Seat No: _____ **Enrollment No: _____**

PARUL UNIVERSITY

FACULTY OF ENGINEERING & TECHNOLOGY

B.Tech Summer 2017 – 18 Examination

Semester: 3 **Date: 12/6/2018**
Subject Code: 03103203 **Time: 2.00 pm to 4.30 pm**
Subject Name: Process Calculation **Total Marks: 60**

Instructions:
1. All questions are compulsory.
2. Figures to the right indicate full marks.
3. Make suitable assumptions wherever necessary.
4. Start new question on new page.

Q.1 Objective Type Questions - (All are compulsory) (Each of one mark) **(15)**

1. …….is the process in which solid particles are formed from liquid solution by evaporating and/or cooling of a saturated solution.
2. A mixture contains 7 kg of air and 77 g of water vapor. What is mass ratio of air in the mixture? (mol. Wt. of air =29 and water vapor= 18)
3. Conversion factor for Celsius to Kelvin?
4. Convert an acceleration of 1 cm/s to its equivalent in km/week?
5. What is the conversion factor for m^3 /cm^3?
6. Molecular weight of aluminum sulfate. (Al-26.9, S-32, O-15.99)
   a) 149.8
   b) 342.15
   c) 106.9
   d) 117.8
7. R in (m^3.kPa/(kmol.K)) is
   a) 0.08314
   b) 8.314
   c) 0.082
   d) 1.987
8. …… is used in industries for concentrating aqueous solutions by vaporizing the solvent water and removing it as vapor.
9. Which of the following is not the unit of pressure
   a) Pa
   b) N/m^2
   c) $N/s.m^2$
   d) mm of mercury
10. Unit of velocity in CGS system
    a) m/s
    b) cm/s
    c) cm/h
    d) m/h
11. …… is the molecular weight of phosphoric acid (H_3PO_4) (P:30; H:1; O:16)
12. …….. are the basic concepts of measurements such as length, time, mass and temperature.
13. Normality is equal to molarity when …… is one
14. If a plane travels at speed twice that of the speed of sound ($3x10^8$ m/s). How fast it is going in miles/hour? (1 mile= 1609.344 m)……..
15. In the SI system of units, the weight of 180 lb man standing on the surface of the earth is approximately. (1 lb= 0.45359 kg)
    a) 801 N
    b) 81.54 Kg
    c) Neither of these
    d) Both of these

Q.2 Answer the following questions. (Attempt any three) **(15)**

A) Assuming that dry air contains 21% oxygen and 79% nitrogen, calculate the following: **(a)** The composition in weight percent **(b)** The average molecular weight of dry air. (mol. Wt. of O-16, N-14)

B) Define molarity, normality and molality with formula

C) Explain Dalton's law, Raoult's law and Ideal Gas law with mathematical statement

D) A solution containing 25% benzene (MW = 78.048), 35% toluene (MW = 92.064) and 40% xylene (MW = 106.08) is in equilibrium with its vapor at 373 K. All percentages are on a weight basis. Determine the following:
(a) The total pressure
(b) The average molecular weight of the liquid
The vapor pressures at 373 K are: benzene = 178.7 kPa, toluene = 74.7 kPa and xylene = 28 kPa

Q.3

A) A gaseous mixture has following composition by volume: CO_2 = 8%, CO = 14 % , O_2= 6% , H_2O = 5% ,CH_4 = 1% , N_2 = 66% Calculate (i) the average molecular weight of the gas mixture and (ii) density of the gas mixture at 303 K (30^0C) and 101.325KPa. **(07)**

B) An evaporator system concentrating a weak liquor from 5% to 50% solids handles 100kg of solids per hour. If the same system is to concentrate a weak liquor from 4% to 35%, find the capacity of the system in terms of solids that can be handled per hour assuming water evaporation capacity to be same in both the cases. **(08)**

OR

B) 10,000 kg/hr of solution containing 20% methanol is continuously fed to the distillation column. Distillate (product) is found to contain 98% methanol and waste solution from the column carries 1% methanol. All percentages are by weight. Calculate (a) the mass flow rates of distillate and bottom product and (b) the percent loss of methyl alcohol. **(08)**

Q.4

A) What is Extraction? Soybean seeds are extracted with hexane in batch extractors. The flaked seeds contain 20% oil, 68% solids and 12% moisture. At the end of the extraction process, the cake is separated from the hexane-oil mixture. The cake analysis yields 0.8% oil, 88% solids, and 11.2% moisture. Find the percentage recovery of oil **(07)**

OR

A) Define drying. Wet lumber (5% moisture) is dried to 1% moisture in a hot-air drier. Air fed to the drier contains 0.5% water. The moist air leaving the drier contains 2% (weight) water. How much air is required to dry 2000 kg/h of lumber? What is the % recovery of moisture **(07)**

B) One hundred moles of a hydrocarbon mixture consisting of 20% ethane, 40% propane and 40% butane is admitted to the first column of a series of two distillation columns. The top product from this column contains 95% ethane, 4% propane and 1% butane. The bottom product enters the second column in the series where it is subjected to further purification. The distillate leaving the second column is 99% propane and 1% butane and the bottom product is 8.4% propane and 91.6% butane. Calculate **(08)**
(a) The quantity and composition of the bottom product from the first column and
(b) The quantity of the distillate from the second column