(Following Paper ID and Roll No. to be filled in your Answer Books)

Paper ID : 2289923 Roll No.

B.Tech.

Regular Theory Examination (Odd Sem-III), 2016-17

PROCESS CALCULATIONS

Time : 3 Hours *Max. Marks : 100*

Section - A

1. Attempt all parts. All parts carry equal marks. Write answer of each part in short. **(2×10=20)**

a) Convert 10 gal/hr to m^3/sec.

b) Write general material and energy equations.

c) What do you mean by normality and molality?

d) Define recycle stream and by-pass stream.

e) Define yield and Selectivity.

f) What is dry bulb and wet bulb temperatures?

g) State Raoult's law and Amagat's law.

h) Define ppm(parts per million).

i) What is psychrometric ratio?

j) Convert 45g/lit of HCI into normality.

Section - B

Note : Attempt any five questions from this section. **(10×5=50)**

2. Vent gases from a plant has following composition : 70% *HCl*, 20% Cl_2 and rest CCl_4 (by volume). Determine average molecular weight and density at standard conditions.

3. Draw P-V-T diagram of a pure fluid and write any two equation of state for real fluids.

4. i) The heat transfer coefficient in a heat exchanger is 1000 kcal/(hr)(m^2)(^{o}c) Convert this value to Btu./(hr)(ft^2) of

ii) What do you understand by fundamental quantities and derived quantities?

5. The dry bulb temperature and dew point of ambient air were found to be 303K and 289 K respectively. Calculate:

i) The absolute molal humidity.

ii) The absolute humidity.

iii) The percentage saturation

iv) The percentage RH.

Data: V.P of water at 291 K=2.0624 kPa, V.P of water at 302 K = 4.004 kPa. Barometer reads 100 kPa.

6. 5000 kg of mixture of benzene and toluene containing

50 mole % benzene is distilled to get an overhead product containing 95 mole % benzene and a residue containing 90% toluene. Calculate the weight of benzene and toluene in feed, distillate and residues.

7. Assuming air to contain 79% N_2 and 21% O_2 by volume. Calculate the density of air at NTP and its average molecular weight.

8. A lime stone has the following composition.

   $CaCO_3$ = 93%, $MgCO_3$ = 6% and Insoluble's = 1%. Calculate:

   i) How many kg of CaO will be obtained from 2000kg of limestone?

   ii) kg of CO_2 available per kg of limestone.

9. Consider a half filled spherical storage tank with 12500 kg of an organic liquid at 7000 kPa. If the total internal energy in the tank is 5.3×10^6 kJ. Calculate specific enthalpy of the fluid?

Section - C

Note : Attempt any two questions from this section. **(15×2=30)**

10. Hydrogen gas is burned in an adiabatic reactor wit 2 times the theoretical quantity of air, both at 298 K initially. What will be temperature of reaction product? The standard heat of formation of gaseous water is -241826 KJ/mol. The heat capacities of gaseous are given below:

Water vapour $30.474+9.652\times10^{-3}\ T+1.189\times10^{-6}\ T^2$

Nitrogen: $27.034+5.815\times10^{-3}\ T-0.2889\times10^{-6}T^2$

Oxygen: $25.11+13.260\times10^{-3}\ T\ -4.2077\times10^{-6}T^2$

11. i) The spent acid from a nitrating process contain 43.4% H_2SO_4, 11.3% HNO3 and 45.3% water by weight. This acid is to be strengthened by the addition of conc. Sulphuric acid containing 98% H_2SO_4 and conc. Nitric acid containing 90% HNO_3. The strengthened mixed acid is to contain 60% H_2SO_4 and 32% HNO_3. Calculate the quantities of spent and concentrated acids that should be mixed together to yield 1500 kg of the desired mixed acid.

ii) Calculate the vapor pressure of

a) N hexane at 305 K

b) Water at 395 K by using Antoine equation. Given data are as follows:

	A	B	C
n-hexane	5.9951	11668.70	-48.950
water	7.0436	1636.90	-48.25

12. Flue gases leaving the boiler stack at 523 K have the following composition: CO_2-11.31% , H_2O = 13.04%, O_2 = 2.17% and N_2 = 73.48% by volume. Calculate the

heat lost in 1 K mole of gas mixture above 298 K using the heat capacity data given as:-

$Cp = a + bT + cT^2 + dT^3$, kJ/(kmol.K)

Gas	a	$b\times10^{-3}$	$c\times10^{6}$	$d\times10^{9}$
CO_2	21.3655	64.2841	-41.0506	9.7999
H_2O	32.4921	0.0796	13.2107	-4.5474
O_2	26.0257	11.7551	-2.3426	-0.5323
N_2	29.5909	-5.141	13.1829	-4.968

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