Ref. No. EX/FTBE/T/321/2018

B.E (FTBE) 3RD YEAR, 2ND SEMESTER EXAM 2018

FOOD PROCESS ENGINEERING TIME: 3 H FULL MARKS = 100

PART- I (50 MARKS)

USE SEPARATE ANSWER SCRIPT FOR EACH PART

Answer **Q1** and **any Two** from the rest

Q1. Answer either (a) or (b) in this block.

(a) Describe the following (any 1): $1 \times 5 = 5$

I. Thermice process
II. Temperature profiles of Freezing and Thawing in block freezing

(b) Define the following (any 2): $2 \times 2.5 = 5$

I. Refrigeration load
II. Dimensionless numbers in Cleland-Earle modification of Plank equation
III. Dimensionless freezing time

Q2. Differentiate between (any 2): $2 \times 5 = 10$

a. LN Batch Freezer and Continuous LN freezer
b. POLARSTREAM and PELICAN systems
c. Determination of Static and Dynamic angles of repose for food grains

Q3. Explain any two from (a), (b) and (c) in this block. $5 + 5 = 10$

(a) Complete thawing is not preferred for a food product undergoing processing.
(b) Influence of moisture content of seeds on their terminal velocity inside an air column.
(c) Limitations of Planck equation.

Q4. Answer any one from (a) and (b) in this block.

(a) Illustrate diagrammatically two models of industrial spiral belt freezers. 5

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(b) Diagrammatically illustrate the freezers you would use to freeze **2 × 2.5 = 5**

i) A crate of apples
ii) Sausage packages

Q5. Answer any two from (a), (b) and (c) in this block.

a) A continuous plate-freezer is used to freeze 0.5 Kg cod fillet packages at a rate of 500 Kg/h. The package dimensions are 0.04 m by 0.1 m by 0.14 m which enters the freezer at 5°C. Each freezing station or compartment is 1 m wide and can accommodate 8 packages of the above dimensions. The plates have a surface heat transfer co-efficient of 28 W/m^2K and are maintained at a temperature of -30°C. Compute the number of freezing stations (or compartments) required for freezing the product to -25°C by **Mott procedure**. Use standard tables and charts and make assumptions, if necessary with justifications. **10**

b) 1.030 Kg of cod fish fillets of dimensions 7 cm × 2 cm × 2 cm are frozen in an air blast freezer with the air damper kept half closed. The air velocity is in the range of 2-10 m/s. It was noted that the fish required 12 min to reach a surface temperature of -20°C from 33°C. A thermocouple inserted into the core of the fish muscle recorded -20°C after an additional 5 min. Determine the time of freezing of the cod fillets using Planck equation. Take remaining data from tables and appendices and make justified assumptions wherever necessary. Compare the calculated freezing time obtained with the experimentally obtained actual freezing time and account for reasons of discrepancy, if any.

Apply **Nagoaka method** for the above problem and compare the freezing time obtained by both methods. **4 + 1 + 4 + 1 = 10**

c) A 0.4 m thick slab of tuna fish at 27°C is transported in a refrigerated truck. The ambient temperature inside the truck is 2°C. Determine the time required to freeze the slab of tuna to - 4.4°C. **Use Gurnie-Lurie chart and Tao chart** and compare the freezing time obtained by both methods. Given: K_{fish} = 5.21 cal/hcm^2°C, h_{air} = 1.95 cal/cm^2°C, Cp_{fish} = 0.85 cal/g°C, ρ_{fish} = 1.04 g/cc; take remaining data from tables and appendices and make justified assumptions wherever necessary. **4 + 5 + 1= 10**

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B.E. FOOD TECHNOLOGY AND BIO-CHEMICAL ENGINEERING THIRD YEAR SECOND SEMESTER EXAM 2018

Subject - FOOD PROCESS ENGINEERING **Time-3 hr** **full marks-100**

PART-II (50 MARKS)

Use separate answer script for each part

(Answer question no 1 or 2 and 3 or 4)

(Part of Steam table and psychometric chart will be supplied)

1. In a fluidized bed dryer air which is entering has a temperature of 50^0 C and a dew point of 21^0 C. determines actual humidity, percentage humidity, humid heat and humid volume. (10)
2. Air temperature entering inside the spray dryer and mixing with liquid milk is more than 240^0C but color detoreation of milk powder was not visible - explain. Discuss different parts of spray dryer and there function. (4+6=10)
3. a) Beans (spherical shape) are dried in a pan 0.45 m x 0.45 m and 25.4 mm deep. The material is 25.4 mm deep in the pan, and the sides and bottom can be considered to be insulated. Heat transfer is by convection from an air stream flowing parallel to the surface at a velocity of 5.8 m/s. the air is at 62.6^0 C and has a humidity of 0.011 kg H_2O/ kg dry air. Estimate the rate of drying for the constant rate period using. (20)
   b) Derive an equation for calculation of drying time in freeze drying. What do you mean by geometry factor in bed? (16+4=20)
4. a) A continuous countercurrent dryer is being used to dry 500 kg dry solid/ h containing 0.045 kg total moisture/ kg dry solid to a value of 0.0021 total moisture/ kg dry solid. The granular solid enters at 30^0 C and is to be discharged at 65^0C. The dry solid has a heat capacity of 1.45 KJ/Kg.K, which is assumed constant. Heating air enters at 90^0 C, having a humidity of 0.011 kg H_2 O/ kg dry air, and is to leave at 37^0 C. Calculate the air flow rate and the outlet humidity, assuming no heat losses in the dryer. (20)
   b) Derive an equation for predicting constant rate dryer in tray dryer. Why we should increase the diameter of cone used in a fluidized bed dryer. (16+4=20)