GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER–V (NEW) - EXAMINATION – SUMMER 2016

Subject Code:2151404   **Date:09/05/2016**

Subject Name:Food Engineering Operations - I

Time:02:30 PM to 05:00 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)**	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**
	(b)	A fruit juice is passing through a hot pipe of 7.5cm diameter and 3.3m long @60 lpm and the wall temperature is 120^0C. The juice is entering at 25^0C and is leaving at 75^0C. Find the heat transfer coefficient and Nusselt number if the fluid properties are assumed to be those of water. Fluid properties are ρ = 1000 kg/m^3, k = 0.6 W/m^{0}C, Cp = 4.2 kJ/kg^{0}C and μ = 1x10^{-3} Pas.	**07**

Q.2	**(a)**	Explain principle, construction and working of blake jaw crusher with figure.	**07**
	(b)	Derive the following equations for conductive heat transfer through a tubular pipe;	**07**

$$q_r = \frac{T_i - T_o}{\dfrac{Ln\left(\dfrac{r_o}{r}\right)}{2\Pi L K}}$$

OR

	(b)	What is meant by diffusion? Write short notes on diffusional mass transfer. What is Fick's law of diffusion?	**07**

Q.3	**(a)**	What are the advantages of modern storage bins? Define plane of rupture and differentiate between shallow bin and deep bin showing plane of rupture with help of diagram.	**07**
	(b)	Write a short note on belt conveyor with merits and demerits. Also explain the different types of idlers used in belt conveyor.	**07**

OR

Q.3	**(a)**	Differentiate between;	**07**

1. Round and Oblate shape
2. Particle density and Bulk density
3. Static angle of repose and Dynamic angle of repose
4. Open pore porosity and Closed pore porosity
5. Sensible heat and Specific heat.

	(b)	A piece of meat carcase is kept in a deep freezer maintained at -21^{0}C. Calculate the	**07**

radiative heat transfer if the meat carcase is at 28^0C and has an average area of 0.045m^2. The emissivity of carcase is 0.82. A loaf of bread passing through the baking oven, the temperature of the wall is maintained at 220^0C. The bread has an area of 0.09m^2 and is at 100^0C. The emissivity of bread is 0.52. In addition to radiation heat, there is convective heat also by air at 220^0C. Calculate the heat transfer rate.

Q.4 **(a)** 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**

(b) 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**

OR

Q.4 **(a)** Write short notes on convective mass transfer? Describe the process of mass transfer in gas-liquid system. **07**

(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 labelled diagram and formula. **07**

Q.5 **(a)** Describe the importance of radiation heat transfer. Explain absorbivity, reflectivity, transmissivity and emissivity. What is Kirchhoff's law and Stefan-Boltzmann law? **07**

(b) A thick walled nuclear coolant pipe (K_s = 12.5 BTU/hr-ft-F) with 10 inch inside diameter and 12 inch outside diameter is covered with a 3 inch layer of insulation (K_s = 0.14 BTU/hr-ft-F). If the inside wall temperature is 550F, calculate the heat loss per foot of length. The outside temperature is 100F. **07**

OR

Q.5 **(a)** A square silo of side 3.5m and height 25m of reinforced concrete is filled with paddy. Calculate the load on the bottom of silo and the lateral thrust at every 2.5m of depth on the wall. The characteristics of stored paddy are: **07**

1. Minimum bulk density: 576kg/m^3
2. Maximum bulk density: 656kg/m^3
3. Minimum angle of internal friction: $36°$
4. Maximum angle of internal friction: $40°$
5. Minimum angle of friction on concrete: $36°$
6. Angle of repose of paddy: $36°$

(b) Write short note on following cleaning and grading equipments. **07**
  1. Specific Gravity Separator
  2. Colour Separator

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