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



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

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| **Code :** | **17FP2001** | **Duration :** | **3hrs** |
| **Sub. Name :** | **PRINCIPLES OF FOOD PROCESSENGINEERING** | **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. | Milk is flowing through a full pipe of diameter 1.8 cm. The only measure available is a tank calibrated in cubic feet that takes 1 h to fill 12.4 ft3. Determine the velocity of the liquid in the pipe. | CO1 | 10 |
| b. | Elaborate on the concept of water activity. | CO1 | 6 |
| c. | Deduce the dimensional consistency for hydrostatic Pressure  P= ρgh | CO1 | 4 |
| **(OR)** | | | | |
| 2. | a. | Verify the dimensional consistency of the equation   1. V=ut+1/2at2 2. Re =(DV ρ)/µ | CO1 | 10 |
| b. | The analysis of magnesite ore obtained from the chalk hill area, Salem district, yields 81% MgCO3, 14% SiO2 and 5% H2O (by mass). Convert this analysis into mole %. | CO1 | 5 |
| c. | The potential energy of a body at a height of 15 m is kJ. If the body is moving at a velocity of 50 m/s deduce its kinetic energy. | CO1 | 5 |
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| 3. | a. | Outline the kinetic theory of gases and derive the kinetic equation of ideal gases. | CO2 | 10 |
| b. | Define relative humidity and humidity ratio. | CO2 | 2 |
| c. | Atmospheric air at 1 bar pressure has 45 ºC dry bulb temperature and relative humidity of 34%. Solve the following using the psychrometric chart. i) Wet bulb temperature ii) Humidity ratio iii) Dew Point Temperature iv) Enthalpy v) Specific Volume of Air. | CO2 | 8 |
| **(OR)** | | | | |
| 4. | a. | Derive the equation of state for ideal gases using Boyles and Charles laws. | CO2 | 10 |
| b. | Two engineers are calculating the average molecular weight of a gaseous mixture containing oxygen and other gases. One of them using the correct molecular weight of 32 for oxygen determines the average molecular weight correctly as 39.2. The other using an incorrect value of 16, determines the average molecular weight as 32.8. This is the only error in his calculations. Calculate the mole percent of oxygen in the mixture. | CO2 | 10 |
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| 5. | a. | Derive Bernoulli's equation using Euler’s equation of motion for a fluid system. | CO3 | 10 |
| b. | Water is flowing through a pipe of diameter 300mm and 200mm at the bottom and upper end respectively.The intensity of pressure at the bottom end is 24.525N/cm2 and the pressure on upper end is 9.81 N/cm2. Determine the difference in datum head if the rate offlow through the pipe is 40lit/s. | CO3 | 10 |
| **(OR)** | | | | |
| 6. | a. | A pipe through which water is flowing is having diameter 20cm and 10cm at cross-sections 1& 2.the velocity of water in section 1 is 4m/s. Find the velocity of water in section 2 also find the rate of discharge. | CO3 | 10 |
| b. | Elaborate on the working principle of Venturi meter & express its rate of flow. | CO3 | 10 |
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| 7. | a. | Enlist any 6 basic operations for which material balance is carried. | CO4 | 3 |
| b. | An evaporator has an evaporation capacity of 20kg water/h. The system consists of a heater through which the fluid flows down in a thin film and the heated fluid discharges into a collecting vessel maintained under a vacuum where flash evaporation reduces the temperature of the heated fluid to the boiling point. In continuous operation, a recirculating pump draws part of the concentrate from the reservoir, mixes this concentrate with feed, and pumps the mixture through the heater. The recirculating pump moves 10 kg of fluid/h. The fluid in the collecting vessel should be at the desired concentration for withdrawal from the evaporator at any time. If feed enters at 5.5% solids and a 25% concentrate is desired, calculate: (i) the feed rate and concentrate production rate, (ii) the amount of concentrate recycled, and (iii) concentration of the mixture of feed and recycled concentrate. | CO5 | 10 |
| c. | Draw a diagram and set up a total mass and component balance equation for a crystallizer where 100 kg of a concentrated sugar solution containing 85% sucrose and 1% inert, water-soluble impurities (balance, water) enters. Upon cooling, the sugar crystallizes from the solution. A centrifuge then separates the crystals from a liquid fraction, called the mother liquor. The crystal slurry fraction has, for 20% of its weight, a liquid having the same composition as the mother liquor. The mother liquor contains 60% sucrose by weight. | CO4 | 7 |
| **(OR)** | | | | |
| 8. | a. | A processing plant is producing minced meat, which must contain 15% of fat. If this is to be made up of boneless cow beef with 23% of fat and from boneless bull beef with 5% of fat. Determine the proportions in which these should be mixed. | CO5 | 6 |
| b. | Determine the amount of juice concentrate **(**containing65% solids& 35% water**)** and single- strength juice **(**containing 15% solids & 85% water**)** that must be mixed to produce 100 kg of concentrate **(**containing 35% solids& 65 % water**)**. | CO4 | 6 |
| c. | Two methanol-water mixtures are contained in separate tanks. The first mixture contains 40.0 wt% methanol and the second contains 70.0 wt% methanol. If 200 kg of the first mixture is combined with 150 kg of the second, calculate the mass and composition of the product. | CO4 | 8 |
|  | | **Compulsory**: |  |  |
| 9. | a. | Calculate the amount of steam at 121.1◦C that must be added to 100 kg of a food product with a specific heat of 3559 J/(kg K) to heat the product from 4.44◦C to 82.2◦C by direct steam injection. | CO6 | 12 |
| b. | Elaborate on Hess's law of constant heat summation. | CO6 | 8 |