



CBCS SCHEME



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Fourth Semester B.E. Degree Examination, Dec.2019/Jan.2020 Bioprocess Principles and Calculations

Time: 3 hrs.

Max. Marks: 80

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

Module-1

- Explain briefly about the general material balance equation for steady and unsteady state process. Which are commonly used in distillation column, crystallization and extraction? (08 Marks)
 - An aerobic fermented broth of methanol in water contains 20kmol of methanol. Express the composition as weight percentage of methanol. (08 Marks)

OR

- Derive the relationship between partial pressure, mole fraction of component gas to the total pressure of the system. (10 Marks)
 - Calculate the volume occupied by 20kg of chlorine gas at pressure of 100kpa and 298°K (25°C). (06 Marks)

Module-2

- A dilute acid containing 25% H_2SO_4 is concentrated by commercial grade sulphuric acid. Containing 98% H_2SO_4 . To obtain the desired acid containing 65% H_2SO_4 . Find the quantities of acid required to make 1000 kg of desired acid. (06 Marks)
 - An evaporator is fed with 15000 kg/hr of solution, containing 10% NaCl, 15% NaOH and rest is water. In this operation water is evaporated and NaCl is precipitated as crystals. The thick liquor leaving the evaporator containing 45% NaOH, 2% NaCl and rest is water, Calculate:
 - Kg/hr of water evaporated
 - Kg/hr of salt precipitated
 - Kg/hr of thick liquor obtained. (10 Marks)

OR

- Differentiate between ultimate and proximate analyses of coal. (06 Marks)
 - Liquid from a brewery industries can be considered to contain 10% ethanol and 90% water 50,000 kg/h of this fermentation product are pumped to a distillation column on factory site, under the current operating conditions a distillate of 45% ethanol and 55% water is produced from top of the column at rate one-tenth of the feed.
 - What is the composition of waste 'bottoms' from the still?
 - What is the rate of alcohol loss in the bottoms? (10 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-3

- 5 a. Explain the terms bypass, recycle and purge. (08 Marks)
 b. Define the following with examples:
 i) Stoichiometric co-efficient
 ii) Stoichiometric ratio
 iii) Stoichiometric proportion
 iv) Stoichiometric equation. (08 Marks)

OR

- 6 a. Define: i) % Conversion ii) % yield iii) Limiting reactant iv) Excess reactant. (08 Marks)
 b. Sulphur dioxide is oxidized to sulphur trioxide. The % conversion of SO₂ is 70%. The % excess air used is 25%. Find the composition of gases leaving the reactor. (08 Marks)

Module-4

- 7 a. Derive an expression for the effect of temperature on heat of reaction. (08 Marks)
 b. The heat capacity data of gaseous SO₂ is given below:

$$C_p^\circ = 43.548 + 10.63 \times 10^{-3} T - 5.94 \times \frac{10^5}{T^2}$$

Calculate the heat required to raise temperature of 1kmol of pure sulphur dioxide from 300°K to 1000°K. (08 Marks)

OR

- 8 a. A stream flowing at a rate of 15000 mole/h containing 25mol% N₂ and 75 mole% H₂ is to be heated from 298°K to 473°K. Calculate the heat that must be transferred using C_p^o data given below, C_p^o = a + bT + cT² + dT³, (KJ/K mol K)

Gas	a	b × 10 ³	c × 10 ⁶	d × 10 ⁹
N ₂	29.59	-5.41	13.18	-4.968
H ₂	28.61	1.019	-0.1476	0.769

- b. Define the following terms:
 i) Standard heat of formation
 ii) Standard heat of combustion. (04 Marks)

Module-5

- 9 a. With neat sketch, explain briefly about the various steps involved in development of complete bioprocess for commercial manufacturing. (10 Marks)
 b. Explain briefly about the various unit operation involved in manufacturing of penicillin. (06 Marks)

- 10 Aerobic degradation of an organic compound by mixed culture of organism in waste water can be represented as follows:



- i) Determine the a, b, c, d and e if R.Q = 0.9.
 ii) Determine the yield coefficients Y_{x/s} and y_{x/O₂}
 iii) Determine the degree of reduction of substrate of biomass. (16 Marks)

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