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



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

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| **Code :** | **18FP2001** | **Duration :** | **3hrs** |
| **Sub. Name :** | **PRINCIPLES OF FOOD PROCESS ENGINEERING** | **Max. Marks :** | **100** |

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| **Q. No.** | **Questions** | **Course Outcome** | **Marks** |
| **PART – A (10X1 = 10 MARKS)** | | | |
| 1. | Define Molarity. | CO1 | 1 |
| 2. | Convert - 60°C into °F. | CO1 | 1 |
| 3. | Construct Amagat’s law for gases. | CO2 | 1 |
| 4. | Define Dew Point Depression. | CO2 | 1 |
| 5. | Recall Bernoulli’s equation for fluid system. | CO3 | 1 |
| 6. | Give the value for the viscosity of water at 20oC. | CO3 | 1 |
| 7. | Define Tie Materials. | CO4 | 1 |
| 8. | Derive an expression for Material Balance. | CO4 | 1 |
| 9. | Write the concept of Heat of combustion. | CO6 | 1 |
| 10. | Define Heat Capacity. | CO6 | 1 |

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| **PART – B (6 X 3 = 18 MARKS)** | | | |
| 11. | Convert **80 mg/s** to its equivalent **kg/h.** | CO1 | 3 |
| 12. | Deduce the vapor pressure (PV) of atmospheric air having barometric pressure as 1 bar dry bulb temperature as 40 ºC and wet bulb temperature as 30 ºC. | CO2 | 3 |
| 13. | Define surface tension and give the units in MKS and SI system. | CO3 | 3 |
| 14. | 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. | CO4 | 3 |
| 15. | Calculate the heat in joules required to raise the temperature of 25 grams of water from 0 degrees Celcius to 100 degrees Celcius, also determine the heat in calories. | CO6 | 3 |
| 16. | Calculate the standard heat of reaction for the following reaction:  C2H6(g) C2H4(g) + H2(g)  Data  Component ∆Cº(KJ/mol)  C2H6  1561  C2H4 1411  H2  286 | CO6 | 3 |

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| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.no 17 to 23. Q.No 24 is a Compulsory Question)** | | | | |
| 17. | a. | The flow rate of water through a pipe is reported as 15 cubic feet per minute. Taking the density of water 1 g/cc, calculate the mass flow rate in kg/s. | CO1 | 4 |
| b. | Check whether the given equation is dimensionally consistent or not  X=ut +1/2at2where X= length u and v denotes velocity and a = acceleration. | CO1 | 4 |
| c. | Elaborate on the concept of wet basis and dry basis. | CO1 | 4 |
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| 18. | a. | A cylinder of 120 L contains CO2 at 100 bar and 20 ºC.  i) Determine the mass of the gas.  ii) Molar Volume of the gas. | CO2 | 4 |
| b. | 1000 m3 of a mixture of H2, N2 and CO2 at 150°C was found to have the following ratio of the partial pressures of the gases: PH2: PN2: PCO2 = 1:4:3, if the total pressure is 2 atm, absolute, find i) mole fraction of each of these gases ii) Weight percent of these gases iii) Average molecular weight iv) Weight of CO2 in kilograms. | CO2 | 8 |
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| 19. | a. | Derive Euler’s equation of motion for a fluid system. | CO3 | 7 |
| b. | A horizontal venturi meter with inlet and throat diameters 30cm and 15cm respectively is used to measure the flow of water. The reading of differential manometer connected to the inlet and the throat is 20cm of mercury. Determine the rate of flow. Take Cd = 0.98. | CO3 | 5 |
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| 20. | a. | Fresh orange juice with 12% soluble solids content is concentrated to 60% in a multiple-effect evaporator. To improve the quality of the final product the concentrated juice is mixed with an amount of fresh juice (cut back) so that the concentration of the mixture is 42%. Calculate how much water per hour must be evaporated in the evaporator, how much fresh juice per hour must be added back and how much final product will be produced if the inlet feed flow rate is 10000 kg/h fresh juice. | CO4 | 6 |
| b. | Two types of milk having 3.8% and 0.5% fat content are blended to produce a final product having 3.5% fat content. Determine the ratio in which they needed to be mixed to produce the end product. | CO5 | 6 |
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| 21. | a. | Calculate the amount of steam at 121.1ºC 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 4.44ºC to 82.2ºC by direct steam injection. | CO6 | 6 |
| b. | Paraphrase on Hess Law of Constant Heat Summation. | CO6 | 6 |
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| 22. | a. | Determine the amount of a juice concentrate containing 65% solids and single- strength juice containing 15% solids that must be mixed to produce 100 kg of a concentrate containing 45% solids. | CO5 | 4 |
| 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 to yield 1500 kg of the desired mixed acid. | CO4 | 8 |
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| 23. | a. | Atmospheric air at 1 bar pressure has 25 ºC dry bulb temperature and 75% of relative humidity. Using Psychometric Chart, calculate dew point temp, the specific volume of air, Enthalpy, and wet bulb temperature & specific humidity. | CO2 | 10 |
| b. | Outline the state of an ideal gas at a constant temperature with the help of Boyles law. | CO2 | 2 |
|  | **Compulsory:** | | | |
| 24. |  | Calculate the amount of saturated steam at 121.1ºC that must be supplied to a dehydrator per hour. The steam condenses in the heater, which heats the drying air from steam to water at 121.1ºC. The dehydrator is operated as follows: Apples at 21.1ºCenter the dehydrator with 80% moisture and leave the dehydrator at 37.7ºC and 10% moisture. One hundred pounds per hour of fresh apples enter the drier. Fresh air at 21.1ºC and a humidity of 0.002 kg H2O/kg dry air enter the drier, mixes with recycled hot air until the humidity is 0.026 kg H2O/kg dry air, and is heated to 76.7ºC using steam in a ﬁnned heat exchanger. Hot air leaves the drier at 43.3ºC and a humidity of 0.04 kg H2O/kg dry air. | CO6 | 12 |