Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER– VI• EXAMINATION–SUMMER 2015

Subject code: 161404 **Date:14/05/2015**

Subject Name: Food Drying and Dehydration

Time: 10:30 am to 01:00 pm **Total Marks: 70**

Instructions:

I. Attempt all questions.
II. Make suitable assumptions wherever necessary.
III. Figures to the right indicate full marks.

Q.1 **(a)** A composition of a typical fruit and densities at 25^0C are **07**

Components	Weight (%)	Density (kg/m^3)
Carbohydrate	72.9	1592.9
Water	22.5	995.7
Protein	2.2	1319.6
Fat	0.5	917.15
Ash	1.9	2418.2

Calculate the thermal conductivity of fruit by Parallel, Series and Krisher model. Distribution factor is 0.80.

(b) Discuss different types of food moisture. State the methods for measurement of moisture in foods. Explain how moisture is measured by Karl-Fisher titration. Hundred metric tons of freshly grated raw onion flakes having an average initial moisture content of 85% was dried in a spin flash dryer in two stages to produce dehydrated onion powder having moisture content of 5 (% d.b). Calculate the total mass of water driven out during the process in kg and express this in terms of per kg of dry matter in onions. **07**

Q.2 **(a)** Give the advantages and limitations of Superheated Steam Drying (SSD). Discuss the basic principle of SSD also mention the factors contributing to the feasibility of SSD. **07**

(b) Differentiate between drying and dehydration. List out advantages of drying. What are two processes occurs simultaneously when wet solid is exposed to thermal drying. **07**

OR

(b) Define water activity and explain its thermodynamic basis. The following EMC data are given for a dry food at a given temperature: **07**

EMC (g water /g product)	a_w - values
0.235	0.8
0.175	0.7
0.15	0.6
0.125	0.5
0.12	0.4
0.10	0.3
0.08	0.2
0.06	0.1

(i) Develop a neat plot of equilibrium moisture isotherm for moisture content on % dry basis and % wet basis.
(ii) Predict % dry and wet basis EMC values for a_w values of 0.35 and 0.58.

Q.3 **(a)** Discuss the mechanism of transport of moisture during drying. List out the unique features **07**

of drying.

(b) With the help of neat 'moisture content' versus 'water activity plot', explain different types of moisture sorption isotherms and hysteresis phenomenon. Calculate the resultant water activity of a solution prepared by mixing pure solutions of 50% sucrose with 50% fructose. [$k_{sucrose}$ = 2.7, $k_{glucose}$ = 0.7, $M_{sucrose}$ =342, $M_{glucose}$ = 180]. **07**

OR

Q.3 (a) What are the parameters required for the selection of fluidized bed dryer? Discuss the characteristics and properties of various types of dryers. **07**

(b) Explain the mechanism of mass transfer by capillary action and liquid diffusion during drying of foods. With the help of neat drying kinetics plots explain constant and falling rate drying. Show that the drying time for constant rate drying can be expressed as $t = \frac{M_s}{R_c A}\left[X_1 - X_2\right]$. State what do the symbols in this expression stand for? **07**

Q.4 (a) Discuss the followings in brief; **07**

1. Importance of thermal properties
2. Fourier's law of heat conduction
3. Thermal diffusivity
4. Selection of dryers

(b) Explain in detail the concept, mechanism, modes and applications of thin layer drying of foods. Name some of the widely accepted drying kinetics models applicable to thin layer drying. **07**

OR

Q.4 (a) List out the criteria for selection of typical dryer. Discuss direct and indirect dryers in details. **07**

(b) Explain constant and falling rate drying of foods with the help of drying kinetics plots. Explain the mechanism of mass transfer during falling rate drying of hydrophilic foods like starches etc. A 200 μm diameter spherical droplet of concentrated milk of 850 kg/m^3 density is injected into a spray dryer where its moisture content reduces from 45% (w.b) to 6% (w.b). The inlet drying air temperature is 185 ^oC and its WBT is 60 ^oC. The convective heat transfer coefficient is 250 W/m^2/K and the latent heat of vaporization of water at 60 ^oC is 2359 kJ/kg. Calculate the following assuming that drying occurs at constant rate: **07**

(i) Drying rate in kg H_2O/s
(ii) Drying time in seconds.

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

1. Hybrid dryers and their relevance for foods.
2. Dryer efficiency and need for energy conservation

(b) Explain deep bed drying in detail with the help of a neat diagram. Explain the variation of moisture content versus bed depth for different temperature and air velocities. Mention the factors that would affect the drying time for such drying operations. **07**

OR

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

(i) Dryer performance indices.
(ii) Basic steps for dryer design.
(iii)

(b) Give the working principle of tray dryer and vacuum dryer with diagram. **07**

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