Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VI • EXAMINATION – SUMMER 2013

Subject Code: 161404 **Date: 03-06-2013**

Subject Name: Food Drying and Dehydration

Time: 10.30 am - 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)** What do you mean by equilibrium moisture content (EMC)? Mention the importance of EMC and with help of graphical representation (Moisture content dry basis versus Relative humidity) show EMC, Free moisture, Bound and Unbound moisture. **05**

(b) The initial moisture content of a food product is 75% (wet basis), and the critical moisture content is 40% (wet basis). If the constant drying rate is 0.2 kg $H_2O/(m^2s)$, compute the time required for the product to begin the falling rate drying period. The product has a cube shape with 6-cm sides, and the initial product density is 850 kg/m^3. **05**

(c) How much water must be added to potato granules containing 10% moisture (dry basis) to give a final mass of 50 kg with a moisture content of 80% (wet basis)? **04**

Q.2 **(a)** Estimate the time necessary to dry dates from 75% to 20% moisture content (on wet basis) under constant external conditions. Under the conditions of the process, falling rate regime is known to prevail during drying. Linear relation between drying rate and residual moisture is assumed. The initial drying rate (when the moisture content of the dates is 75%) is 0.5 kg water removed per kg dry matter per hour. The moisture content of the dates at equilibrium with the drying air is 8% (wet basis) and the drying surface is 0.81 m^2 per kg of dry matter. **07**

(b) What do you mean by deep bed drying of food grains? With help of a schematic diagram, explain the deep bed drying of food grains and write the equations for the time of advance of drying front and decreasing rate period along with total drying time, indicating each variable with proper units. **07**

OR

(b) What do you mean by thin layer drying? Derive the expression for time of drying in a thin layer indicating each variable with proper units. And draw a typical drying rate curve between rate of drying versus free moisture content (% dry basis) clearly showing first falling rate, second falling rate, critical moisture content and equilibrium moisture content. **07**

Q.3	**(a)**	Explain briefly the followings terms (i) Super heated steam drying (ii) Fluidized bed drying (iii) Osmotic dehydration (iv) Flash drying	**06**
	(b)	Classify different types of dryer based on following criterion: Mode of operation, Heat input type, State of material in dryer, Operating pressure, Drying medium (convection), Drying temperature, Relative motion between drying medium and drying solids and Number of stages.	**04**
	(c)	What are the minimum quantitative informations necessary for selection of an industrial dryer?	**04**

OR

Q.3	**(a)**	With help of a labeled diagram, explain the construction and working of a single- stage spray dryer.	**06**
	(b)	What do you mean by rehydration ratio? A dried food powder has a particle density of 1228 kg/m^3 and a bulk density of 700 kg/m^3. What is the inter-particle voidage of the powder bed?	**04**
	(c)	Give a typical example of possible energy saving method in drying processes applied in food industries. How solar drying technique helps in environment conservation?	**04**
Q.4	**(a)**	What are the three principal stages in a freeze drying process? Briefly explain each stage.	**06**
	(b)	What do you mean by hybrid drying techniques? Explain briefly with a suitable example.	**03**
	(c)	Explain different physical quality characteristics of dried fruits and vegetables.	**05**

OR

Q.4	**(a)**	Write basic design steps for (Any one). (i) Tray dryer (ii) Vacuum dryer	**06**
	(b)	List out few (at least three) novel drying techniques with an example of a food product which is dried on that technique.	**03**
	(c)	How drying affect the water activity, shelf - life and microbial quality of a food product? Explain.	**05**
Q.5	**(a)**	Drying is a simultaneous heat and mass transfer operation. Justify the statement.	**03**

(b) Briefly explain different mechanisms of moisture transport within solids during the process of drying. **07**

Determine the equilibrium moisture content (in % w.b) of sorghum at a relative humidity of 50% and temperature of 60°C using Hendersonôs equation. Product constants are $C = 3.5 \times 10^{-4}$ and $n = 2.25$.

(c) Mention the importance of drying of agricultural produce. Estimate the quantity of wheat with 22% moisture content on wet basis required to produce 10 tonnes of product with 13 % moisture content dry basis. **04**

OR

Q.5 **(a)** Briefly explain the phenomena of hysteresis in drying of food grain with help of a typical sorption isotherm. Name the hypothesis which duly explains the reason for hysteresis. **03**

(b) Define thermal diffusivity with help of a mathematical expression indicating each term with proper units. **07**

Determine the value of C and n from Hendersonôs equation for the following data:

Relative humidity (%)	Temperature (°C)	Equilibrium Moisture content (% wet basis)
60	50	7
80	50	10

(c) Calculate the amount of moisture evaporated from one tonnes of parboiled paddy with 40% (d.b) moisture content to final milling moisture content of 14% (w.b). **04**

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