CBCS Scheme

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15BT44

Fourth Semester B.E. Degree Examination, Dec.2017/Jan.2018
Bioprocess Principles and Calculation

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing one full question from each module.

Module-1

1 a. Define the following :
   i) Normality
   ii) Molarity
   iii) Molality **(06 Marks)**

b. Nitric acid and water form maximum boiling azeotrope containing 65% (mole) water. Find the composition of azeotrope by weight percent. **(03 Marks)**

c. The analysis of the gas sample is given below (volume basis) CH_4 = 66%, CO_2 = 30%, NH_3 = 4% . Calculate
   i) The average molecular weight of the gas
   ii) The density of the gas at 2 atm and 303K. **(07 Marks)**

OR

2 a. Write the block diagram and material balance for the following unit operations :
i) Extraction ii) Drying iii) Mixing iv) Absorption. **(08 Marks)**

b. A solution containing 55% benzene, 28% toluene and 17% xylene by weight is in contact with its vapour pressure at 373K. Calculate the total pressure and molar composition of the liquid and vapour. **(08 Marks)**

Vapour pressure of C_6H_6 at 373 K = 1.762 atm
Vapour pressure of $C_6H_5CH_3$ 373 K = 0.76 atm
Vapour pressure of $C_6H_4(CH_3)_2$ 373 K = 0.276 atm

Module-2

3 a. A distillation column separates 20% C_6H_6, 50% toluene, 30% xylene into 95% C_6H_6, 4% toluene and 1% xylene and the waste product containing 2% C_6H_6. Calculate the quantities of distillate and residue if 1000kg mol/h of fuel is fed. **(08 Marks)**

b. For carrying out nitration reaction, it is desired to have mixed acid containing 40% HNO_3, 42% H_2SO_4 and 18% H_2O by weight, Nitric acid of 69.5% weight is readily available. Calculate :
   i) Required strength of sulfuric acid to obtain the above mixed acid
   ii) The weight ratio of nitric acid to sulfuric acid to be mixed. **(08 Marks)**

OR

4 a. Define ultimate and proximate analysis of fuel. Explain. **(04 Marks)**

b. What are biofuels? List out the sources of biofuel and their characteristics. **(04 Marks)**

c. A coke contains 85% carbon and 15% non combustible material by weight.
   i) The amount of oxygen theoretically required to burn 120kg of coke completely.
   ii) The composition of gas in the product stream if 60% excess air is supplied. **(08 Marks)**

Module-3

5 a. Define the following :
i) Limiting reactant ii) Excess reactant iii) Percentage conversion. **(06 Marks)**

b. Moist hydrogen containing 4 mole% H_2O is burnt completely in a furnace with 30% excess air. Calculate the orsat analysis of flue gas. **(10 Marks)**

OR

6 a. A limestone analysis is shown below
$CaCO_3 = 92.89\%$ $M_gCO_3 = 5.41\%$
Insoluble = 1.70% (All by percentage by wt)
i) How many kilograms of CaO can be made from 6 tonns of this limestone?
ii) How many kilograms of CO_2 can be converted per kg of limestone?
iii) How many kilograms of limestone are needed to make 2 tonns of lime? **(10 Marks)**

b. A fuel oil is burnt in a furnace. The orsat analysis of flue gas found to contain.
$CO_2 = 11.2\%$, $O_2 = 5.8\%$, $N_2 = 83.0\%$
All percentage are by mole. Calculate the C:H ratio of fuel oil. Assume that fuel does not contain nitrogen. **(06 Marks)**

Module-4

7 a. Define the following :
i) Heat capacity ii) Heat of formation iii) Heat of reaction. **(06 Marks)**

b. A natural gas has the following composition on mole basis.
$CH_4 = 83\%$ $C_2H_6 = 15\%$ $N_2 = 2\%$
Calculate the heat to be added to heat 20kg mol of natural gas from 300k to 520k using the heat capacity data given below :
$C_p = a + 6T + CT^2$, KJ/Kg mol K **(10 Marks)**

Component	a	$b \times 10^3$	$c \times 10^6$
CH_4 (g)	19.26	52.12	11.98
C_2H_6(g)	5.41	178.09	- 67.38
N_2 (g)	29.60	- 5.15	13.19

OR

8 a. Define the following :
i) Calorific valve ii) Heat of solution iii) Heat of vaporization iv) Hess's law **(08 Marks)**

b. The heat capacity of air is given by
$C_p = a + 6T + CT^2$, cal/mol.K
Where $a = 6.39$ $b = 1.76 \times 10^{-3}$ and $c = -0.27 \times 10^{-6}$. Calculate the mean molal heat capacity in the range 298 K to 530 K. What is the quantity of heat required for 20 kg mol of air to heat from 298K to 530K? **(08 Marks)**

Module-5

9 a. Write a note on historical development of bioprocess. **(08 Marks)**

b. With neat sketch explain the production of pencil. **(08 Marks)**

OR

10 a. With neat sketch explain the production of enthanol and discuss all unit operations involved. **(10 Marks)**

b. Define: i) Overall growth yield ii) Respiratory quotient. **(06 Marks)**

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