Ref. No. Ex/FTBE/PC/B/T/321/2025

B.E (FTBE) THIRD YEAR, SECOND SEMESTER EXAMINATION 2025

FOOD PROCESS ENGINEERING

Time : Three hours Full Marks : 100

(Use separate answer-script for each Part.)

PART- I (50 MARKS)

Q1. Define the following: **5 × 1 = 5**

a. Cryofreezing
b. Dynamic angle of repose
c. 'g' w.wr.t retorting
d. ICF
e. Sphericity of food grains

Q2. Comparatively evaluate the following with examples and diagrams wherever applicable (any 5): **5 × 3 = 15**

a. Spiral belt freezer vs. ICF-Spiral belt freezer combination
b. PELICAN vs. POLARSTREAM
c. Bulk density vs. True density
d. Batch FBF vs. Continuous FBF
e. Freezer for a crate of Apples vs. Custard apples
f. Decimal reduction vs. Probability of survival

OR

Q2. Diagrammatically illustrate the following (any 3): **3 × 5 = 15**

a. Microbial inactivation curves explaining significance of lag phase in calculating lethal value of a sterilization process

b. Two models of industrial plate freezers

c. The apparatus used for determination of terminal air velocities of food grains and seeds. In the diagram (inside the air column), indicate positions of *cumin seeds, pumpkin seeds and chick pea seeds* whose terminal air velocities you can measure using this apparatus with justification.

d. The method you would you use to determine the moisture content of sacks of wheat flour placed in a palletized store (with inclined shelves) in a biscuit manufacturing factory and justify choice of your method over other available methods.

e. Freezer for mushrooms

Q3. Analyze the following (any 2): **2 × 15 = 30**

a. Using **Planck equation**, compute the time required to freeze a 0.1 m thick slab of vacuum packaged 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.

b. Heat penetration curve is plotted for canned peas 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 100 °F and steam was introduced into the retort for 30 min, determine the F_o value by **Stumbo's method** taking data from relevant tables and graphs (consider simple heating curve). Given: heating and cooling curves parameters- $f_h = f_c =$ 22 min; $J_h = 1.3$ and $J_c = 1.5$. Consider Z value for a relevant test organism form tables.

c. An ice cream mix having $\mu = 60$ cP and $\rho = 950$ kg/m^3 is being canned aseptically in a system which uses a 90 ft long-1 inch sanitary pipe as a holding tube. Flow rate of the mix is 4 gallon/min and its temperature at the exit of the holding tube is 140 °C. The concerned microorganism has $D_0 = 1.8$ min and its Z value is 22 °F. Taking remaining data from standard tables, calculate:

   1. S.V of the process **based on V_{max}**
   2. S_i of the process **based on V_{max} and V_{avg}** and comment on the reliability of both data

Ref. No.: Ex/FTBE/PC/B/T/321/2025

B.E. FOOD TECHNOLOGY AND BIO-CHEMICAL ENGINEERING THIRD YEAR SECOND SEMESTER EXAM 2025

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

PART-II (50 MARKS)

Use separate answer script for each part

(Answer question no 4 and any two from the rest)

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

1. Discuss different parts of spray dryer and there function. Derive a relation between wet bulb temperature and psychometric ratio. (7+13=20)
2. Derive an equation for calculation of drying time where convection conduction and radiation are taking place together during constant rate period. What do you mean by geometry factor in bed? (15+5=20)
3. A trey dryer with countercurrent flow is being used to dry 500 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 1.5 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)
4. Determines actual humidity, percentage humidity, humid heat and humid volume when air entering in to a fluidized dryer has a temperature of 60^0 C and a dew point of 25^0 C. (10)