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

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV (NEW) - EXAMINATION – SUMMER 2017

Subject Code: 2141407 **Date: 12/06/2017**

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 **Answer the following questions:** **14**

1 If m.c. on wet basis is 80%, calculate the % m.c. on dry basis.
2 List measures to improve tray dryer performance?
3 Define monolayer moisture in foods.
4 What is the unit of water activity?
5 Name products which are fluid bed dried.
6 Define hysteresis.
7 Define bulk density.
8 How is water activity expressed mathematically?
9 Write equation for BET model.
10 Give examples of at least 2- hybrid dryers.
11 What is the SI unit of diffusivity?
12 List factors affecting thermal conductivity of foods.
13 List advantages of low temperature drying.
14 Define critical moisture content.

Q.2 **(a)** Explain the following briefly: **03**

(i) Equilibrium moisture content
(ii) Water activity

(b) Five metric tons grapes having an average initial moisture content of 80% are dried to yield raisins having moisture content of 20% (w.b) in 8-hours. Calculate **04**

(i) The mass of water removed in kg.
(ii) Express removed water in terms of per kg of dry matter.
(iii) What is the final moisture content of raisins in % (d.b.)?
(iv) Drying rate in kg/h.

(c) Discuss the significance of water activity in food processing operations and shelf- life studies. A dried food product containing 25g residual water has a water activity of 0.5. Calculate the resultant water activity after 42 g sorbitol (M=182. k = 0.85) is added to the product. **07**

OR

(c) Discuss variation of water activity with temperature. Suggest methods to reduce water activity of foods. Calculate the water activity of 26% NaCl solution.[k_{NaCl} = 15.7], M = 58.5] **07**

Q.3 **(a)** Explain the following briefly: **03**

(i) Super heated steam drying
(ii) Thermal properties of foods

(ii) Agglomeration

(b) Explain thin layer drying of foods giving examples. Give a Model for thin layer drying of foods. **04**

(c) Define specific heat, convection and thermal diffusivity of foods? Calculate the specific heat of water, carbohydrate, protein, fat and ash at 20^0C. Make suitable assumptions and state them. **07**

OR

Q.3 **(a)** Explain the following briefly: **03**

(i) Porosity
(ii) Spray drying
(iii) Drum drying

(b) Explain deep bed drying with the help of a neat diagram. What are its limitations? **04**

(c) Classify fluidized bed dryer and explain the principle and working of fluid bed dryers. State the criterion for their selection. **07**

Q.4 **(a)** Describe Fick's second law of unsteady state liquid diffusion. Explain constant and falling rate drying with the help of graphical representation. **03**

(b) Prove that falling rate drying is given by **04**

$$R = \frac{\Pi^2 M_s D_L X}{4 A x_1^2} .$$

What can be done to reduce drying time?

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

(i) Steps for dryer design.
(ii) Hybrid dryers for foods.

OR

Q.4 **(a)** Explain constant and falling rate drying of foods with the help of drying curves. Explain the principle of moisture movement by diffusion or capillary method? **03**

(b) A food paste having a moisture content of 88% (w.b.) is dried in a flash dryer at a constant rate of 0.320 kg/minute/kg dry matter until it reaches its critical moisture content. Determine the total drying time if it is dried to a final moisture content of 8% (wb). **04**
Take X_c = 1.20 kg/kg dry matter

(c) Explain the following in detail: **07**

(i) Quality attributes of dried food products.
(ii) Dryer performance indices.

Q.5 **(a)** Explain the following briefly: **03**

(i) Dryer COP
(ii) Specific drying rate
(iii) SMEC

(b) Write short notes on the following: **04**

(i) Freeze drying of foods.
(ii) Recuperative dryers.

(c) List desirable attributes of an efficient dryer. Explain and differentiate between direct and indirect fired dryers. State the criteria for the selection of industrial dryers. **07**

OR

Q.5 **(a)** Define ERH. The ERH of a food product having 20% EMC at 25 ^{o}C is 28%. Calculate its water activity. **03**

(b) A tunnel dryer reduces the moisture content of 20 tons of a product from 60% to 15% in 10 hours using hot air inlet at 82 ^{o}C. The atmospheric air and dryer exit temperatures are 20 ^{o}C and 42 ^{o}C respectively. The net heat available for moisture removal in the dryer is 4.0 x 10^6 kJ. Calculate **04**

(i) COP of the dryer
(ii) SMEC of the dryer

Given: Inlet product temperature = 20 ^{o}C,
Sp. Heat of product = 2.8 kJ/kgK,
Latent heat of water vaporization at 42 ^{0}C = 2133 kJ/kg

(c) Discuss the opportunities and challenges of solar drying of foods. Explain the working of LSU dryer with a neat diagram. **07**

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