

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER- V (New) EXAMINATION – WINTER 2019

Subject Code: 2151404
Date: 21/11/2019
Subject Name: Food Engineering Operations - I
Time: 10:30 AM TO 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)** State the followings **03**
1. Kick's law
 2. Gumminess
 3. Angle of repose
- (b)** Explain the working of ball mill. The rate of heat transfer through a glass window with 3m^2 surface area and 5 mm thickness if the temperature on the two sides of the glass is 14°C and 15°C respectively and the thermal conductivity of the glass is $0.7\text{ W/m}^\circ\text{C}$ is 420 W. **04**
- (c)** Explain the followings **07**
1. Bond's law of crushing
 2. Jaw crusher works on which principle.
 3. Which is the most suitable conveyor for transportation of sticky material?
 4. What is the relation between screen capacity and screen effectiveness?
- Q.2 (a)** Discuss in brief the design consideration of air screen grain cleaner. **03**
- (b)** Define plane of rupture and differentiate between shallow bin and deep bin showing plane of rupture with help of diagram. **04**
- (c)** Derive the following equations for conductive heat transfer. **07**
- $$Q_x = \frac{T_1 - T_2}{\frac{x_2 - x_1}{KA}}$$
- $$Q_x = \frac{T_2 - T_1}{R_{tB} + R_{tC} + R_{tC}}$$
- OR**
- (c)** Explain briefly the Bond's law for energy requirement in size reduction. 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**
- Q.3 (a)** Draw pattern of flow for granular bulk product with centre discharge. **03**
- (b)** What is the importance of Texture Profile Analysis (TPA), discuss with diagram. **04**
- (c)** A cold storage wall of $3 \times 6\text{m}$ in size is constructed of 15cm thick concrete of thermal conductivity of $1.37\text{ W/m}^\circ\text{C}$. Insulation must be provided to maintain heat transfer rate through the wall at or below 500W. If the thermal conductivity of the insulation is $0.04\text{ W/m}^\circ\text{C}$, compute the required thickness of the insulation. The outside temperature of the wall is 38°C and inside temperature is 5°C . **07**
- OR**
- Q.3 (a)** Discuss the importance of angle of repose, internal and external friction in design of modern silo. **03**
- (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° . **04**

The ratio of horizontal and vertical pressure intensity 'K' is 0.4. Calculate the lateral pressure intensity at 12 m using Janssen's equation.

- (c) (i) Differentiate between shallow and deep bin. **07**
 (ii) Discuss the pressure distribution in bin.
- Q.4** (a) Describe modified and controlled atmosphere storage. **03**
 (b) What rotational speed, in revolutions per minute, would you recommend for a ball mill 1200 mm in diameter charged with 75 mm balls? **04**
- (c) A storage structure having smooth wall used for storing rice has diameter of 2.5 m and height 25 m. The characteristics of stored rice are as follows: **07**
 Minimum bulk density : 720 kg/m³
 Maximum bulk density: 830 kg/m³
 Minimum angle of internal friction: 25°
 Maximum angle of internal friction: 30°
 Minimum angle of friction on smooth wall: 18°
 Angle of repose: 25°
 Calculate the load on the bottom, and the lateral pressure thrust at 14 m depth on walls.
- OR**
- Q.4** (a) List out the importance of engineering properties of food materials and discuss any one in detail. **03**
 (b) The capacity of toughened belt conveyor is 60 m³/hr. Belt width is 35.6 cm and cross sectional area of the belt is 0.0089 m². Calculate belt speed and horse power for given belt conveyor. **04**
 (c) Define the followings **07**
 Open Pore, Closed Pore, Material density, Particle density, Absorbivity, Reflectivity and Hardness
- Q.5** (a) What are the different sources of infestation for stored grain? **03**
 (b) A food product has its minimum and maximum temperatures respectively 27°C and 227°C. Find the ratio of radiated power at its maximum and minimum temperatures. **04**
 (c) Write Short notes on (i) Belt Conveyor and idlers (ii) Screw Conveyor **07**
- OR**
- Q.5** (a) Define 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? **03**
 (b) 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. **04**
 (c) Describe the construction and working of: **07**
 a. Indented Cylinder separator.
 b. Specific gravity separator.
