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



**UNIVERSITY**

(Karunya Institute of Technology & Sciences)

(Declared as Deemed-to-be University under Sec.3 of the UGC Act, 1956)

**End Semester Examination – April/May– 2017**

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| **Code :** | **14FP2021** | **Duration :** | **3hrs** |
| **Sub. Name :** | **FOOD PROCESS EQUIPMENT DESIGN** | **Max. marks :** | **100** |

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

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| Q. No. | Sub Div. | Questions | Course  Outcome | Marks |
| 1. | a. | Illustrate with a neat diagram the construction and working of the following   1. Tunnel dryer. 2. Puff drying. | CO3 | 8 |
| b. | A cabinet dryer is being used to dry a food product from 68% moisturecontent (wet basis) to 5.5% moisture content (wet basis). The drying airenters the system at 54 8 C and 10% RH and leaves at 30°C and 70% RH. The product temperature is 25°C throughout drying. Compute the quantityof air required for drying on the basis of 1 kg of product solids. | CO3 | 7 |
|  | c | Write a note on critical moisture content. | CO3 | 5 |
| (OR) | | | | |
| 2. | a. | Derive an expression for mass and energy balance of a dehydration system. | CO1 | 8 |
| b. | Illustrate with a neat sketch the working of fluidized bed dryer. | CO2 | 8 |
| c. | Give the advantage of freeze drying. | CO2 | 4 |
| 3. | a. | Apple juice is being concentrated in a natural-circulation single-effect evaporator. At steady-state conditions, dilute juice is the feed introduced at a rate of 0.75 kg/s. The concentration of the dilute juice is 13% total solids. The juice is concentrated to 77% total solids. The specific heats of dilute apple juice and concentrate are 3.9 and 2.3 kJ/(kg°C), respectively. The steam pressure is measured to be 304.42 kPa. The inlet feed temperature is 43.3°C. The product inside the evaporator boils at 62.2°C. The overall heat-transfer coefficient is assumed to be 943 W/(m2°C). Assume negligible boiling-point elevation. Calculate the mass flow rate of concentrated product, steam requirements, steam economy, and the heat-transfer area.  Data:  Temperature of steam at 304.42 kPa = 134 °C  Enthalpy for saturated vapor Hvs (at Ts = 134 °C) =2725.9 kJ/kg  Enthalpy for saturated liquid Hcs (at Ts = 134 °C) = 563.41 kJ/kg  Enthalpy for saturated vapor Hv1 (at T1 = 62.2 °C) = 2613.4 kJ/kg | CO3 | 15 |
|  | b. | A hot stream is cooled from 1000°F to 520°F by cold stream entering 350°F and exiting at 800°F. Calculate the LMTD. | CO3 | 5 |
| (OR) | | | | |
| 4. | a. | A manufacturer is to design a heat exchanger in which the specification takes some steam at 4 bar g to heat secondary water from 10°C to 60°C. It is assumed that 1 litre of water has a mass of 1 kg. The manufacturer uses a Heat Transfer Coefficient 'U' for the heat exchanger of 2500 W/m2°C. Take the Specific Heat of water (cp) as 4.19 kJ/kg°C = 4190 J/ kg°C.  Determine:  i. The design heat load.  ii. The corresponding steam flow rate.  iii. The minimum heating area required. | CO3 | 15 |
|  | b. | Wrie down the role of temperature correction factor in heat exchanger design. | CO1 | 5 |
| 5. | a. | The gas phase reaction A→B+C will be carried out isothermally in a 20 dm3 constant volume, well-mixed batch reactor. 20 moles of pure A is initially placed in the reactor. If the rate is –rA=kCA and k=0.865 min-1, calculate the time needed to reduce the number of moles of A in the reactor to 0.2 mol. | CO3 | 10 |
|  | b. | Derive an expression of basic molar balance eqations for CSTR, PFR and Batch reactors. | CO2 | 10 |
| (OR) | | | | |
| 6. | a. | Explain in detail the Stresses in a Thin Cylindrical Shell due to an Internal Pressure. | CO1 | 15 |
|  | b. | A spherical vessel 3 metre diameter is subjected to an internal pressure of1.5 N/mm2 . Find the thickness of the vessel required if the maximum stress is not to exceed 90 MPa. Take efficiency of the joint as 75%. | CO3 | 5 |
| 7. | a. | Describe in detail about the non-ferrous alloys in used for construction of food processing equipments. | CO2 | 15 |
|  | b. | Write a note on polymers used in coating and as construction material in equipments. | CO1 | 5 |
| (OR) | | | | |
| 8. |  | Describe the general design procedureof food engineering equipments. | CO2 | 20 |
|  | | **Compulsory**: |  |  |
| 9. | a. | Explain in detail about various roofs available in storage tanks. | CO2 | 10 |
|  | b. | Illustrate with a neat sketch the parts of any one storage tank and its features. | CO2 | 10 |

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