Exam.Code:0434
Sub. Code: 3460

1058

M.Sc. (Applied Chemistry) Fourth Semester
Paper – 402: Chemical Process Development

Time allowed: 3 Hours Max. Marks: 60

NOTE: *Attempt five questions in all, including Question No. 1 which is compulsory and selecting one question from each Unit. Missing data can be assumed, if any.*

x-x-x

Q.1 (i) Define chemical process giving examples.

(ii) State the difference between space time and residence time.

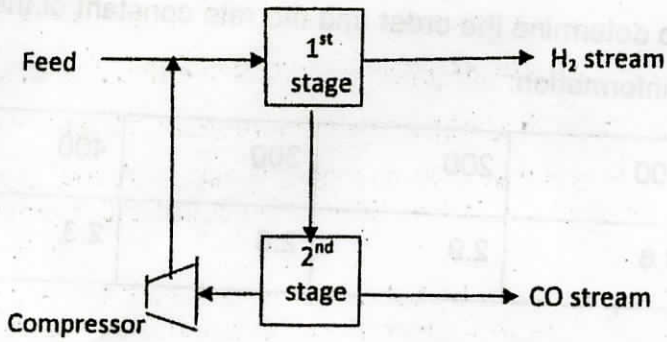
(iii) Pure A in gas phase enters a reactor, 50% of this A is converted to B through the reaction A → 3B. What will be the mole fraction of A in the exit stream?

(iv) A reaction A→ B is conducted in an isothermal batch reactor for several values of C_{Ao} (initial concentration of A) and its half life ($t_{1/2}$) is determined. The plot of $\ln(t_{1/2})$ *vs* $\ln(C_{Ao})$ is a straight line with a slope of -1. What would be the order of reaction?

(v) Explain the working of thermocouple. (2,2,3,3,2)

Unit-I

Q.II (i) A two stage membrane process is designed for separation of CO from a mixture of CO (47 % mole basis) and rest H_2.



The system is designed to recover 93.2 % CO with 98 mole% purity. Recycle stream is kept at 3000 mol/h for a fresh feed rate of 5000 mol/h. This requirement is stipulated to achieve 1:1 mole ratio of H_2/CO in the feed to second stage. Find

P.T.O.

(i) flow rate of product CO stream

(ii) composition of product H_2 stream

(iii) composition of mixed feed in the first stage membrane process

(12)

Q.III (i) Write a brief note on primary raw materials and their potential uses in industry.

(ii) Name some industrially important chemical agents and discuss their potential uses in industry.

(6,6)

Unit-II

Q.IV (i) Define order, molecularity and specific rate constant for a given reaction.

(ii) Find the first order rate constant for the disappearance of A in the gas reaction $2A \rightarrow R$, if on holding the pressure constant, the volume of the reaction mixture starting with 80% A, decreases by 20% in 3 minutes. (6,6)

Q.V (i) Use the half life method to determine the order and the rate constant of the reaction using the following information:

$t_{1/2}$ (s)	0	100	200	300	400
C_{Ao} (mol/l)	4.4	3.6	2.9	2.6	2.3

(ii) For the irreversible first order series reaction $A \xrightarrow{k_1} R \xrightarrow{k_2} S$ with the values of rate constant $k_1 = 0.17\ min^{-1}$ and $k_2 = 0.11\ min^{-1}$ respectively. Derive and calculate (a) the time at which the concentration of R is maximum

(b) maximum concentration of R (6,6)

Unit-III

Q.VI (i) Derive the design equation for mixed flow reactor.

(ii) Discuss the various metals and non-metals that can be used for construction in pharmaceutical plant listing their advantages and disadvantages. (6,6)

Q.VII A homogeneous liquid phase reaction, with stoichiometry and kinetics

$A \rightarrow S, \quad -r_A = kC_A^2$

takes place in a mixed flow reactor and results in 50% conversion.

i) Find the conversion if this reactor is replaced by another mixed flow reactor having volume six times that of the original reactor – all else remains unchanged.

ii) Find the conversion if the original reactor is replaced by plug flow reactor of the same size – all else remains unchanged. (12)

Unit-IV

Q.VIII (i) Explain the working of bimetallic thermometer. Discuss its advantages, disadvantages and applications.

(ii) What is a pressure transducer? Explain the working of any one. (6,6)

Q. IX (i) Explain the working of rotating concentric cylinder viscometer for the measurement of viscosity.

(ii) Explain various methods for the measurement of liquid level, citing appropriate examples.

(6,6)

x-x-x