GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER–IV(NEW) – EXAMINATION – SUMMER 2019

Subject Code:2141407   **Date:25/05/2019**
Subject Name: Food Drying & Dehydration
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)**	Answer the following:	**03**
		(i) Why are foods dried?	
		(ii) List methods of moisture measurement.	
		(iii) Define multilayer moisture content.	
	(b)	How do you express moisture content on dry basis? One metric tonne of tomato paste having total solids content of 30% was dried in a foam mat dryer to yield dried flakes of 6% (d.b) moisture content in 70-minutes. Calculate the rate of drying in kg/h and express your answer in terms of per kg solids.	**04**
	(c)	Discuss any two of the following in detail:	**07**
		(i) Drum drying and its applications	
		(ii) Steps for dryer design.	
		(iii)Factors affecting drying rate of foods.	

Q.2	**(a)**	Define EMC and water activity and write mathematical expressions for each.	**03**
	(b)	Explain moisture sorption isotherms and hysteresis phenomenon with the help of a neat duagram. Calculate the water activity of 40% glucose solution. [$k_{glucose}$ = 0.7, M for glucose = 180].	**04**
	(c)	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? Prove that falling rate drying is given by	**07**

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

OR

	(c)	State the quality attributes of dried food products? Explain the following properties of dried food products:	**07**
		(i) Rehydration (ii) Colour (iii) Shelf-life (iv) Texture	

Q.3	**(a)**	State Fick's second law of unsteady state liquid diffusion.	**03**
	(b)	Define specific heat, thermal conductivity and diffusivity of foods? Why is it needed to measure them?	**04**
	(c)	Explain critical moisture content with the help of a diagram and state its importance. A food slurry having an initial moisture content of 78 % (w.b) is dried in two stages. First it is dried at a constant rate of 0.22 kg/minute/kg dry matter up to its critical moisture content of 1.19 kg/kg dry matter and then further dried to a final moisture content of 5% (w.b). Calculate the total drying time.	**07**

OR

Q.3	**(a)**	Explain the following briefly: (i) Specific drying rate (ii) Dryer COP	**03**

(b) A 88 μm diameter spherical droplet of malto-dextrin of 950 kg/m^3 density is fed to a spray dryer where it is dried from initial m.c. of 40% (w.b) to 5% (w.b). The inlet drying air temperature is 185 °C and its WBT is 80 °C. The convective heat transfer coefficient is 280 W/m^2/K and the latent heat of vaporization of water at 80 °C is 2489 kJ/kg. Calculate the drying rate and drying time. **04**

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

    (i) Dryer efficiency.
    (ii) Specific energy consumption.
    (iii) Sun drying.
    (iv) Porosity.
    (v) Bulk density
    (vi) Low temperature drying
    (vii) Monolayer moisture content

Q.4 (a) Describe thin layer drying and state the operating factors affecting drying rate. **03**

(b) Explain the operation and applications of super heated steam drying. **04**

(c) Write notes on any two of the following: **07**

    (i) Energy conservation.
    (ii) Fourier's law of heat conduction.
    (iii) Recuperative dryers.

OR

Q.4 (a) Explain deep bed drying with the help of a neat diagram. What are its limitations? **03**

(b) Write short notes on the following: (i) Hybrid dryers (ii) Flash dryers **04**

(c) Explain the operation and applications of fluid bed dryers in food industry. Describe characteristics and properties of various groups of dry powders and particulates. **07**

Q.5 (a) A tunnel dryer reduces the moisture content of 1ton of sorghum millet from 76% to 15% in 10 hours using hot air at 70 °C. The ambient air and dryer exit temperatures are 30 °C and 35 °C respectively. The heat available for moisture removal in the dryer is 4.2 x 10^6 kJ. Calculate **03**
(i) COP of the dryer (ii) SMEC of the dryer
Given: Inlet temperature of sorghum = 30 °C,
Sp. Heat of sorghum = 2.66 kJ/kgK,
h$_{fg}$ of water at 35 ^{0}C = 2110 kJ/kg

(b) Explain parallel and series models for determination of thermal conductivity of foods. **04**

(c) Classify dryers. Describe in detail the criteria for selection of industrial dryers. List and discuss desirable attributes of an industrial dryer. **07**

OR

Q.5 (a) Explain freeze drying of foods with examples. **03**
(b) Discuss new and emerging drying techniques and their need in food industry. **04**
(c) List different methods for grain drying. Describe LSU dryer with a neat diagram. **07**

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