Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

B. E. Sem. - V - Examination – June- 2011

Subject code: 151404

Subject Name: Food Engineering Operations-I

Date:20/06/2011 **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)** Describe in detail the different thermal properties of food products. Predict the specific heat of a food contains 60% moisture, 10% protein, 15% carbohydrate, 10% fat and 5% ash. Also estimate the thermal conductivity of food that contains 65% water. **07**

(b) Describe the followings in detail **07**

1. Convective heat transfer process with convective heat transfer coefficient of different fluids.
2. Terminal velocity with drag coefficient.

Q.2 **(a)** Write in short; **07**

1. Purpose to study physical properties
2. Reasons to study chemical composition
3. Rice caryopsis
4. Solid volume
5. Radiation heat transfer
6. Pecklet number
7. Stanton number

(b) What are the applications of conduction and convection mode of heat transfer in food industry? Drive an expression for heat flux through a cylindrical pipe. **07**

OR

(b) A screw conveyor mounted on a 5 cm diameter shaft has screw pitch and diameter both equal to 40 cm. Estimate its actual capacity of conveying wheat weighing 850 kg/m^3 while operating at 160 rpm. Assume actual capacity as 50 percent of theoretical capacity. **07**

For a screw length of 10 m, what horsepower motor will be required if the horsepower material factor for wheat is 0.4?

Q.3 **(a)** A cold storage wall of 3X6m is constructed of 15cm thick concrete (K = 1.37 W/m^{0}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 0.04W/ m^{0}C, compute the required thickness of the insulation. The outside temperature of the wall is 38^{0}C and inside wall temperature is 5^{0}C. **07**

(b) Define an ideal screen and an actual screen. Show graphically, how an ideal screen is different from an actual screen. **07**

OR

Q.3 **(a)** What is the expected percent 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? **07**

(b) Discuss the structure of maize seed with diagram. Write down the proximate chemical composition of main parts of maize kernel. **07**

Q.4 **(a)** List out different size reduction procedures. **07**

Sorghum (3.8 mm size) was milled by a burr mill at gaps between the burr stones. The flour was analyzed by IS sieves for particle size determination as shown in table given below.

IS Sieve No.	100	70	50	40	30	20	15	Pan
Weight of material retained , g	0.0	3.4	29.9	37.3	78.1	84.1	9.2	8.0

The power requirement was 8 kW, at a feed rate of 0.2 t/h. Calculate the power required to mill sorghum by the same mill to IS sieve 15 (0.157 mm opening) by Rittinger's law.

(b) Describe briefly different sources of infestation in agricultural products. Calculate the operating speed of the ball mill from the following data: **07**

(i) Diameter of ball and ball mill are 40 mm and 500 mm respectively.

(ii) Operating speed is 50 % of the critical speed of the mill.

OR

Q.4 **(a)** Describe the principle, construction and working of a vibratory air screen cleaner. **07**

(b) Define screen effectiveness and write the formula for screen effectiveness denoting the meaning of each variable. **07**

Calculate the opening size (Aperture) in mm of a 200-mesh screen of Tyler standard screen series with a wire of 0.053 mm diameter. Calculate the percentage open area for this square mesh.

Q.5 **(a)** Write the Janssen's formula of lateral pressure induced by granular materials against wall in deep bins indicating each variable with proper units. With help of a diagram, explain improved storage structure 'Pusa bin'. **07**

(b) Briefly describe the Rittinger's law and kick's law for size reduction. What will be the power required to crush 15 tonnes per hour of a grain if 80% of the feed passes through a 7.5 mm screen and 80% of the product a 0.25 mm screen? Work index of the grain is 5.6. **07**

OR

Q.5 **(a)** Define plane of rupture and with help of diagram, differentiate between shallow bin and deep bin showing plane of rupture. **07**

A RCC cylindrical grain storage bin has internal diameter of 5 m and is 20 m deep. It is completely filled with paddy weighing 600 kg/m^3. The angle of internal friction for paddy can be taken as 35°, while the angle of friction between the paddy and bin wall is 30°. The ratio of horizontal and vertical pressure intensity 'K' is 0.4. Calculate the lateral pressure intensity at a depth of 16 m using Janssen's equation.

(b) Define the angle of repose and briefly 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. **07**

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