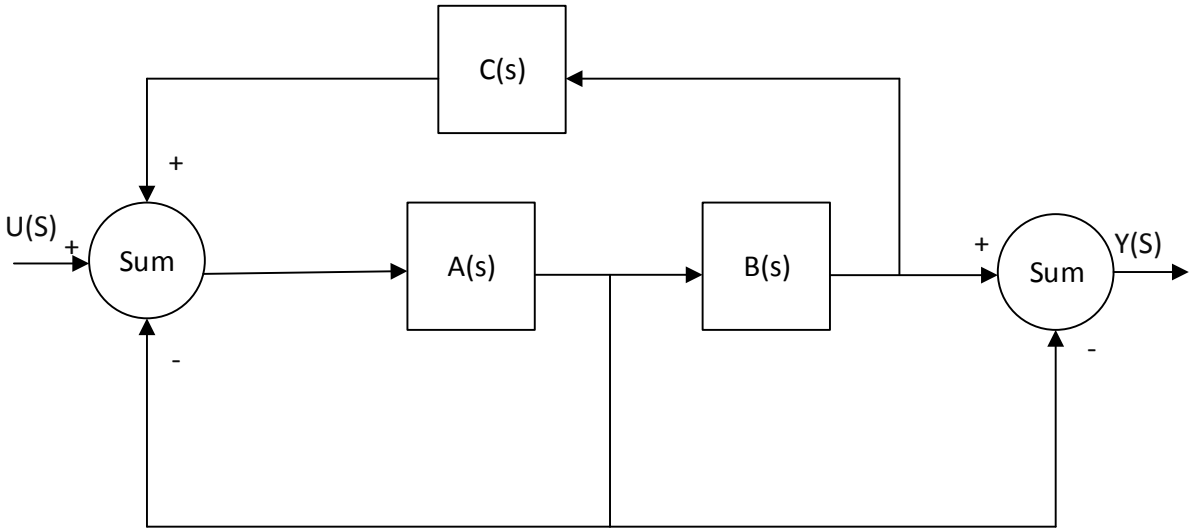
ECE 386 MIDTERM

DATE: 21-04-2016

Q1) Find the transfer function for the system whose state flow diagram is given below where the transfer function is $H(s) = \frac{Y(s)}{U(s)}$. **(15 points)**



Q2) The open loop transfer function of a system is given by the formula $G_o(s) = K\frac{(s+2)^2}{(s-1)^2(s+x)}$. It is also given that one of the break-in break-away points of this root locus plot is located at the point s=-3.

a) Find the value of x. **(10 points)**
b) Find the root locus plot with all the details (rules 6 and 7 are not valid for this root locus plot). **(35 points)**

Q3) A non-linear system is given by the formula

$$\dot{x} = \begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} x_1^2 + x_2^2 + e^{x_1} - 2 \\ x_1 - x_2 + u \end{bmatrix} = f(x,u) = \begin{bmatrix} f_1(x,u) \\ f_2(x,u) \end{bmatrix}$$

and

$$y = x_1^2 + x_2^2 = h(x,u)$$

a) Linearize this system and obtain the linearized systems state space representation around the set point y=1. (when the set point y=1 then determine the other set point values for x_1, x_2, and u such that they are all non-positive). **(7 points)**
b) Obtain the state flow diagram for the linearized system in the state flow diagram (in Laplace domain). In construction of state flow diagram only use derivative blocks (derivative block is represented by 's'), constant gain terms (example: K=1, K=5, K=-2 ect.) and summation blocks. **(13 points)**

Q4) A transfer function is given by the formula

$$H(s) = \frac{1-2s}{1+20s}$$

a) Find the magnitude response $|H(jw)|_{dB} = 20\log|H(jw)|$ in Decibels and plot approximately in logarithmic scale (obtain the Bode plot for magnitude response). **(8 points)**
b) Find the phase response $\angle H(jw)$ in Degrees and plot approximately in logarithmic scale (obtain the Bode plot for phase response). **(12 points)**