Assignment #2

(Submission Date: on or before 6 PM, 27/03/24)

Prob 1

Consider the following dynamic model of biochemical reactor

- $\frac{dC_b}{dt} = (\mu - F_d)C_b$
- $\frac{dC_s}{dt} = F_d\left(C_{sf} - C_s\right) - \frac{\mu C_b}{P}$

$\mu = \frac{\mu_m C_s}{k_m + C_s + k_1 C_s^2}$

Where, C_b and C_s are the biomass and substrate concentration respectively.

a) Derive linear state space model for the system to control c_b by manipulating F_d
b) Show that this reactor is not fully state controllable irrespective of parameter and steady state values.

Prob 2

Consider the following dynamic model of an isothermal reactor

- $\frac{dC_A}{dt} = \frac{F}{V}\left(C_{Af} - C_A\right) - k_1 C_A - k_3 C_A^2$
- $\frac{dC_B}{dt} = -\frac{F}{V} C_B + k_1 C_A - k_2 C_B$

Data: $k_1 = 50,\ k_2 = 100,\ k_3 = 10,\ C_{Af} = 10,\ V = 1$

a) Find the steady state values of C_A and C_B for steady state F=60.
b) Derive linear state-space model for the system to control C_B by manipulating F.
c) Design state feedback controller for the reactor using Bass-Gura method by judiciously placing the closed loop poles at desired location of your choice.