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 – Nov/Dec – 2016**

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|  |  | **Semester :** | **2016-17 ODD** |
| **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. | The initial moisture content of a food product is 77% (wet basis), and the critical moisture content is 30% (wet basis). If the constant drying rate is 0.1 kg H2O/(m2s), compute the time required for the product to begin the falling-rate drying period. The product has a cube shape with 5-cm sides, and the initial product density is 950 kg/m3. | CO3 | 8 |
| b. | Onions with 75 per cent moisture content on wet basis is dried to a final moisture content of 20 percent. If we dry 1000 kg of onions, what is the final weight of the product, and how much water is removed? | CO3 | 7 |
|  | c | Write a note on constant drying rate period |  | 5 |
| (OR) | | | | |
| 2. | a. | A food solid was dried from 40 to 10% moisture content in 2 h in a batch drier with constant air conditions. The drying rate remained constant down to a moisture content of 15%. If the equilibrium moisture content is 2%, calculate the total time required to dry from 40 to 4% moisture content. All moisture contents are given on a dry basis. | CO3 | 8 |
| b. | Give the classification of dryers | CO1 | 8 |
| c. | A 50 kg mass of food has a moisture content of 33.3% (dry basis). How much water is present? What is the moisture content on a wet basis? | CO2 | 4 |
| 3. | a. | 1000 kg/h of milk is heated in a heat exchanger from 45°C to 72°C. Water is used as the heating medium. It enters the heat exchanger at 90°C and leaves at 75°C. Calculate the mass flow rate of the heating medium, if the heat losses to the environment are equal to 1 kW. The heat capacity of water is given equal to 4.2 kJ/kg°C and that of milk 3.9 kJ/kg°C | CO3 | 10 |
|  | b. | Calculate a preliminary estimate of the heat exchanger area needed to cool 55,000 lb/hr of a light oil (specific heat = 0.74 Btu/lb.°F) from 190°F to 140°F using cooling water that is available at 50°F. The cooling water can be allowed to heat to 90°F. An initial estimate of the Overall Heat Transfer Coefficient is 120 Btu/hr ft² °F. Also estimate the required mass flow rate of cooling water | CO3 | 10 |
| (OR) | | | | |
| 4. | a. | Illustrate with a diagram construction and working of single effect evaporators used in food industries. | CO2 | 10 |
|  | b. | Taking the shell and tube heat exchanger has an area of 178.7 ft2, how many tubes of 3 inch diameter and 10 ft length should be used? | CO3 | 5 |
|  | c | A quantity of water is heated with steam of 5 bar from a temperature of 35°C to 100° C over a period of 1200 s. The mass of water is 50 kg and the Specific Heat capacity of water is 4.19 kJ/kg°C. Calculate the heat transfer rate. | CO3 | 5 |
| 5. | a. | A thin cylindrical pressure vessel of 1.2 m diameter generates steam at a pressure of 1.75 N/mm2. Find the minimum wall thickness, if (a) the longitudinal stress does not exceed 28 MPa; and (b) the circumferential stress does not exceed 42 MPa | CO3 | 8 |
|  | b. | A cast iron cylinder of internal diameter 200 mm and thickness 50 mm is subjected to a pressure of 5 N/mm2. Calculate the tangential and radial stresses at the inner, middle (radius = 125 mm) and outer surfaces. | CO3 | 12 |
| (OR) | | | | |
| 6. | a. | The reaction A→B is to be carried out isothermally in a continuous-flow reactor. Calculate the CSTR,PFR volume to consume 79% of A, when the entering molar flow rate is 5 mol A/h, the volumetric flow rate is constant at 10 lit/h and the rate is –rA=(3 lit/mol•h)CA2 | CO3 | 15 |
|  | b. | Give the classification of pressure vessels | CO1 | 5 |
| 7. | a. | Explain about various stresses to be estimated to find strength of an equipment | CO2 | 8 |
|  | b. | Write a note on different types of corrosion | CO1 | 5 |
|  | c. | Give a note on choice of material in equipment design | CO2 | 5 |
| (OR) | | | | |
| 8. | a. | Enumerate the usage of various ferrous metals in construction of food processing equipments. | CO2 | 20 |
|  | | **Compulsory:** |  |  |
| 9. | a. | Explain in brief about the following losses in storage vessels:   1. Breathing losses 2. Filling losses 3. Boiling losses | CO2 | 10 |
|  | b. | Describe in detail about the Hortonspheres | CO2 | 10 |

ALL THE BEST