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

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**End Semester Examination – Nov/Dec – 2018**

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| **Code :** | **14FP2001** | **Duration :** | **3hrs** |
| **Sub. Name :** | **PRINCIPLES OF FOOD PROCESS ENGINEERING** | **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. | Show that the equation for hydrostatic pressure P = ρ.g.h is dimensionally consistent, where ρ is the density of the fluid, g acceleration due to gravity and h is the height of the fluid. | CO2 | 6 |
| b. | Milk is flowing through a full pipe whose diameter is known to be 1.8 cm. The only measure available is a tank calibrated in cubic feet and it is found that it takes 1 hour to fill 12.4 ft3. What is the velocity of the liquid in the pipe? | CO2 | 8 |
| c. | Define molarity, molality and normality. | CO1 | 6 |
| (OR) | | | | |
| 2. | a. | Show that the expression for kinetic and potential energy are dimensionally consistent. | CO2 | 6 |
| b. | Calculate the available nitrogen in the following i) Commercial ammonium sulphate (96% pure) ii) Pure sodium nitrate (100%). | CO3 | 8 |
| c. | 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. What is the mole percent of oxygen in the mixture? | CO1 | 6 |
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| 3. |  | Atmospheric air at a pressure of 1 bar and 25°C has a relative humidity of 75%. Find i. Partial pressure of water vapour and air ii. specific volume iii. dew point temperature iv. specific humidity v. degree of saturation vi. Density of the mixtures vii. Water vapour condensed per kg of dry air when the mixture is cooled at constant pressure to a temperature of 10°C. | CO2 | 20 |
| (OR) | | | | |
| 4. |  | Calculate the volume occupied by 1 gm mole of water vapour at 900°C and 100 atm. (i) by the ideal gas law and (ii) using Vander Waal’s equation. The Vander Waal’s constants for water are, a = 5.404 (liter)2(atm)/(gm.mole)2 and b = 0.3049 (liter/gm.mol). Vander Waal’s equation is (P+a/V2 )(V-b) = RT. | CO3 | 20 |
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| 5. | a. | State Bernouli theorem and derive the equation for the steady flow of incompressible fluids. | CO1 | 15 |
| b. | The discharge through a horizontal tapering pipe is 80 liters per sec. The diameters at the inlet and outlet are 300mm and 200mm respectively. If water enters at a pressure of 0.15N/mm2, determine the pressure at which it leaves. | CO2 | 5 |
| (OR) | | | | |
| 6. | a. | A pipe of 500mm diameter carrying water splits into two pipes of diameters 400mm and 200mm. If the mean velocity in the 500mm pipe is 2m/s and that in the 400mm pipe is 1.6 m/s. Determine the discharge in the pipes and the velocity in the 200mm pipe. | CO2 | 10 |
| b. | Find the total head and total energy per kg of the flowing fluid at a section of a pipe carrying oil of specific gravity 0.8. The pipe diameter is 0.35m. Discharge 200 lps, pressure at the section is 100 kN/m2. The section is 3.5m above the datum. | CO3 | 10 |
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| 7. |  | Milk with 3.8% fat and 8.1% fat-free solids (FFS) is used for the production of canned concentrated milk. The process includes separation of the cream in a centrifuge and concentration of the partially defatted milk in an evaporator. If the cream that is produced in the centrifuge contains 55% water, 40% fat, and 5% fat-free solids, calculate how much milk is necessary in order to produce a can of concentrated milk that contains 410 g milk with 7.8% fat and 18.1% fat-free solids. How much cream and how much water must be removed in the centrifuge and the evaporator respectively? Assume steady state. | CO2 | 20 |
| (OR) | | | | |
| 8. | a. | Find the ratio of milk with 3.8% fat to milk with 0.5% fat that have to be mixed in order to produce a blend with 3.5% fat. | CO2 | 6 |
| b. | The spent acid from a nitrating process contains 33% H2SO4, 36% HnO3 and 31% water by weight. This acid is to be strengthened by the addition of concentrated sulphuric acid containing 95% H2SO4, and concentrated nitric acid containing 78% HnO3. The strengthened mixed acid is to contain 40% H2SO4 and 43% HnO3. Calculate the quantities of spent and concentrated acids that should be mixed together to yield 1500 kg of the desired mixed acid | CO3 | 14 |
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|  | | **Compulsory**: | | |
| 9. |  | Calculate the number of kilo calories required to heat from 500K to 1500K, 1 cubic meter (1atm 0°C) of a gas having the following composition by volume. CO2 – 70%, N2 – 27%, O2 – 2% and H2 – 1%. The specific heat correlation is given belowCp = a + bT + cT2  Where a b c  CO2 6.339 10.14x10-3 -3.415x10-6  N2 6.457 1.389x10-3 -0.069x10-6  O2 6.117 3.167x10-3 -1.005x10-6  H2 6.946 -0.196x10-3 0.4757x10-6  T is in kelvin and Cp is in kcal/kmol K | CO2 | 20 |