Seat No.: _____ Enrolment No.

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject Code: 2141407 **Date: 16/12/2019**

Subject Name: Food Drying & Dehydration

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)** Answer the following: **03**

(i) Define hysteresis.
(ii) List instruments used for moisture measurement of foods.
(iii) Define monolayer moisture content.

(b) Five metric ton of garlic paste having 50% moisture content is dried to yield powder having a moisture content of 6 % (d.b). Calculate **04**

(i) Mass of water evaporated in kg per kg of dry solids
(ii) Moisture content of garlic powder in % (w.b)

(c) Answer the following: **07**

i. What is equilibrium moisture content?
ii. Define water activity.
iii. What factors affect drying rate of foods?
iv. Name some food products which are fluid bed dried?
v. Give at least five applications of drying food.
vi. What is Fourier's law of heat conduction?
vii. Write unit and dimensions of specific drying rate.

Q.2 **(a)** Calculate the resultant water activity of a solution prepared by mixing pure aqueous solutions of 50% sucrose and 50% fructose. [$k_{sucrose}$ = 2.7, $k_{glucose}$ = 0.7, $M_{sucrose}$ =342, $M_{glucose}$ = 180]. **03**

(b) What is Flash Dryer? A flash dryer reduces the moisture content of 5 metric ton wet flour mix from 29% to 6% using hot air at 70 ^{o}C. The ambient air and dryer exit temperatures are 25 ^{o}C and 35 ^{o}C respectively. Calculate **04**

(i) Adiabatic efficiency of dryer (ii) COP of the dryer

(c) Explain the mechanism of drying with the help of drying curves. A pasty food having 55% (wb) moisture content & bulk density of 680 kg/m^3 is drawn into spheres of 2.54 cm diameter. 300 such spheres are transferred to a tray dryer for drying at an air inlet temperature of 70^{o}C. After constant rate drying, the moisture of the product reduces to 15% (wb). Calculate the constant drying rate in kg/h. Assume that the size of the product remains constant during the entire drying period. WBT temperature of air in the dryer is 30 ^{0}C. Take h = 160 W/m^{2}K & h_{fg} of water at 30 ^{0}C = 2129 kJ/kg. **07**

OR

(c) Explain the principle of moisture movement by liquid diffusion method? Prove that falling rate drying is given by, $R = \frac{\Pi^2 M_s D_L X}{4 A x_1^2}$ and the total drying time **07**

is given as, $t = \frac{M_s}{R_c A}\left[(X_1 - X_2) + X_c \ln\left(\frac{X_c}{X_3}\right)\right]$. Treat the symbols to have their usual meanings.

Q.3 **(a)** Explain deep bed drying with the help of a neat diagram. **03**

(b) State the quality attributes of dried food products? Explain the following properties of dried food products: **04**
(i) Rehydration (ii) Porosity (iii) Shrinkage (iv) Texture

(c) Explain the terms briefly: **07**

(i) SMER
(ii) Applications of freeze drying
(iii) Bulk density
(iv) Osmotic dehydration
(v) Types of grain dryers
(vi) Dryer efficiency
(vii) Variation of water activity with temperature

OR

Q.3 **(a)** Describe thin layer drying of foods. **03**

(b) List and explain possible changes in nutritional aspects of food during drying. **04**

(c) Explain briefly: **07**

i. Drum drying
ii. Solar dryers
iii. Need for environment conservation
iv. Critical Moisture content.
v. Recuperative dryers
vi. Role of porosity in grain drying
vii. Green house effect

Q.4 **(a)** State basic measures that can improve dryer performance? **03**

(b) Explain the operation and applications of super heated steam drying with a diagram. Give examples. **04**

(c) Discuss opportunities and challenges of solar drying of foods. **07**
Fermented broth containing 88% moisture content at NTP is to be dried at 67°C to reduce its moisture content to 5% (wb). Calculate the quantity of heat required per unit initial weight of the material for drying under vacuum of 610 mm Hg. The latent heat of vaporization of water at 67°C at saturation pressure of 160 mm Hg absolute is 2290 kJ/kg.
The specific heat of the food is 3.5 kJ/ kg K and that of water is 4.2 kJ /kgK

OR

Q.4 **(a)** Describe the graphical method to determine the moisture diffusivity of foods based on 'time versus moisture content' data obtained during drying. **03**

(b) Give basic steps for design of a simple tray dryer. **04**

(c) Classify fluid bed dryers and explain its operation. Describe characteristics and properties of various groups of dry powders and particulates. **07**

Q.5 **(a)** Describe any one: **03**

(i) LSU dryer with a neat diagram.
(ii) Spray dryer with a neat diagram.

(b) Explain direct and indirect dryers. Give a list of necessary information that is required to select a suitable dryer. **04**

(c) What are the main thermal properties related to drying of foods? Explain parallel, series and Krischer models for determination of thermal conductivity of foods. **07**

OR

Q.5 **(a)** Discuss hybrid and novel drying techniques and their need in food industry. **03**

(b) Give a general classification of dryers. Describe the criteria (checklist) for selection of suitable industrial dryers. **04**

(c) The composition of a certain fruit, densities and thermal conductivities of its components are given below: **07**

S.No.	Component	% Mass	Density (kg/m^3)	Thermal Conductivity (W/mK)
1	Carbohydrate	73	1593	0.23
2	Water	22	996	0.61
3	Protein	2.5	1320	0.21
4	Ash	2	2420	0.36
5	Fat	0.5	918	0.11

Determine the thermal conductivity of the fruit using parallel, series and Krischer models. Take $f_k = 0.3$.

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