BACHELOR OF TECHNOLOGY (C.B.C.S.) (2014 COURSE)
B.Tech.Sem - VIII CHEMICAL :SUMMER- 2022
SUBJECT : CHEMICAL PROCESS MODELING & SIMULATION

Day : Monday
Date : 20-06-2022

S-13602-2022

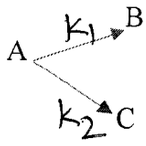
Time : 02:30 PM-05:30 PM
Max. Marks : 60

N.B.

1) All questions are **COMPULSORY.**
2) Figures to the right indicate **FULL** marks.
3) Use of non-programmable calculator is allowed.

Q.1 **a)** Elaborate steps involved in formulating a model and also give significance of modeling in chemical engineering. **(05)**

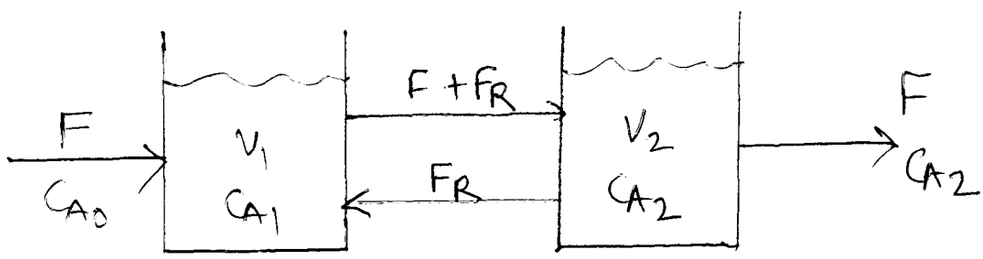
b) Derive the component continuity equation for a perfectly mixed CSTR with reaction as **(05)**



OR

Q.1 Derive the component continuity equations for a perfectly mixed batch reactor (no inflow or outflow) with first-order isothermal reactions in each case given below: **(10)**
i) Consecutive **ii)** Simultaneous **iii)** Reversible.

Q.2 An oil passes through two tank system of constant volume, it is suggested to add heat Q_1 to first tank and assume perfect mixing with back mixing in first tank, as shown in the sketch below. Assuming F and F_R are constant, Derive the equations describing the system. **(10)**



OR

Q.2 A hollow cylinder with an outer diameter of 10 cm and an inner diameter of 5 cm has an inner surface temperature of 200 °C and an outer surface temperature of 100 ^{0}C. Determine the temperature of the point halfway between the inner and outer surfaces. If the thermal conductivity of the cylinder material is 70 W/mK, determine the heat flow through the cylinder per linear metre. **(10)**

Q.3 Develop a mathematical model for ideal binary distillation column. State assumptions and degree of freedom. **(10)**

OR

Q.3 Elaborate the mathematical modeling for multicomponent nonideal distillation systems with a neat sketch for a single tray and governing equation considered for mathematical consistency. **(10)**

P.T.O.

Q.4 Consider a system in which temperature can change with time. An irreversible, exothermic reaction is carried out in a single perfectly mixed CSTR A $\rightarrow$ B with rate constant k and nth-order in reactant A and has a heat of reaction λ. 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 volumetric flow rate Fj, and with an inlet temperature of T_{j0} and exit temperature Tj. The volume of water in the jacket V, is constant. Estimate the model equation describing the system for perfectly mixed cooling jacket. **(10)**

OR

Q.4 Derive mathematical model for semi batch reactor with assumptions, governing equations and degree of freedom. **(10)**

Q.5 Elaborate the steps involved in Barkley and Motard algorithm. **(10)**

OR

Q.5 Elaborate simultaneous modular approach of simulation of chemical engineering system with flow diagram. **(10)**

Q.6 Elaborate any three numerical methods applied for treatment of nonlinear models. **(10)**

OR

Q.6 A CSTR is presently operating under steady state conditions. The first order reaction with k = 0.2 Sec^{-1} is occurring. Take reactor volume = 50 cc, volume flow rate = 50 cc/min and inlet concentration 0.5 moles/cc. At time t = 0, assume that the inlet concentration is changed to 0.6 moles/cc and kept in that level. Estimate equation describing concentration profile of reactant A. **(10)**

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