Ref. No. EX/FTBE/T/321/2017

B.E (FTBE) 3RD YEAR, 2ND SEMESTER EXAM 2017

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. a. 1.030 Kg of par-fried potatoes of dimensions (7 cm × 1 cm × 1 cm) are frozen in an air blast freezer with the air damper kept half closed. The air velocity range is 2-10 m/s. It was noted that the potatoes required 12 min to reach a surface temperature of -20°C from 33°C. A thermocouple inserted in the core of the potato fries recorded -20°C after an additional 5 min. Determine time of freezing of the par-fried potatoes using Planck equation. Take remaining data from tables and appendices provided and make assumptions, wherever necessary, providing appropriate justification. (Assume ρ_{potato} = 956 Kg/m^3). Compare the freezing time obtained above with the actual freezing time and account for reasons of discrepancy if any. **4 + 3**

b. Heat penetration curve is plotted for a canned green beans processed in a retort at 240°F. It took 5 min from the introduction of steam to the time the retort reached 240°F. If the initial product temperature was 140°F and steam was introduced into the retort for 30 min, determine the F_0 value by Stumbo's procedure taking data from relevant tables and graphs (consider simple heating curve). Given: heating and cooling curves parameters f_h = f_c = 22 min; J_h -= 1.2 and J_c = 1.6. Consider z value for *Clostridium botulinum* type B. **7**

c. What is refrigeration load? How is respiration load of fruits and vegetables in cold storage calculated? **1 + 2**

d. Why is lag time of microbial growth not considered in calculating lethal value of a sterilization process? **3**

Q2. a. Using Tao charts, compute the time required to freeze a 0.1 m thick slab of lean beef with 73% moisture content using a plate freezer. The product initial temperature is 5°C and the plates maintained at -40°C provide a heat transfer co-efficient of 50 W/m^2 K. Take remaining data from tables and appendices provided and make assumptions wherever necessary, providing appropriate justification. **7**

[Turn over

b. With diagrams, comparatively evaluate two models of industrial plate freezers. **8**

Q3. Write short notes on (any three): **3 × 5 = 15**

a. Acceptable sterilizing value for processes
b. Dimensionless numbers in Cleland-Earle modification of Plank equation
c. Thermice process
d. Transient heat transfer charts
e. Product shape in freezing time estimation

Q4. Comparatively evaluate the following (any three): **3 × 5 = 15**

a. POLARSTREAM and PELICAN systems
b. Temperature profiles of Freezing and Thawing in block freezing
c. Straight belt freezers and Spiral belt freezers
d. Immersion freezing and ICF
e. Ball method and Bigelow method

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B.E. FOOD TECHNOLOGY AND BIO-CHEMICAL ENGINEERING THIRD YEAR SECOND SEMESTER EXAM 2017

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 any two from the rest)

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

1. In a trey dryer air which is entering has a temperature of 60^0 C and a dew point of 23^0 C. determines actual humidity, percentage humidity, humid heat and humid volume. (10)
2. A machine operator was surprise to see that air temperature entering inside the spray dryer and mixing with liquid milk is more than 250^0 C but color detoreation of milk powder was not visible - explain. Discuss different parts of spray dryer and there function. (4+6=10)
3. An insoluble wet granular material is dried in a pan 0.457 x 0.457 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 6.1 m/s. the air is at 65.6^0 C and has a humidity of 0.010 kg H_2O/ kg dry air. Estimate the rate of drying for the constant rate period using. (20)
4. Derive an equation for calculation of drying time in Through-Circulation Drying in packed beds during constant rate period and falling rate period. What do you mean by geometry factor in bed? (16+4=20)
5. A continuous countercurrent dryer is being used to dry 450 kg dry solid/ h containing 0.05 kg total moisture/ kg dry solid to a value of 0.0025 total moisture/ kg dry solid. The granular solid enters at 26.7^0 C and is to be discharged at 62.8^0C. The dry solid has a heat capacity of 1.465 KJ/Kg.K, which is assumed constant. Heating air enters at 90^0 C, having a humidity of 0.010 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)