(3 Hours) **[Total Marks: 80]**

N.B.: (1) Question No.1 is compulsory.

(2) Attempt any three questions out of remaining five questions.

(3) Each question carries 20 marks.

Q. 1. Write short notes on any four of the following (each question is of equal marks) (20)

(a) F curve

(b) Chemostat

(c) Heterogenous system

(d) Rate law

(e) Autocatalytic reactions

Q. 2. (a) Solve the following:

(i) The rate constant of a zero order reaction is 0.2 mol/l.h. What will be the initial concentration of the reactant if, after half an hour its concentration is 0.05 mol/l. (05)

(ii) The activation energy of a chemical reaction is 17982 cal/mol in the absence of a catalyst and 11980 Cal/mole with a catalyst. By how many times will the rate of the reaction will grow in the presence of a catalyst, if a reaction proceeds at 25 ºC. (05)

(b) Discuss cell growth kinetics in batch reactor and derive equation for doubling time. (10)

Q.3. (a) Derive the expression for concentration profile for first order kinetics for spherical catalyst. (10)

(b) Compare between major modes of reactor operation. (10)

Q.4 (a) A particular fermentation is to be carried out in a chemostat. Before carrying out the actual fermentation, it was decided to evaluate the flow characterstics of the chemostat by introducing a tracer in the form of pulse input. The time versus concentration of the tracer data are presented in the table below. Find the average residence time and plot the exit age distribution E. (10)

t (min)	0	10	20	30	40	50	60	70
$C_{pulse(g/l)}$ tracer output concentration	0	2	6	7	5	3	1	0

(b) Explain air lift reactor ? What are its different types. (10)

Q.5 (a) A second order reaction carried out in a single CSTR results in 80% conversion of reactant A. It is proposed to put another similar CSTR in series with the first one. For all other parameters remain identical how will this addition affect the conversion of reactant. (10)

(b) Explain integral method of analysis of data using first order reaction as an example. (10)

Q. 6. (a) What do you understand by tracer? How does RTD studies are performed on a reactor. (10)

(b) Derive performance equation for batch reactor (10)
