CBCS SCHEME

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18BT52

Fifth Semester B.E. Degree Examination, June/July 2025
Chemical Reaction Engineering

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. i) Milk is pasteurized of it is heated to 63 °C for 30 min, but if it is heated to 74 °C it only needs 15S for the same result. Find the activation energy of this sterilization process.

ii) A reaction with stiochiometric equation

$\frac{1}{2}$ A + B $\Rightarrow$ R + $\frac{1}{2}$ S.

Has the following rate expression $-r_A = 2\,C_A^{0.5}\,C_B$.

What is the rate expression for this reaction? If the stoichiometric equation is written as A + 2 B = 2 R + S.

iii) Show a graphical representation between R (rate constant) Vs Temperature for High and low activation energy conditions. **(10 Marks)**

b. Derive a mathematical expression for evaluating 'R' – rate constant and 'n' – order of a reaction by using differential method of analysis. **(10 Marks)**

OR

2 a. A gas phase decomposition of A takes place according to the irreversible reaction A → 3 P. the kinetics of the reaction was studied by measuring the increase in pressure in a constant volume reaction vessel. At 504 °C and an initial pressure of 312 mm Hg, the following data were obtained.

Time (sec)	390	777	1195	3155	α
P_t, mm Hg	408	488	562	779	931

Evaluate the given data follows first order kinetic reaction (or) not. **(10 Marks)**

b. Derive an expression for an irreversible Bimolecular -Type Second order reactions

A + B → Products. **(10 Marks)**

Module-2

3 a. Derive an expression for evaluating the performance equation for an unsteady state batch reactor. In addition give the graphical representation to evaluate volume of a batch reactor. **(10 Marks)**

b. Pure gaseous reactant A (C_{AO} = 100 milli mol / litre) is fed at a steady rate into a mixed flow reactor (V = 0.1 litre) where it dimerizes (2A → R). For different gas feed rates the following data are obtained.

Run number :	1	2	3	4
V_o, litre/hr	30.0	9.0	3.6	1.5
C_{Af}, milli mol/litre :	85.7	66.7	50	33.4

Determine the rate equation for this reaction. **(10 Marks)**

OR

4 a. Derive an expression for a steady state plug flow reactor. **(10 Marks)**

b. For a homogenous gas decomposition of phosphine $4\,PH_{3(g)} \rightarrow P_{4(g)} + 6H_2$. Proceeds at 649 °C with the first order rate

$-r_A = (10/hr)\ C_{PH_3}$

Determine the size of plug flow reactor operating at 649 °C and 460 KPa can produce 80% conversion of a feed consisting of 40 mol of pure phosphine per hour? **(10 Marks)**

Module-3

5 a. Enumerate the graphical representation of properties of the E and F curves for various flow models in steady state reactors. **(10 Marks)**

b. Explain detail about the factors to know about reactor behavior for the conversion in non – ideal flow reactors. **(10 Marks)**

OR

6 a. Calculate the mean residence time of fluid in the vessel t and tabulate and plot the exit age distribution for the given data represent a continuous response to a pulse input into a closed vessel which is used as a chemical reactor. **(15 Marks)**

Time (t), min :	0	5	10	15	20	25	30	35
Tracer output concentration , Cpulse gm/litre fluid :	0	3	5	5	4	2	1	0

b. Write about the significance of transforming an experimental C_{pulse} curve into an E – curve in a pulse experiment in RTO. **(05 Marks)**

Module-4

7 a. Derive the expression for relating enzyme activity with respect to substrate concentration. **(10 Marks)**

b. Infer the changes in a enzymatic process inhibited by competitive and uncompetitive inhibition with a non – inhibitive enzymatic process by using only Graphical representation. **(10 Marks)**

OR

8 a. Evaluate the parameters K_m (&) V_{max} by using line weaver – Burk plot and Eadie Hofstee plots. **(10 Marks)**

b. An enzymatic reaction for the conversion of starch to glucose was carried out by varying the reaction time from 10 min to 60 min with a fixed volume of enzyme around 2 Mℓ. The observed data is given in the below table. Determine the enzyme activity and plot the response by graphically between Time Vs Enzyme Activity.

Note : There is no dilutions of the samples.

Time (min) :	10	20	30	40	50	60
Conc. Of Glucose (mg/ℓ)	12	18	25	33	41	41

(10 Marks)

Module-5

9 a. Explain about the changes of filamentous organisms growth as a function of time by using mathematical model. **(10 Marks)**

b. Evaluate the biomass concentration (X) and utilized substrate concentration (ΔS) by using Monod growth model for a batch culture condition growth process. **(10 Marks)**

OR

10 a. Explain about Leude King – Piret model for growth associated and non – growth product formation by mathematically and graphically. **(10 Marks)**

b. Explain about the factors which influence the choice of carbon source. In addition to that, write a short note on various sources of carbon sources. **(10 Marks)**

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