

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. [$k_{\text{sucrose}} = 2.7$, $k_{\text{glucose}} = 0.7$, $M_{\text{sucrose}} = 342$, $M_{\text{glucose}} = 180$]. **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 °C. The ambient air and dryer exit temperatures are 25 °C and 35 °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/m³ 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°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 °C. Take $h = 160$ W/m²K & h_{fg} of water at 30 °C = 2129 kJ/kg. **07**
- OR**
- (c)** Explain the principle of moisture movement by liquid diffusion method? Prove **07**
- that falling rate drying is given by, $R = \frac{\Pi^2 M_s D_L X}{4A x_1^2}$ and the total drying time

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 $f_k = 0.3$.
