Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV • EXAMINATION – SUMMER • 2014

Subject Code: 141405 **Date: 25-06-2014**

Subject Name: Principles of Food Engineering

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)** Explain the law of conservation of energy in process unit operations and write expressions in terms of inflow, outflow and accumulation for steady and non- steady state operations. Tomato puree input @ 1000 kg/h is being cooled in a shell and tube heat exchanger from 92 ^{o}C to 20 ^{o}C. If the specific heats of water and tomato puree are 4.186 kJ/kgK and 2.85 kJ/kgK respectively, calculate the cooling water flow requirement in kg/h if cooling water temperature rise is to be limited to 10 ^{o}C. **07**

(b) Fresh orange juice with 12% soluble solid content is concentrated to 60% in a three effect evaporator. To improve the quality of the final product the concentrated juice is mixed with an amount of fresh juice so that the concentration of mixture is 42%. Calculate how much water per hour must be evaporated in the evaporator, how much fresh juice per hour must be added back and how much final product will be produced if the inlet feed flow is 10000 kg/h fresh juice **07**

Q.2 **(a)** Define food and explain its functions. Enumerate different factors responsible for food spoilage and explain in perspective any one in detail. **07**

(b) Explain the role of plastics as a food packaging material and mention the prescribed precautions while using plastics in food industry. **07**

OR

(b) Discuss important characteristics of glass and metals as packaging material and state their suitability for food processing and packaging applications. **07**

Q.3 **(a)** List out different engineering properties of food materials. Explain roundness, sphericity and purpose of studying their physical properties. **07**

(b) Explain the following in brief: Law of conservation of mass, Specific heat, Apparent density, True density, Material density, Apparent density and Bulk density. Give their SI units. **07**

OR

Q.3 **(a)** Differentiate between convection and conduction? Derive an expression for heat transfer in a multilayered system of cylinder and also demonstrate its electrical resistance analogy. **07**

(b) What do you understand by rheological properties of food products? Explain Adhesiveness, Cohesiveness, Chewiness, Gumminess and Hardness. **07**

Q.4 **(a)** State the purpose and methodology of food irradiation and mention the criteria to determine its dosage for different foods. **07**

(b) Discuss the factors affecting thermal resistance of micro-organisms. **07**

OR

Q.4 **(a)** Explain the concept of water activity in reference to shelf-life of food products and give some examples. **07**

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

a) Food Processing by heat application.
b) Thermal Death Time of Bacterial Cells.

Q.5 **(a)** Differentiate between drying and evaporation and give examples for each. 50 kg of Cottage Cheese having a typical average heat transfer area of 1 m^2 is to be dried from 50 % moisture content to 20 % moisture content by using hot air at a temperature of 150 ^oC. Calculate the drying rate in kg/h and the drying time in hours. The surface temperature of the product is at 40 ^oC and the latent heat of vaporization (h_{fg}) at 40 ^oC is 2407 kJ/kg. Take h = 12 W/m^2 K. **07**

(b) Briefly explain the following giving examples: **07**

(i) Distillation (ii) Water activity (iii) Aseptic Processing.
(iv) Steam economy (iv) Leaching (v) Enthalpy.
(vii) Rheological properties

OR

Q.5 **(a)** Define drying and state its purpose in food processing. Enumerate some of the dryers used in food industries. A thin sheet of mango pulp weighing 1 kg having 1 m^2 heat transfer area is to be dried from 65% moisture content to 10% moisture content by convective hot air drying at 160 ^oC. The drying set up offers a convective heat transfer coefficient of 8 W/m^2 K. The surface temperature of the sheet is maintained at 40 ^oC and the latent heat of vaporization (h_{fg}) at 40 ^oC is 2407 kJ/kg. Calculate the following: **07**

(a) Mass of the dried product in kg.
(b) Drying rate in kg/minute
(c) Drying time in minutes.

(b) Write short notes on the following giving examples: **07**

(i) Evaporation (ii) Specific steam consumption (iii) Extraction.
(iv)Homogenization (v) Multiple effect evaporators
(vi) Leaching (vii) Centrifugation.

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