

**GUJARAT TECHNOLOGICAL UNIVERSITY****B.E. Sem-IV Examination June- 2010****Subject Code: 141405****Subject Name: Principles of Food Engineering****Date: 21 /06 /2010****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.
4. Avoid cutting/over writing

- Q.1** (a) Discuss with applicable examples the effect of the following parameters on spoilage of foods: **07**  
(i) Temperature (ii) Moisture (iii) Micro-organisms (iv) Enzymes (v) Oxygen (vi) Light (vii) Macro-organisms.
- (b) A retort carrying 2000 cans of Tuna fish has been heated to a uniform temperature of 116 °C. It is desired to cool the cans to 35 °C before removing them from the retort. How much cooling water is required if it enters the retort at 20 °C and leaves at 30°C. Given that: Specific heat of Tuna fish ( $C_p$ ) = 3.65 kJ/kg °C, Specific heat of the can wall = 0.46 kJ/kg °C, Specific heat of water = 4.18 kJ/kg °C, Mass of Tuna fish/can = 450g, Energy required to cool retort = 75000 kJ and mass of can wall/can = 55g. **07**
- Q.2** (a) Discuss the concept of water activity in food products and express it in appropriate mathematical expressions. A dry product having 7.5% (w.b.) moisture content was exposed to 30% RH, 15 °C environment for 5 hours without any weight change. The product was later transferred to a 50% RH, 15 °C environment, kept for 5 hours where its moisture content became 17.5% (w.b.). Calculate the water activity of the product in the first and second environments. **07**
- (b) 1000 kg of a fresh fruit mango juice with 10% solids is freeze concentrated to 40% solids. Freeze concentration involves feeding the fresh juice to a freezer where ice crystals are formed, separating the slush in a centrifugal separator into ice crystals and concentrated juice and recycling the concentrated juice from the separator to the freezer till the desired concentration of juice is achieved. Draw a material and process flow diagram clearly indicating various streams for the above process and calculate the amount of ice that is removed in the separator and the amount of concentrated juice produced. **04**
- (c) List out different dimensionless numbers used in convective heat transfer. Also write the same in the form of a dimensionally balanced empirical equation. **03**

**OR**

- (b) Calculate the total mass balance and component balance for mixing of ingredients to make 25 kg of beef sausages having a fat content of 30%. The sausages is to be made by mixing of beef meat containing 18% protein, 12% fat and 68% water and beef fat containing 78% fat, 12% water and 5% protein. Draw a process diagram showing material flow streams. **04**

- (c) Prove that  $MC_{db} = \frac{MC_{wb}}{1 - MC_{wb}}$ . A food is initially at a moisture content of 90% dry basis. Calculate the moisture content on wet basis. 03

- Q.3** (a) Describe the hysteresis of moisture sorption isotherm. Calculate the water activity of a fruit bar containing 76% soluble solids, 4% insoluble solids and rest water. The soluble solids present are 50% sucrose and 50% glucose. Given that :  $k_{\text{sucrose}} = 2.7$ ,  $k_{\text{glucose}} = 0.7$ ,  $M_{\text{sucrose}} = 342$ ,  $M_{\text{glucose}} = 180$ . 07
- (b) Explain the terms ‘pasteurization’ and ‘sterilization’ w.r.t. food products. What do you understand by ‘commercially sterile’? A food product containing  $10^6$  spores of a certain microorganism having a D-value of 1 minute at 121.1 °C is uniformly heated at a constant temperature of 121.1 °C. Calculate the heating time which would yield a residual probability of spoilage of 1/10000 (0.01%). 07

**OR**

- Q.3** (a) Show graphically how do bacterial, yeast and mold growth and activity vary with water activity of foods. What % content of NaCl in water would give the same water activity as a 20% aqueous solution of sucrose? 07  
Given that:  $k_{\text{sucrose}} = 2.7$ ,  $k_{\text{NaCl}} = 15.8$ ,  $M_{\text{sucrose}} = 342$ ,  $M_{\text{NaCl}} = 58.5$ .
- (b) Differentiate between blanching and cooking of food products. What is UHT sterilization? A food product containing  $10^7$  spores of a certain bacteria is heated uniformly at 122 °C for 20 minutes so that the spore population is reduced to  $10^{-4}$ . Calculate the decimal reduction time (D) in minutes and the associated rate constant (k) for the bacterial spore inactivation. 07
- Q.4** (a) Explain the following: (i) Counter flow (ii) Parallel flow (iii) Distillation (iv) Evaporation 06
- (b) A 2 cm thick steel pipe is being used to convey steam from a boiler to process equipment for a distance of 40 m. The inside pipe surface temperature is 115 °C and the outside is 90 °C. Calculate the total heat loss to the surroundings and the steady state heat conduction through the pipe wall. 05
- (c) What do you mean by drying? List out different advantages of drying. 03

**OR**

- Q.4** (a) Derive an expression for conductive heat transfer through a multi-layered slab system. 04
- (b) Write short notes on: (i) Mixing type dryer (ii) Non-mixing type dryer (iii) Deep bed dryer 06
- (c) What is convective heat transfer? List out different types of convective heat transfer media with respect to its heat transfer coefficient. 04
- Q.5** (a) What kind of nuclear radiations are commonly employed for food preservation? Mention possible undesirable effects of high dose of irradiation on foods. 04

(b) What are the requirements of effective packaging of food products? What is 'form-fill-seal' packaging? Mention some of its applications in food packaging. 04

(c) Define rheological properties. State with the help of a graph what is bio-yield point, rupture point and adhesiveness. 06

**OR**

**Q.5** (a) What is meant by radiation processing of foods? What dose-determining factors are considered while selecting the magnitude and type of radiation treatment of foods? 04

(b) What are different packaging materials used in food industry? Mention at least five plastic based packaging materials suitable for food products. 04

(c) Explain the following: (i) Roundness (ii) Sphericity (iii) Roundness ratio (iv) Density 06

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