Registration no: | | | | | | | | | | |

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B.Tech
PEBT5304

5th Semester Regular / Back Examination 2016-17
BIOCHEMICAL REACTION ENGINEERING
BRANCH: BIOTECHNOLOGY
Time: 3 Hours
Max Marks: 70
Q.CODE: Y450

Answer Question No.1 which is compulsory and any five from the rest.
The figures in the right hand margin indicate marks.

Q1 Answer the following questions: **(2 x 10)**

- **a)** Write the mass balance equation for a CSTR operating at steady state condition.
- **b)** What are the limitations of Monod's model?
- **c)** Differentiate between the integral and differential methods for analyzing kinetic Data.
- **d)** Differentiate between order and molecularity.
- **e)** Differentiate between uncompetitive and non-competitive enzyme inhibition.
- **f)** Write the importance of Arrhenius' Law?
- **g)** Compare the time required for a given work in batch, CSTR and PFR .
- **h)** Find the value of ε_A for a reaction $A \rightarrow 3R$.
- **i)** Define space time and space velocity.
- **j)** Write the working principle of fluidized bed reactor.

Q2 a) Write the integral method of analysis for a varying volume batch reactor following 1st order reaction kinetics. **(5)**

b) A fermentation broth containing *Streptomyces kanamyceticus* cells is filtered by a vacuum rotary filter. The feed rate is 120 $kg.h^{-1}$; each kilogram of broth contains 60 g of cells. To improve filtration, filter aids are added at a rate of 10 $kg.\ h^{-1}$. The concentration of kanamycin in the broth is 0.05%. The filtrate is collected at a rate of 112 $kg.\ h^{-1}$. The concentration of kanamycin in the filtrate is 0.045%. The filter cake contains cells, and filter aid is continuously removed from the filter cloth. Then find the moisture content in the filter cake? **(5)**

Q3 a) Derive the Monod equation for growth kinetics. **(5)**

b) During the growth of *Saccharomyces cerevisiae* on glucose in a fermenter, the following data were observed on glucose concentration (s) and the specific growth rate (μ). Calculate the μ_m and K_s. **(5)**

(s), g/l	15	12	9	6	2.5	1.7
(μ), h^{-1}	0.34	0.33	0.32	0.3	0.22	0.18

Q4 Derive an expression for the concentration profile inside the porous catalyst considering cylindrical pore and 1st order kinetics. **(10)**

Q5 a) The pyrolysis of ethane proceeds with an activation energy of about 100 kJ/mol. How much faster is the decomposition at 500°C than at 400°C? **(5)**

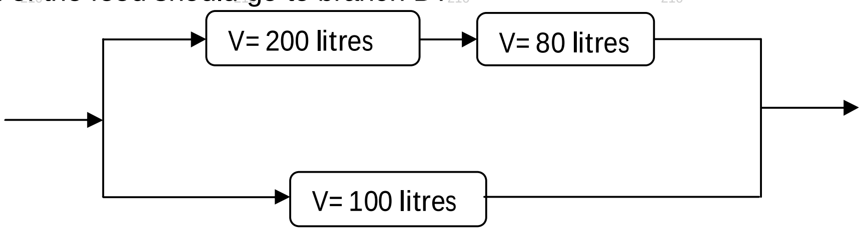
b) Derive the performance equation for a plug flow reactor operating at steady state condition.

Q6 a) **A** gaseous feed of pure A (1 mollliter) enters a mixed flow reactor (2 liters) and reacts as follows: **(5)**

$$2A \rightarrow R, \qquad -r_A = 0.05\, C_A^2 \ \frac{\text{mol}}{\text{liter} \cdot \text{sec}}$$

Find what feed rate (liter/min) will give an outlet concentration CA= 0.5 mol/liter.

b) The reactor setup (shown in Figure) consists of three plug flow reactors in two parallel branches Branch D has a reactor of volume 200 litres followed by a reactor of volume 80 litres. Branch E has a reactor of volume 100 litres. What fraction of the feed should go to branch D? **(5)**



Q7 a) One liter per minute of liquid containing A and B (C_{A0} = 0.10 mol/liter, C_{Bo} = 0.01 mol/liter) flow into a mixed reactor of volume V = 1 liter. The materials react in a complex manner for which the stoichiometry is unknown. The outlet stream from the reactor contains A, B, and C (C_{Af} = 0.02 mol/liter, C_{Bf} = 0.03 mol/liter, C_{cf} = 0.04 mol/liter). Find the rate of reaction of A, B, and C for the conditions within the reactor for v_0 =1 lit/min. **(5)**

b) From a series of batch runs with a constant enzyme concentration, the following initial rate data were obtained as a function of initial substrate concentration. Evaluate the Michaelis-Menten kinetic parameters by employing the Langmuir plot, the Lineweaver-Burk plot. **(5)**

Substrate Concentration mmol/L	1	2	3	5	7	10	15	20
Initial Reaction Rate mmol/L min	0.2	0.22	0.3	0.45	0.41	0.5	0.4	0.33

Q8 **Write short notes on ANY TWO:** **(5 x 2)**

a) Psychometric chart

b) Packed bed reactor

c) Competitive inhibition

d) Michaelis-Menten equation