

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-V • EXAMINATION – WINTER • 2014****Subject Code: 151404****Date: 26-11-2014****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) a) The maximum particle size of a limestone sample received from a cone crusher was 2.5 cm. It was required to further crush it down to 0.5 cm in a roll crusher with smooth rolls. The co-efficient of friction between particle and steel was 0.25, If the rolls were set at 6.3 mm and both revolved to crush, estimate the diameter of the rolls. **04**

b) Explain hydraulic Jigs in detail with a neat sketch. **03**

(b) The interior of a refrigerator has inside dimensions 60 cm x 45 cm base area and 120 cm high. The composite wall is made of two 3 mm mild steel sheets ($k = 145 \text{ kJ/m-hr-deg}$) with 6 cm of glass wool ($k = 0.188 \text{ kJ/m-hr-deg}$) insulation sandwiched between them. The average values of convective heat transfer coefficient at the interior and exterior wall is 40.8 and 52.3 $\text{kJ/m}^2\text{-hr-deg}$ respectively. **07**

1. Draw the thermal circuit.

2. Calculate the individual resistance of this composite wall

For the air temperature inside the refrigerator at 6.5°C and outside of 25°C , determine the rate at which heat must be removed from the refrigerator. Also, calculate the temperature on the outer surface of the metal sheet.

Q.2 (a) What do you understand by conductive heat transfer? Derive the following expression for multilayered system of circular pipe and also show its electrical resistance analogy; **07**

$$q = \frac{T_1 - T_3}{\frac{\ln\left(\frac{r_2}{r_1}\right)}{2\pi L K_a} + \frac{\ln\left(\frac{r_3}{r_2}\right)}{2\pi L K_b}}$$

(b) Define the followings **07**

(a) Absorbivity, (b) Transmissivity, (c) Reflectivity, (d) Stefan-Boltzmann Law, (e) Boundary volume, (f) Gumminess (g) Angle of repose

OR

(b) a) Draw pattern of flow for granular bulk product with centre discharge. **07**

b) Explain briefly Bond's law for energy required in size reduction.

Q.3 (a) Explain the principle of diffusion?. Discuss the process of mass transfer in gas liquid system only. **07**

(b) Explain principle, construction and working of disk separator with diagram. **07**

OR

Q.3 (a) Describe in brief about ball mill and derive an equation for critical speed of mill. Also explain closed circuit grinding by an example. **07**

(b) a) A piece of meat carcass is kept in a deep freezer maintained at -18°C . Calculate the radiative heat transfer if the meat carcass is at 25°C and has an average area of 0.045m^2 . The emissivity of carcass is 0.82. **07**

- b) A loaf of bread passing through the baking oven, the temperature of the wall is maintained at 220°C . The bread has an area of 0.09m^2 and is at 100°C . The emissivity of bread is 0.52. In addition to radiation heat, there is convective heat also by air at 220°C . Calculate the heat transfer rate.

Q.4 (a) Explain construction and working of belt conveyor with a sketch and also discuss about idler spacing. **07**

(b) Define rheological properties? List out the importance of TPA in processing of foods. **07**
Explain Adhesiveness, Cohesiveness and Springiness

OR

Q.4 (a) Differentiate between; **07**

1. Ribbed and Irregular shape
2. Particle density and Material density
3. Newtonian and Non-Newtonian fluids
4. Open pore porosity and Closed pore porosity
5. Sensible heat and Specific heat.

(b) Explain the construction and working of a grizzly screen. Write a short note on cumulative screen analysis. **07**

Q.5 (a) Calculate the true density of coriander leaves at 25°C having the composition in given table. **07**

Component	Water	Protein	Fat	Carbohydrate	Ash
Composition (%)	91.57	2.86	0.35	1.72	3.50

(b) Explain pressure distribution in a bin and 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**

OR

Q.5 (a) Derive the expression for screen effectiveness of a screen indicating each variable. **07**

(b) Calculate the convective heat transfer coefficient when air is at 90°C is passed through a deep bed of green peas. Assume surface temperature of a pea to be 30°C . The diameter of each pea is 0.5cm. The velocity of air through the bed is 0.3m/s. Given; $\rho = 1.025\text{kg/m}^3$, $C_p = 1.017\text{KJ/kg}^{\circ}\text{C}$, $K = 0.0279\text{ W/m}^{\circ}\text{C}$, $\mu = 19.907 \times 10^{-6}\text{ PaS}$, $N_{pr} = 0.71$ **07**
