Seat No.: _____ **Enrolment No._____**

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V (NEW) - EXAMINATION – SUMMER 2018

Subject Code:2151404 Date:02/05/2018

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 is black body? How does it differ from a gray body? State the Stefan – Boltzmann law. **03**

(b) Derive the expression for temperature distribution, under one dimensional steady state heat conduction for composite wall. **04**

(c) A steel pipe with 50 mm outer diameter is covered with a 6.4 mm asbestos insulation (k = 0.166 W/mK) followed by a 25 mm layer of fiber glass insulation (k = 0.0485 W/mK). The pipe wall temperature is 393K and outside insulation temperature is 311K. Calculate the interface temperature between the asbestos and the fiber glass. **07**

Q.2 **(a)** The capacity of troughed belt conveyor is $55m^3$/hr. belt width is 50cm and and cross sectional area is $0.0204m^2$ calculate belt speed. If length of belt is 50m, estimate horse power required for operation of belt conveyor. Values of A and B are 0.3 and 0.00187 respectively. **03**

(b) What is fineness modulus? Calculate the average particle size for the given data: **04**

IS Sieve Number	Weight of material retained (g)
100	0.0
70	1.4
50	16.7
40	36.7
30	82.2
20	96.0
15	8.0
Pan	8.7

(c) The wall of a furnace is made up of 0.229m of firebrick (k = 1.245 W/m^0C), 0.127m of insulating bricks (k = 0.014 W/m^0C) and 0.190m red brick (k = 0.086 W/m^0C). The inner and outer surface temperatures of the wall are 816^0C and 66^0C. Neglect the resistance of the mortar joints, compute the other temperatures between firebrick and insulating brick and also between red brick and insulating brick contact surfaces. **07**

OR

(c) Derive the Janssen's formula of lateral pressure induced by granular materials against wall in deep bins indicating each variable. **07**

Q.3 **(a)** Define **03**
(i) Sorting (ii) Crushing Efficiency (iii) Mechanical Efficiency

(b) For bucket elevator prove that $n= 29.9/ r^{0.5}$ **04**

	(c)	Mention different criteria for selection of proper conveying system. Explain construction and working of screw conveyor.	**07**

OR

Q.3	**(a)**	Enlist the types of screens used for cleaning and grading of grains. Briefly explain the construction and working of trommel.	**03**
	(b)	What do you understand by convective mass transfer? Discuss Continuous phase and Dispersed phase.	**04**
	(c)	A cylindrical silo of 2.5m diameter and 20m height is filled with wheat. Calculate load on the bottom and lateral thrust every 2m depth on walls. The silo is made of steel with smooth walls. The characteristics stored wheat are as follows: Minimum bulk density 720 kg/m^3, Maximum bulk density 830 kg/m^3 Minimum angle of internal friction 25º, Maximum angle of internal friction 30º Minimum angle of friction on smooth sheeting 18º, Angle of repose 25º	**07**
Q.4	**(a)**	Discuss the importance of thermal properties in food processing.	**03**
	(b)	Explain working principles of indented cylinder and specific gravity separator.	**04**
	(c)	Define plane of rupture and with help of diagram, differentiate between shallow bin and deep bin showing plane of rupture. Also mention the moisture migration in storage bin.	**07**

OR

Q.4	**(a)**	Write a short note on 'Pusa bin'.	**03**
	(b)	With help of a diagram, explain traditional storage structure 'Bukhari'.	**04**
	(c)	What are the laws of energy requirement for size reduction? How much power is required to crush 4t/hr of a material if 80% of the feed passes through IS sieve No 480 (4.75 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 6.25.	**07**
Q.5	**(a)**	Write a procedure to measure angle of repose of a grain with help of a labeled diagram and formula. Also explain the role of moisture during the measurement of the same.	**03**
	(b)	Explain the principles of diffusion. Describe the process of mass transfer in gas-liquid system.	**04**
	(c)	Draw the detailed diagram of Texture Profile Analysis (TPA). Also define Farcturability, Cohesiveness, Adhesiveness, Springiness, Gumminess	**07**

OR

Q.5	**(a)**	Define the followings Roundness, Sphericity, Drag coefficient	**03**
	(b)	(i) A body has its minimum and maximum temperatures respectively 27ºC and 227ºC. Find the ratio of radiated power at its maximum and minimum temperatures. (ii) A body with area surface of 100 cm^2 and temperature of 727ºC. If Stefan-Boltzmann 5.67x10^{-8} W/mK^4 and the body emissivity is 0.6 determine the average of radiated energy of the body.	**04**
	(c)	Discuss different types of pores with diagram. Also Define the followings True density, Material density, Particle density, Bulk density	**07**