Reg. No. \_\_\_\_\_\_\_\_\_\_\_\_\_



**End Semester Examination – Nov / Dec – 2019**

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| **Code :** | **18FP3006** | **Duration :** | **3hrs** |
| **Sub. Name :** | **ADVANCES IN FOOD PROCESS ENGINEERING** | **Max. Marks :** | **100** |

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| **Q. No.** | **Sub Div.** | **Questions** | **Course Outcomes** | | **Marks** |
| **ANSWER ANY FIVE QUESTIONS (5 x 16 = 80 Marks)** | | | | | |
| 1. | a. | A specific culture containing 1400 spores/ml is divided among several containers and is subjected to a temperature 245°F for different time upto 50 min. The number of survivors/ml upto 50 min are given below.   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | Time (min) | 0 | 10 | 20 | 30 | 40 | 50 | | Spores / ml | 1100 | 400 | 100 | 11 | 6 | 0.3 |   Plot the data in a graph sheet and find out the D value and the slope. | | CO1 | 6 |
| b. | Use the **General method** to calculate the lethality rate for the given kinetic data. TDT is characterized by an Fo (at 121.1°C) of 2.52 min with  a z- value of 10°C.  **Time (min):** 0, 5,10,15,20,25,30,35,40,45,50,55,60,65,70,75,80,85 and 90  **Temp.(ºC):**60,65,70,78,86,93,102,110,115,118,120,121,121,118,111,101,  85, 74 and 60. | | CO1 | 10 |
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| 2. | a. | Interpret the various types of freeze dryers with neat sketch. | | CO3 | 6 |
| b. | Five- centimetre apple cubes are individually quick frozen (IQF) in a blast freezer operating at -45ºC and with a surface heat transfer coefficient of 38 W/m2 K. If the freezing point of the apple is measured as -1ºC and the density is 1100 kg/m3. Calculate the expected freezing time for each cube. If the cubes are then packed into a cardboard carton measuring 25cm x 12cm x 12cm, calculate the freezing time. Also calculate the freezing time for IQF freezing of 3 cm cubes.  (**Additional data:** the thickness of the card is 1.5 mm, the thermal conductivity of the card is 0.07 W/mK, the thermal conductivity of apple is 2.5 W/mK and the latent heat of crystallisation 2.74 x 105 J/ kg). | | CO2 | 10 |
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| 3. | a. | Discuss the various design aspects of spray dryer in detail. | | CO3 | 8 |
| b. | Explain the principle and working of Heat pump dryer. | | CO6 | 8 |
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| 4. | a. | Describe the construction and working of single screw extruder with a neat sketch. | | CO5 | 8 |
| b. | Discuss the various factors affecting extrusion cooking process. | | CO5 | 8 |
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| 5. | a. | Categorize the membrane separation process and explain them in detail. | | CO4 | 8 |
| b. | List out the applications of reverse osmosis. | | CO4 | 8 |
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| 6. | a. | Summarize the various thermal methods of food processing. | | CO1 | 8 |
| b. | Demonstrate the working of Foam mat dryer. | | CO6 | 8 |
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| 7. | a. | An ultrafiltration membrane was examined microscopically and found to have about 1,80,000 pores with an average diameter of 0.6 x 10-6 m per mm2 of membrane surface. The thickness of the membrane is 140x10-6 m. The viscosity of the permeate is 0.0013 Pa.s. Estimate the following:  i) Porosity of the membrane (€)  ii) Hydraulic Permeability (LP)  iii) Permeate Flux(J) for a Trans membrane Pressure Difference  (∆PTM) of 1.5 Pa. | | CO4 | 8 |
| b. | Food with an initial moisture content of 510% (dry-weight basis) is poured into 0.3 cm layers in a tray placed in a freeze drier operating at 50 Pa. It is to be dried to 15% moisture (dry-weight basis) at a maximum surface temperature of 60ºC. Assuming that the pressure at the ice front remains constant at 80 Pa, calculate;  (i) the drying time  (ii) the drying time if the layer of food is increased to 0.8 cm and dried  under similar conditions.  **(Additional data:** the dried food has a thermal conductivity of 0.03 W/mK, a density of 480 kg/m3, a permeability of 2.4x10-8 kg/s, and the latent heat of sublimation is 2.95x103 kJ /kg) | | CO3 | 8 |
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| **COMPULSORY QUESTION (1 x 20 = 20 Marks)** | | | | | |
| 8. | a. | Elaborate the working of retort packaging machines. | CO2 | | 10 |
| b. | Interpret the recent advances in aseptic packaging of foods. | CO2 | | 10 |