Registration No : | | | | | | | | | | |

Total Number of Pages : 02 **B.Tech**
PCE3I001

3rd Semester Back Examination 2019-20
CHEMICAL PROCESS CALCULATION
BRANCH : CHEM, PT
Max Marks : 100
Time : 3 Hours
Q.CODE : HB817

Answer Question No.1 (Part-1) which is compulsory, any EIGHT from Part-II and any TWO from Part-III.
The figures in the right hand margin indicate marks.

Part-I

Q1 **Only Short Answer Type Questions (Answer All-10)** **(2 x 10)**

a) Define Dalton's law of partial pressure.
b) Write down any two assumptions of Clausius-Clapeyron equation.
c) Differentiate between wet bulb and dry bulb temperature.
d) Convert 1 btu to Calories and Joules.
e) What is limiting and excess reactant?
f) Explain the difference between the recycle and bypass stream
g) Name any four separation processes.
h) Define Drying and crystallization operation.
i) Brief the difference between sensible and latent heat with an example.
j) Differentiate between heat of formation and heat of reaction.

Part-II

Q2 **Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)** **(6 x 8)**

a) A chemist is interested in preparing 500 ml of 1 normal, 1 molar and 1 molal solution of H2SO4. Assuming the density of H2SO4 solution to be 1.075 g/cm3, calculate the quantities of H2SO4 to be taken to prepare these solutions.
b) A gas mixture containing 12% CO2, 8% O2 and 80% N2 by volume leaves from the fermenter at 1.5 atm (abs) pressure and 400C and 1 m3 /hr. Calculate how many kg/hr of the gas mixture is coming out.
c) 10 kg of C H4 is burnt with 10% excess air. What will be the volume of the air used for combustion if air is at 30°C and 1.3 atm pressure?
d) 1000 kg of Na2CO3 solution containing 25% Na2CO3 is subjected to evaporative cooling. During its process 15% of H2O present in the solution is evaporated. From the concentrated solution Na2CO310.H2O crystallizes out. Calculate how much crystals would be produced if the solubility of Na2CO3 is 21.5 g per 100 g of H2O.
e) Explain the various thermodynamic processes like constant volume, constant pressure, isothermal & adiabatic process.
f) The Orsat analysis of the flue gases from a boiler house chimney gives CO2:11.4%, O2:4.2% and N2:84.4% (mole %). Assuming that complete combustion has taken place, (a) Calculate the % excess air, and (b) find the C: H ratio in the fuel.
g) Define(i) Relative humidity (ii) Absolute humidity
h) 200 kg of pure sulphur is burnt with 25% air in excess of that required to convert all the sulphur to sulphur dioxide, 4.5% of sulphur is oxides to sulphur trioxide and 95.5% to sulphur dioxide. The air is assumed to be dry. Calculate the composition (in mole %) of the gas leaving the burner.
i) A mixture of NaCl and KCl was treated with H2SO4 and 1.2 kg of mixed sulphate was obtained. If the original sample weighted 1 kg, determine the percentage of chlorine in the sample.

j) Octane is burnt with 10% excess air. Calculate: (i) air/fuel ratio by weight (ii) air/fuel ratio by volume

k) Moist air contains 0.0109 kg water vapor per cubic meter of the mixture at 300K and 101.3 kPa. Calculate (i) the partial pressure of water vapor (ii) the relative saturation

l) A body weights 1 kg in air, 0.90 kg in water and 0.82 kg in liquid. What is the specific gravity of the liquid?

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

Q3 Pure sulphur is burnt in a burner at the rate of 0.3 kg/s. fresh dry air is supplied at 30°C and 100 kPa. The gases from the burner contain 16.5%SO2, 3% O2 and rest N2 on SO3 free volume basis. The gases leave the burner at 800°C and 101.325 kPa. Calculate the (i) Fraction of sulphur burnt into SO3 (ii) The percentage excess air over the amount required to oxidize sulphur to SO2 (iii) The volume of dry air in m3 /s (iv) The volume of burner gases in m3 /s. **(16)**

Q4 The heat capacity of CO2 is given by the following relation Cp = 26.540 + 42.454 x 10-3T – 14.298 x 10-6 T 2 where Cp KJ/Kmol K and T is in Kelvin. (i) How much heat is required to heat 1 kg of CO2 from 300 K to 1000K? (ii) Obtain the relation expressing the heat apacity in kcal/kmol°C and temperature in °C (iii) Obtain the relationship giving heat capacity in Btu/lb mol °F and temperature in °F. **(16)**

Q5 5000 kg of Kcl are present in a saturated solution at 80°C. The solution is cooled to 20°C in an open tank. The solubilities of Kcl at 80°C and 20°C are 55 and 35 parts per 100 parts of water. i) Assuming water equal to 3% by weight of solution is lost by evaporation; calculate the weight of crystal obtained. ii) Calculate the yield of crystals neglecting loss of water by evaporation; Kcl crystallizes without ant water of crystals. **(16)**

Q6 For the reaction A → B, the process flow diagram is shown in following figure. The fresh feed of A contains 0.6% of inerts by volume. Sixty five percentage conversion of A per pass is obtained. The concentration of inerts going into the reactor at point 1 must be held at 2.5% by volume. All streams are ideal gases and the process is steady-state **(16)**

(i) How many moles need to be recycled per mole of total feed to the reactor at point 1?

(ii) How many moles to be purged?

(iii) What is the overall conversion of A?