

# Home Assignment

Problem 1: An autocatalytic reaction  $A \rightarrow R$  takes place in a constant volume isothermal reactor. Component mass balances give the following reactor model:

$$\begin{aligned}\frac{dC_A}{dt} &= \frac{F}{V}(C_{Ain} - C_A) - kC_AC_R \\ \frac{dC_R}{dt} &= \frac{F}{V}(C_{Rin} - C_R) + kC_AC_R\end{aligned}\tag{1}$$

In the above model

- $C_{Ain}$  and  $C_{Rin}$  are the inputs
- $C_A$  and  $C_R$  are the states
- At steady state  $C_{Ain_s} = 1$  and  $C_{Rin_s} = 1$
- $\frac{F}{V} = 1$
- $k = 2$

1. Find the steady state values of  $C_A$  and  $C_R$
2. Linearize the model around the steady state and put it in the form

$$\frac{dX}{dt} = AX + BU\tag{2}$$

3. Suppose the system states are initially at their steady state values but both inputs suddenly increase to 1.5 from 1.0. How do  $C_A$  and  $C_R$  change with time ?