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



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

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |
| **Code :** | **17FP2012** | **Duration :** | **3hrs** |
| **Sub. Name :** | **UNIT OPERATIONS IN FOOD PROCESS ENGINEERING - I** | **Max. Marks :** | **100** |

**ANSWER ALL QUESTIONS (5 x 20 = 100 Marks)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Q. No.** | **Sub Div.** | **Questions** | **Course**  **Outcome** | **Marks** |
| 1. | a. | Explain the moisture content measurement method of food grains using Brown Duvel distillation method. | CO1 | 10 |
| b. | Determine the values of “c” and “n” from Henderson’s equation for the following data.   |  |  |  | | --- | --- | --- | | **RH (%)** | **t (℃)** | **Me (%)** | | 40 | 60 | 8.6 | | 80 | 60 | 14.5 | | CO2 | 10 |
| **(OR)** | | | | |
| 2. | a. | Describe the working of spray dryer with neat diagram. | CO2 | 10 |
| b. | Determine the total time required for drying period for the data given below:  The food material is dried from 28 to 6% moisture content (wb)  Weight of dry solids (Wd) = 300 kg  Weight of dry solids per unit drying area = 20 kg / m2  Moisture content at the end of constant rate period(XC) = 0.23 kg moisture/kg of dry solids  Rate of drying at the end of constant rate period (RC) =1.45 kg/m2 hr  Rate of drying at the end of falling rate period (R2) =0.073kg/m2 hr | CO4 | 10 |
|  |  |  |  |  |
| 3. |  | Discuss filtration process with neat diagram. Derive the formulae for constant rate and constant pressure filtration processes. | CO1 | 20 |
| **(OR)** | | | | |
| 4. | a. | Explain the working of basket centrifuge with neat figure. | CO3 | 10 |
| b. | A basket centrifuge with solid walls of 0.7m height contains 200 kg of water. The centrifuge rotates at 5000 rpm. Consider the density of water as 1000 kg/m3. Calculate the following : i) Angular Velocity, ii) Inner radius of the annular water mass (r22 – r12) and iii) The pressure (P) developed on the walls of the centrifuge. | CO4 | 10 |
|  |  |  |  |  |
| 5. | a. | Draw neat sketch of long tube falling film evaporator and explain its working. | CO3 | 10 |
| b. | A Single effect evaporator is to be used to concentrate a food solution containing 12% (by mass) dissolved solids to 60% solids. The feed stream enters the evaporator at 291 K with a feed rate of 100 kg/min. Steam is available at a pressure of 2.4 bar and an absolute pressure of 0.07 bar is maintained in the evaporator. Assuming that the properties of the solution are the same as those of water and taking the overall heat transfer coefficient to be 2300 W/m2 K, calculate the rate of steam consumption and the necessary heat transfer surface area.  The specific enthalpy data obtained from the steam tables are given below:  Enthalpy of steam (hS) = 2715 kJ/kg  Enthalpy of condensate(hC) = 530 kJ/kg  Enthalpy of feed (hF) = 75.5 kJ/kg  Enthalpy of vapour (hV) = 2572 kJ/kg  Enthalpy of concentrated liquor (hL) = 163 kJ/kg  The temperature of steam (TS) at 2.4 bar is 125.5℃ and the temperature of the saturated liquid water (TE) at the evaporator at a pressure of 0.07 bar is 36℃. | CO5 | 10 |
| **(OR)** | | | | |
| 6. | a. | Describe the different types of feeding methods in triple effect evaporators with suitable figures. | CO1 | 15 |
| b. | An evaporator is used to concentrate fruit juice. A feed of 50,000 kg/day of juice containing 30% sugar is evaporated producing a 65% solution. a) Draw the process flow diagram and indicate the inputs and outputs, b) Calculate the weight of solution produced and amount of water evaporated. | CO4 | 5 |
|  |  |  |  |  |
| 7. | a. | Discuss the principle of size reduction and explain the different laws of grinding. | CO5 | 10 |
| b. | Food grains of average initial size 8 mm were reduced to 0.006 mm size using a 12 hp motor. Check whether this motor would be adequate to reduce the size of the particles to 0.008 mm? Assume Rittinger equation and 1 hp = 745.7 watts. | CO6 | 10 |
| **(OR)** | | | | |
| 8. | a. | Elaborate the working of hammer mill with suitable diagram. | CO6 | 10 |
| b. | Sugar crystals were ground from an average diameter of 600 µm to powder with an average diameter of 150 µm. The net energy consumption was 0.7 kWh per ton. Calculate the net energy consumption for grinding the crystals to 60 µm powder. Apply Rittinger’s and Kick’s law. | CO5 | 10 |
|  | | **Compulsory**: |  |  |
| 9. | a. | Draw the diagram of planetary mixer and explain its working. | CO1 | 10 |
| b. | A vitamin premix of 1 kg is added to 999 kg of a food supplement. After mixing for 8 minutes in a blender, three samples each of 100 grams were collected and analyzed for the vitamin premix. The results of each sample in grams are : 0.12, 0.08, 0.11. Find the standard deviation, mixing index and time required for proper mixing for a standard deviation of 0.01. | CO6 | 10 |