BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(MID SEMESTER EXAMINATION)

CLASS: B.TECH **SEMESTER: III**
BRANCH: BIOTECHNOLOGY **SESSION : MO/2019**

SUBJECT : BE206 CHEMICAL PROCESS CALCULATIONS

TIME: 2:00 HOURS **FULL MARKS: 25**

INSTRUCTIONS:
1. The total marks of the questions are 25.
2. Candidates may attempt for all 25 marks.
3. Before attempting the question paper, be sure that you have got the correct question paper.
4. The missing data, if any, may be assumed suitably.

Q1 (a) An industrial-strength drain cleaner contains 5.00 kg of water and 5.00 kg of NaOH. What are the mass (weight) fractions and mole fractions of each component in the drain cleaner container? [2]

(b) A mixture of gases has the following composition by mass: [3]

O_2	16%
CO	4.0%
CO_2	17%
N_2	63%

What is the molar composition?

Q2 (a) A compound contains 12% of carbon, 16% of oxygen, 28% of nitrogen, 4% of hydrogen and 40% calcium by weight, then what can be the possible molecular formula of the compound? [2]

(b) In the production of a drug having a molecular weight of 192, the exit stream from the reactor flows at a rate of 10.5 L/min. The drug concentration is 41.2% (in water), and the specific gravity of the solution is 1.024. Calculate the concentration of the drug (in kg/L) in the exit stream, and the flow rate of the drug in kg mol/min. [3]

Q3 (a) A solution of ethyl alcohol containing 8.6% alcohol by weight is fed at the rate of 5000 kg/hr to a continuous fractionating column operating at atmospheric pressure. The distillate which is the desired product contains 95.4% alcohol by weight and the residue from the bottom of the column contains 0.1% alcohol by weight. Calculate the mass flow rates of the distillate and residue in kg/hr [2]

(b) A solution of ethyl alcohol containing 8.6% alcohol by weight is fed at the rate of 5000 kg/hr to a continuous fractionating column operating at atmospheric pressure. The distillate which is the desired product contains 95.4% alcohol by weight and the residue from the bottom of the column contains 0.1% alcohol by weight. Calculate the following: [3]
i. the mass flow rates of the distillate and residue in kg/hr, and
ii. the percentage loss of alcohol.

Q4 (a) It is required to prepare 1250 kg of a solution composed of 12 wt.% ethanol and 88 wt.% water. Two solutions are available, the first contains 5 wt.% ethanol, and the second contains 25 wt.% ethanol. How much of each solution are mixed to prepare the desired solution? [2]

(b) A liquid containing 47.5% acetic acid and 52.5% water is to be separated by solvent extraction using isopropanol. The solvent used is 1.3 kg per kg of feed. The final extract is found to contain 82% acid on solvent free basis. The residue has 14% acid on solvent free basis. Find the percentage extraction of acid from the feed. [3]

Q5 The chlorination of methane occurs by the following reaction $CH_4 + Cl_2 \rightarrow CH_3C1+$ HC1 You are asked to determine the product composition if the conversion of the limiting reactant is 67%, and the feed composition in mole % is given as: 40% CH_4, 50% $C1_2$, and 10% N_2. [5]

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