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– 2017**

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| **Code :** | **14FP3021** | **Duration :** | **3hrs** |
| **Sub. Name :** | **DESIGN OF FOOD PROCESSING EQUIPMENTS** | **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. | How the heat transfer coefficient of viscous liquids can be enhanced mechanically. | CO1 | 5 |
| b. | What are the classifications of heat exchangers, explain the construction, operation, merit and demerits of double pipe heat exchangers. | CO1 | 15 |
| (OR) | | | | |
| 2. | a. | Discuss about various non metals used as a construction material in process industries. | CO1 | 15 |
| b. | What is the advantage of multiple effect evaporator over single effect evaporator? | CO2 | 5 |
| 3. | a. | Explain material and energy balance equation for triple effect evaporators. | CO1 | 10 |
| b. | A single effect evaporator is to be designed to concentrate 10000Kg/hr of a chemical solution from 10% to 20% solids by weight. Feed enters at 30°C. Saturated steam at 110° (latent heat 540 kcal/kg) is available. Condensate leaves at saturation temperature. The solution boils at 45°C (latent heat 570 kcal/kg). Specific heats of all solutions may be taken as 1.0. Overall heat transfer co efficient may be taken as 1800 Kcal/hr m2°C. Calculate i. steam consumption ii. Heat transfer area | CO1 | 10 |
| (OR) | | | | |
| 4. |  | An evaporator is fed continuously with 50000 kg/hr of a solution containing 10% NaOH, 10% NaCl and 80% water by weight. During the evaporation, water is boiled off and NaCl precipitates as crystals and removed from the remaining liquor. The concentrated liquor leaving the evaporator contains 50% NaOH, 2% NaCl and 48% water. Calculate i. kg of water evaporated per hour. ii. Kg of salt precipitated per hour. iii. kg of concentrated liquor produced per hour. | CO2 | 20 |
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| 5. | a. | What are the reasons for non ideality in a continuous reactor? | CO1 | 5 |
| b. | An aqueous feed of A and B (400 l/min) with CAo = 100 mmol/l and CBo­­­ = 200 mmol/l is to be converted to product in a plug flow reactor. The kinetics of the reactions is given by  A + B R, -rA = 200 CACB, mol/(l.min)  Find the volume of reactor required to achieve 99% conversion of A. | CO2 | 15 |
| (OR) | | | | |
| 6. | a. | Derive the design equation for the plug flow reactor and continuous stirred tank reactor and ideal batch reactor. | CO1 | 15 |
| b. | What are the major assumption in deriving the design equation for ideal plug flow reactor and what is its significance? | CO1 | 5 |
| 7. |  | A heat exchanger is to be designed to heat 1720 kg/hr of water from 20 to 45°C with steam condensing on the outside surface of brass tubes of o.d. 25mm and i.d. 22.5 mm and 4 m long. The water velocity is 1.2m/sec. Find the number of tubes. Ktube material = 96 kcal/hr.m.°C, weight of steam condensed = 4500 kg/hr, latent heat of vaporisation = 532.6 kcal/kg, steam side film coefficient = 4000 kcal/hrm2°C. Physical properties of water at mean temperature are given as follows. ρ = 995.7 kg/m3, Cp = 0.997 kcal/kg°C, k = 0.531 kcal/m°Chr and v = 0.659x10-6 m2/sec (viscosity/density – kinematic viscosity). | CO2 | 20 |
| (OR) | | | | |
| 8. |  | Crude oil flows at the rate of 1000 kg/hr through the inside pipe of a double pipe heat exchanger and is heated from 30°C to 90°C. The heat is supplied by kerosene initially at 200°C flowing through the annular space. If the temperature of approach (minimum temperature difference) is 10°C, determine the heat transfer area for co-current flow and the kerosene flow rate. Cp for crude oil = 0.5 kcal/kg°C and for kerosene = 0.6 kcal/kg°C and Uo = 400 kcal/hr.m2°C. | CO2 | 20 |
|  | | **Compulsory**: |  |  |
| 9. | a. | A batch of solids is to be dried from 28% to 6% moisture on wet basis. The initial weight of the solid is 380 kg and the drying surface is 0.15 m2/40 kg dry weight. The critical moisture content is 18% dry basis and the constant drying rate is 0.32 kg/m2. h. For the falling rate period, the following data are available. Find the drying time required   |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | Moisture content, % dry basis | 25 | 21.9 | 19 | 16 | 13.6 | 11 | 8.2 | 7.5 | 6.4 | | Rate of drying kg/m2.h | 0.3 | 0.27 | 0.24 | 0.21 | 0.18 | 0.15 | 0.07 | 0.044 | 0.025 | | CO2 | 15 |
| b. | Differentiate critical moisture content and equilibrium moisture content | CO2 | 5 |

ALL THE BEST