(3 HOURS) **(MAX. MARKS : 80)**

Note:
1. **Question No. 1** is compulsory.
2. Attempt **any three** questions out of remaining **five** questions.
3. Assume suitable data wherever necessary.
4. Figures to right indicate full marks.

Q.1   Answer the following

a. Explain biochemical process with the help of example.   5

b. Differentiate between parallel and series reactions.   5

c. Derive the performance equation for PFR.   5

d. Discuss substrate uptake with product formation.   5

Q.2   a. Discuss the concentration gradient and reaction rates in solid catalyst.   10

b. A particular fermentation medium is sterilized in a continuous sterilization   10
system by passing the medium at the rate of 80 lit/min through a hot pipe of 5 cm
diameter. The medium has the following physic-chemical properties. $\rho_{fluid} = 1015 kg/m^3$, $\mu_{fluid} = 0.01$ Pa.s. Find the dispersion coefficient for the flow.

Q.3   a. Discuss different methods of analysis of data for a reactor.   10

b. A fermentation is to be carried out in a reactor. Before carrying out the actual   10
fermentation, it was decided to evaluate the flow characteristics of the reactor by
introducing a tracer in the form of pulse input. The time v/s concentration of
tracer data as follows. Find the average residence time and plot the exit age
distribution E, variance σ^2.

Time (min)	0	10	20	30	40	50	60	70
C (g/lit)	0	2	6	7	5	3	1	0

Q.4   a.   Derive Michaelis Menten equation.   10

      b.   Dilute aqueous solution of acetic anhydride is to be hydrolysed at 25ºC with the   10
rate $-r_A = 0.158 \, C_A$ and $v_0 = 500 \, cm^3/min$ of solution with anhydride
concentration of $C_{AO} = 1.5 \times 10^{-4} \, gmol/cm^3$. There are total 3 reactors. Two of
size 2.5 lie each and one of 5 lit. For getting higher conversion which alternative
will be better.

         i)   Two 2.5 lit reactors were operated in parallel with equal feed rate of
250 cm^3/min in each.

         ii)   Two 2.5 lit reactors used in series.

Q.5   a.   Differentiate between ideal and non ideal reactors.   10

      b.   Discuss the scale up of fixed bed adsorption.   10

Q.6   Write a short note on

      a.   Observable Thiele modulus   5

      b.   Semi batch fed bioreactors   5

      c.   Order of reaction   5

      d.   Fluidized bed reactor   5