Ref. No. EX/FTBE/T/321/2019

B.E (FTBE) 3rd YEAR, 2ND SEMESTER EXAM 2019

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 × 5 = 5**

I. Determination of co-efficient of static friction for food grains
II. Factors to be considered in calculation of heat load in cold storage

(b) Define the following: **5 × 1 = 5**

I. Cryofreezing
II. Dynamic angle of repose
III. Dimensionless freezing time
IV. ICF
V. Sphericity of food grains

Q2. Differentiate between (any 2): **2 × 5 = 10**

a. Temperature profiles of Freezing and Thawing in block freezing
b. Straight belt freezers and Spiral belt freezers
c. True density and Bulk density of food grains

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

a) Use of transient heat transfer charts in evaluating freeing time.
b) Influence of moisture content of seeds on their angles of repose.
c) Cleland-Earle approach of evaluation of freezing time.

[Turn over

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

a) Illustrate diagrammatically two models of industrial FBF. **5**

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

i) A crate of apples
ii) Custard apples

Q5. Solve the following in this block.

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. **10**

b) Sweet cherries, approximately 1.5 cm in diameter, are frozen in an IQF system with air at -30°C and a surface heat transfer co-efficient of 50 W/m^2K. If the initial temperature of the product is 5°C, how much time will be required to reduce its centre temperature to -15°C? Estimate the freezing time using the **Cleland-Earle** approach. Take all relevant data from standard charts and tables. **10**

For spherical geometry, consider:

$P = 0.1084 + 0.0924\ N_{Pk} + N_{Ste}\ (0.231\ N_{Pk} - 0.3114/N_{Bi} + 0.6739)$
$R = 0.0784 + N_{Ste}\ (0.0386\ N_{Pk} - 0.1694)$

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B.E. FOOD TECHNOLOGY AND BIO-CHEMICAL ENGINEERING THIRD YEAR SECOND SEMESTER EXAM 2019

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, 3a or 3b and 4a or 4b)

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

1. In a tray dryer air which is entering has a temperature of 60^0 C and a dew point of 25^0 C. determines actual humidity, percentage humidity, humid heat and humid volume. (10)
2. Why pre-concentration of the material is advisable before spray drying. Discuss different parts of spray dryer and there function. (4+6=10)
3. a) A counter current belt conveyer continuous dryer is being used to dry 200 kg per hour sliced button mushroom from an initial moisture content of 90% (wb) to 6% (wb) using hot air ta 90^0 C and 2% RH. The air leaves the dryer at 50^0 C. Wet mushroom enters at 35^0 C and leaves the dryer at 48^0 C. Heat capacity values of water and bone dry mushroom are 4.187 and 1.26 kj kg^{-1} K^{-1}, respectively. Calculate the air flow rate and humidity of air at the outlet. Also calculate the heat utilization factor of the dryer. The critical and equilibrium moisture contents are 60% (wb) and 4% (wb) respectively. 20
   b) Derive an equation for calculation of drying time in tray dryer. What do you mean by geometry factor in bed? (16+4=20)
4. a) Corn (spherical shape) is dried in a pan 0.35 m x 0.35 m and 20.4 mm deep. The material is 20.4 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 6.0 m/s. the air is at 60.6^0 C and has a humidity of 0.014 kg H_2O/ kg dry air. Estimate the rate of drying for the constant rate period. (20)
   b) Derive a relation between wet bulb temperature and psychometric ratio. Why we should increase the diameter of cone used in a fluidized bed dryer. (14+6=20)