Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV (New) EXAMINATION – WINTER 2015

Subject Code:2141407 **Date:04/01/2016**

Subject Name: Food Drying and Dehydration

Time: 2:30pm to 5:00pm **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)** Discuss the need for measurement of food moisture. List the methods for measurement of food moisture content? Explain the principle of moisture measurement by gravimetric method. One metric tonne of tomato paste having total solids content of 38% was dried in a drum dryer to yield a dried product of 5% (d.b) moisture content in 1 hour. Calculate the mass of water evaporated in the drying process in kg/h and express it in terms of per kg solids content present in the food. **07**

(b) Discuss the following: **07**

1. Super heated steam drying
2. Importance of thermal properties
3. Shrinkage
4. Spray drying
5. Porosity
6. Drum drying
7. Agglomeration of powders

Q.2 **(a)** Define water activity and state its thermodynamic relevance. How is water activity expressed numerically? State the significance of water activity in food processing operations and shelf- life studies. **07**

(b) What are the main quality attributes of dried food products? What is the importance of studying them? Discuss the importance of colour, texture and rehydration ratio and factors responsible for colour change during drying. **07**

OR

(b) What do you mean by specific heat and thermal diffusivity of foods? Calculate the specific heat of Water, Carbohydrate, Protein, Fat and Ash at 30^0C. Make assumptions if required and state them. **07**

Q.3 **(a)** Differentiate between direct and indirect dryer and give examples of each. Explain any one in detail. Give the main criteria for selection of industrial dryers. **07**

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

1. Rehydration ratio
2. Advantages of food drying.
3. Mechanism of transport of moisture in porous foods.
4. Thermal properties of food.

OR

Q.3 **(a)** Explain the working of fluid bed dryers. Also list out the classification of fluidized bed dryer based on different criteria. **07**

(b) Differentiate between sun drying and mechanical drying and state their advantages and disadvantages. Discuss working of LSU dryer with a neat diagram. **07**

Q.4 **(a)** Define equilibrium moisture content and state its significance in establishing shelf-stability of foods. How does EMC vary with temperature? Describe any one moisture sorption isotherm model and state its applications and limitations. The ERH of a food product having 20% EMC at 25 ^{o}C is 28%. Calculate its water activity. **07**

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

(i) Basic steps for dryer design.
(ii) Heat utilization factor of dryers.
(iii) Hybrid dryers for foods
(iv) Freeze drying of foods

OR

Q.4 **(a)** Describe Fick's second law of unsteady state liquid diffusion. Explain constant and falling rate drying. Demonstrate that drying rate during falling rate drying is given by R = $\frac{\Pi^2 M_s D_L X}{4 A x_1^2}$. Write down the nomenclature of the symbols in this expression and mention their SI units. How can you reduce drying time? **07**

(b) A dryer reduces the moisture content of 1 metric ton corn from 15% to 10% in 10 hours using hot air at 90 ^{o}C. The ambient air and dryer exit temperatures are 30 ^{o}C and 49 ^{o}C respectively. The net heat available for moisture removal in the dryer is 3.3 x 10^5 kJ. Calculate **07**

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

[Inlet temperature of corn = 30 ^{o}C, Sp. Heat of corn = 2.8kJ/kgK, h_{fg} of water at 49 ^{0}C = 2230 kJ/kg]

Q.5 **(a)** Explain the principle, mechanism and applications of thin layer drying of foods. Name and write down widely accepted drying kinetics models for thin layer drying. **07**

(b) Write explanatory notes on the following: **07**

(i) Hybrid dryers and their relevance for foods.
(ii) Dryer efficiency and need for energy conservation.
(iii) Need for environment conservation.
(iv) Specific energy consumption

OR

Q.5 **(a)** Write meaningful notes on the following: **07**

(i) Dryer efficiency and COP.
(ii) Measures to improve dryer efficiency
(iii) Recuperative dryers
(iv) Specific drying rate
(v) Design considerations for a fluid bed dryer

(b) Explain the construction and mechanism of deep bed drying of grains with a neat diagram. Explain the variation of moisture with bed depth for different inlet air velocities. State practical techniques that can help decrease the drying time. **07**

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