

Seat No.: \_\_\_\_\_

Enrolment No. \_\_\_\_\_

**GUJARAT TECHNOLOGICAL UNIVERSITY**  
**BE SEM-V Examination-Nov/Dec.-2011**

**Subject code: 151404**

**Date: 22/11/2011**

**Subject Name: Food Engineering Operations-I**

**Time: 2.30 pm -5.00 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)** Define the followings; **07**
1. True density
  2. Particle density
  3. Apparent density
  4. Material density
  5. Bulk density
  6. Open pore porosity
  7. Closed pore porosity

- (b)** List out different properties of food material. Discuss Solid volume, Apparent volume and Bulk volume. Discuss frictional properties in detail. **07**

- Q.2 (a)** What do you understand by conduction? Derive the following expression; **07**

$$q_r = \frac{T_1 - T_2}{\frac{\ln\left(\frac{r_2}{r_1}\right)}{2 \pi L K_A} + \frac{\ln\left(\frac{r_2}{r_3}\right)}{2 \pi L K_B}}$$

- (b)** Water flowing at a rate of 0.02 kg/s, is heated from 20 to 60°C in a horizontal pipe having inside diameter 2.5 cm. The inside pipe surface temperature is 90°C. Estimate convective heat transfer coefficient in the pipe 1 m long. Properties of water at average temperature are given below: **07**
- $\rho = 992.2 \text{ kg/m}^3$ ,  $\mu = 658.026 \times 10^{-6} \text{ Pa.s}$ ,  $C_p = 4.175 \text{ kJ/(kg.}^\circ\text{C)}$ ,  $k = 0.633 \text{ W/(m}^\circ\text{C)}$ ,  $N_{pr} = 4.3$

**OR**

- (b)** In a bucket elevator for lifting paddy, each bucket is 20 cm long and has a cross-section which is a section of a circle having a radius of 15 cm and subtending an angle of 81° at the centre. The buckets are spaced 40 cm apart, the lift is 20 m and the head wheel has a diameter of 50 cm. Calculate **07**
- (a) Belt speed so that the discharge is centrifugal.
  - (b) Capacity of lifting paddy which weighs 580 kg/m<sup>3</sup>.
  - (c) Horsepower required assuming an overall efficiency of 85 percent.

- Q.3 (a)** Differentiate between **07**
1. Bingham plastic and Non Bingham
  2. Pseudoplastic and Dilatant

- (b)** What are the purposes of screen motion? List out different types of perforated metal screen and mention how to denote perforated metal screens with different openings with suitable diagrams. **07**

**OR**

- Q.3 (a)** Write down the importance of textural analysis of food. Show different textural properties with the help of TPA graph. Also define Chewiness and Gumminess. **07**

- (b)** Define Roundness, Roundness ratio, Sphericity and prove that **07**

$$\Phi = \frac{(a b c)^{\frac{1}{3}}}{a}$$

- Q.4 (a)** Briefly explains the following screens **04**
- (i) Grizzly
  - (ii) Trommel

- (b)** Define an aperture. Calculate the opening size (Aperture) in mm of a 250-mesh screen of Tyler standard screen series with a wire of 0.039 mm diameter. Calculate the percentage open area for this square mesh. **03**

- (c)** Define crushing efficiency and mechanical efficiency of a size reduction machine. A certain crusher accepts a feed material having a volume-surface mean diameter of 25 mm and gives a product of volume-surface mean diameter of 4 mm. The power required to crush 20 tonnes per hour is 10 kW. What will be the power consumption if the capacity is reduced to 15 tonnes per hour? Use Rittinger's law. **07**

**OR**

- Q.4 (a)** What do you mean by an ideal screen? Graphically represent it and derive the expression of screen effectiveness. **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)** Mention the engineering properties on which these following cleaning and grading equipments operate. **03**

Indented cylinder separator, Specific gravity separator, Spiral separator, Magnetic separator, Cyclone separator and Velvet roll separator.

- (c)** Define bond's law and work index. Write down the formula for power requirement in bond's law indicating each variable with proper units. **04**

- Q.5 (a)** Enumerate the advantages of modern storage bins. Describe briefly different permanent storage structures with suitable diagrams. **07**
- (b)** Define an angle of repose and its importance in storage of grain. A RCC cylindrical grain storage bin has internal diameter of 3 m and is 8 m deep. It is completely filled with paddy weighing  $580 \text{ kg/m}^3$ . The angle of internal friction for paddy can be taken as  $35^\circ$ , while the angle of friction between the paddy and bin wall is  $30^\circ$ . The ratio of horizontal and vertical pressure intensity 'K' is 0.4. Calculate the lateral pressure intensity at a depth of 6 m using Janssen's equation. **07**

**OR**

- Q.5 (a)** List out different size reduction machinery. Explain briefly the principle and working of a ball mill. **05**
- (b)** Calculate the operating speed of the ball mill from the following data: **02**
- (i) Diameter of ball and ball mill are 50 mm and 1000 mm respectively.
  - (ii) Operating speed is 65 % of the critical speed of the mill.
- (b)** List out some traditional storage structure used in different parts of India. Briefly explain the moisture migration in stored grains in a storage structures results from temperature change with suitable line diagram. **07**

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