Bulk porosity  
 (vii) Bulk particle porosity (viii) Total porosity
- Given: True density = 750 kg/m<sup>3</sup>, Material density = 850 kg/m<sup>3</sup>, Apparent density = 600 kg/m<sup>3</sup>, Width of grain = 7.25mm, Bulk density = 560 kg/m<sup>3</sup>, Particle density = 810 kg/m<sup>3</sup>, Length of grain = 13.05mm, Thickness of grain = 7.04mm
- (b)** Describe the conductive mode of heat transfer. What is Fourier's Law? What is its importance in Food Processing? **07**  
 Derive an expression for heat flux through a cylindrical pipe.
- OR**
- (b)** Write short notes on convective heat transfer. What are meant by natural convection and forced convection. **07**  
 Derive an expression for heat flux through a slab in series.
- Q.3 (a)** Write a note on the followings **07**  
 (1) Boundary volume, (2) True density, (3) Closed pore porosity, (4) Newtonian fluid, (5) Bingham Plastic Fluid, (6) Rice caryopsis, (7) Reasons to study chemical composition
- (b)** Define screen effectiveness and derive the formula for screen effectiveness. **07**

**OR**

- Q.3 (a)** Describe briefly different size reduction procedures. What would be the critical speed of rotation, in revolution per minute for wet grinding in viscous suspensions by a ball mill of 1200 mm diameter charged with 75 mm ball? **07**
- (b)** What do you mean by a 'Mesh' and an 'Aperture'? Calculate the opening size (Aperture) in mm of a 150-mesh screen of Tyler standard screen series with a wire of 0.064 mm diameter. Calculate the percentage open area for this square mesh. **07**
- Q.4 (a)** Define crushing efficiency and mechanical efficiency in size reduction. Explain briefly Rittinger's law and kick's law for size reduction. **07**
- (b)** A RCC cylindrical grain storage bin has internal diameter of 5 m and is 18 m deep. It is completely filled with wheat weighing  $740 \text{ kg/m}^3$ . The angle of internal friction for wheat is  $28^\circ$ , while the angle of internal friction between the wheat and bin wall is  $25^\circ$ . 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**

**OR**

- Q.4 (a)** Briefly explain the Bond's law for energy requirement in size reduction. Define work index. How much power is required to crush 400 kg/h of a 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 6.50. **07**
- (b)** Define the angle of repose with help of appropriate diagram. Enumerate the factors affecting the angle of repose and importance of angle of repose in storage study. **07**
- Q.5 (a)** A horizontal screw conveyor mounted on a 6 cm diameter shaft has a screw pitch and diameter both equal to 40 cm. Estimate its actual capacity of conveying wheat weighing  $850 \text{ kg/m}^3$  while operating at 150 rpm. Assume loading efficiency of 40 %, screw length of 10 m and coefficient of resistance as 3. Calculate **07**
- (i) Power required (in HP) of the motor  
(ii) Load propagation rate  
(iii) Total load per meter run
- (b)** Differentiate Shallow bin and Deep bin on the basis of plane of rupture. What do you mean by a squat silo? Briefly explain different types of flow patterns when emptying a vertical silo with help of diagrammatic representation. **07**

**OR**

- Q.5 (a)** List out different traditional storage structures and briefly explain 'CAP' storage structures by clearly mentioning its constructional features. **07**
- (b)** What does fineness modulus indicate and how is it determined? Determine the average particle size diameter,  $D_p$  in mm from the analysis of a flour sample data given below. **07**

IS Sieve No.	100	70	50	40	30	20	15	Pan
Weight of material retained, g	0.0	1.4	18.3	36.2	75.8	99.6	10.4	8.3

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