

IV B.Tech I Semester Supplementary Examinations, November 2005
PROCESS MODELLING & SIMULATION
(Chemical Engineering)

Time: 3 hours

Max Marks: 80

Answer any FIVE Questions
 All Questions carry equal marks

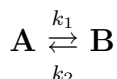
1. The liquid phase hydrolysis reaction of acetic anhydride to form acetic acid is carried out in a constant volume adiabatic batch reactor. The reaction is exothermic with the following stoichiometry. $(\text{CH}_3\text{C})_2\text{O} + \text{H}_2\text{O} \rightarrow 2\text{CH}_3\text{COOH} + \text{Heat}$. Derive mass and energy balances for the system assuming the reaction as first order. [16]

2. Write the component continuity equations for the following reactions taking place in a CSTR (continuous stirred-tank reactor):

(a) Simultaneous reactions (first-order, isothermal)



(b) Reversible (first-order, isothermal)



State the assumptions made and explain the nomenclature used. [16]

3. An irreversible exothermic reaction is carried out in a single perfectly mixed non-isothermal CSTR. The reaction is $\text{A} \rightarrow \text{B}$. The reaction is nth order in reactant A and has heat of reaction λ (energy units/mole of A reacted). Negligible heat losses and constant densities are assumed. To remove the heat of reaction, a cooling jacket surrounds the reactor. Cooling water is added to the jacket at a constant volumetric flow rate. Develop a mathematical model for the system assuming that the CSTR has a perfectly mixed cooling jacket. State all the assumptions made and explain the notation scheme used clearly. [16]
4. Explain the steady state model and thermal equilibrium model for LPG vaporiser with a neat diagram. [16]
5. Derive the Mathematical Model equations for a Binary distillation column. [16]
6. Solve the equation $dy/dx = x + y$ for five iterations by Euler's method with $x(0) = 0$, $y(0) = 1$ and a step size of 0.1. [16]
7. (a) Simulate the series of open loop three isothermal CSTRs using first order explicit Euler integration method.
- (b) Simulate the series of closed loop three isothermal CSTRs using first order explicit Euler integration method. [8+8]

8. Discuss the general “Newton - Rapshan” algorithm to determine the bubble point temperature for a binary system of components 1 and 2. Assume the system is ideal, Raoult’s and Dalton’s laws are applicable. [16]

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