Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE SEMESTER-IV EXAMINATION – SUMMER 2015

Subject Code:141405 **Date: 08/06/2015**

Subject Name: Principles of Food Engineering

Time:10.30am-01.00pm **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) A retort is loaded with 2000 sealed cans containing flavored milk and then heated uniformly to a temperature of 121 ^{0}C for 25 minutes. The cans and its contents were then cooled to 27 ^{0}C in the retort itself by passing cooling water into the retort. Calculate the amount of cooling water required for the said purpose if it enters at 17 ^{0}C and leaves at 30 ^{0}C. The following information is available: **07**

Specific heat (empty can metal) = 1.84 kJ/kgK
Specific heat (Flavoured milk) = 3.92 kJ/kgK
Specific heat (water) = 4.186 kJ/kgK
Mass of one empty can = 60 g
Mass of flavoured milk in each can = 250 g
Heat required to cool retort from 121 ^{0}C to 27 ^{0}C ^{0}C = 85000 kJ

(b) Explain the law of conservation of mass and energy applied to food engineering unit operations. Write energy balance equations in terms of inflow, outflow and accumulation. Concentrated Apple juice containing 20% sugar is flowing through a pipeline @2 kg/s is being sweetened by constantly adding aqueous sugar solution (56% w/w) to the pipe line. What would be the rate of addition of this sugar solution so as to yield an apple juice containing 15% w/w added sugar at the outlet of the pipe? **07**

Q.2 (a) Write brief notes on the following giving related examples: **07**

(i) Leaching (iii) Crystallization
(i) Homogenization (iv) Centrifugation
(vi) Sieving (vi) Aseptic packaging of foods
(ii) Distillation

(b) Differentiate between drying and evaporation of food by giving some examples. Draw a labeled flow diagram of a single effect falling film evaporator indicating various streams. A falling film evaporator is concentrating tomato juice from 5% solids to 72% moisture content to make tomato paste. The feed flow rate to the evaporator is 2000 kg/h and the steam consumption is 750 kg/h at 9bar. Calculate: **07**

(i) Tomato paste output rate in kg/h
(ii) Water evaporation rate in kg/h
(iii) Steam economy and specific steam consumption

OR

Q.2 (b) Define the following terms and write their SI units: **07**

(i) Water activity (ii) Latent Heat
(iii) Specific heat at constant volume (iv)Thermal conductivity

Determine the amount of cooling water required to cool pasteurized ice-cream mix from 87 ^{o}C to 17 ^{o}C flowing in a cross-flow heat exchanger @ 200 kg/h. The permitted increase in the temperature of the cooling water is 10 ^{o}C. The specific heats of the ice-cream mix and water are 4.85 and 4.18 kJ/kg K respectively.

Q.3 (a) Explain the physiological and social functions of food citing examples. **07**

(b) Enlist and explain the physical factors which cause the spoilage of foods. Suggest measures for protecting such spoilage. **07**

OR

Q.3 (a) State reasons for food spoilage. Enlist various techniques of food preservation and explain any one in detail. **07**

(b) Explain the following with examples: **07**

(i) Aseptic packaging of foods.
(ii)Use of plastic and metals for packaging of foods.
(iii) Form Fill Seal machines.

Q.4 (a) Explain the need and methodology to determine the radiation doses for irradiation of specific foods. What kind of nuclear radiations are commonly employed for food preservation? **07**

(b) State the objectives of food packaging and illustrate the requirements for effective food packaging. What is smart packaging? **07**

OR

Q.4 (a) Explain modes of heat transfer in food processing. A cold room wall of size 5m x 3m is constructed from 25 cm thick concrete. Thermal insulation is provided on the inside of the wall as glass wool to limit the heat transfer rate through the wall below 650 W. If the temperature outside the wall is 37 ^{o}C and the inside temperature needs to be maintained at -3 ^{o}C, determine the thickness of the insulation material required. Take thermal conductivities of concrete and glass wool are 1.4 and 0.03 W/m K respectively. **07**

(b) Define rehological properties of foods. What are Explain the following: **07**

(i) Roundness (ii) Sphericity (iii) Roundness ratio
(iv) Bulk density (v) Cohesiveness

Q.5 (a) What is 'Thermal Death Time'? Discuss the importance of thermal death time in food preservation. Discuss the factors affecting thermal resistance of micro-organisms. **07**

(b) Explain the concept and significance of water activity in food processing. How is water activity expressed mathematically? Discuss the relationship between the water activity and shelf life of food. Mention some methods of reducing water activity in foods with examples. **07**

OR

Q.5 **(a)** Mention various nutrients present in food products and state their specific functions. What measures would you suggest to prevent loss of these nutrients during processing? **07**

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

(i) Food processing by heat application
(ii) Heat transfer coefficient
(iii) Controlled atmosphere storage for fruits and vegetables
(iv) Angle of repose
(v) True density
(vi) Apparent density
(vii) US mesh

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