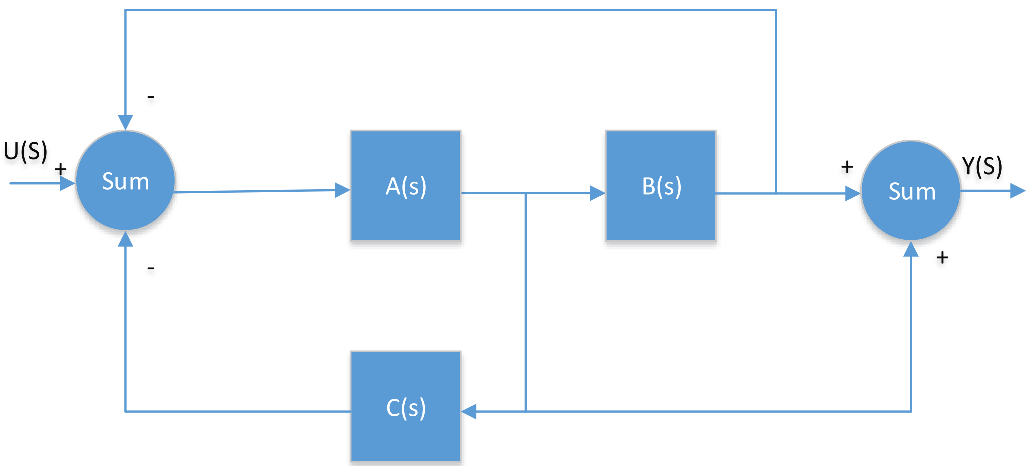
ECE 386 HOMEWORK I
DUE DATE: 20-04-2016

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



Q2) Find the root locus plot for the open loop transfer function $G_o(s)=K\dfrac{(s+1)}{s^2(s+2)}$. While obtaining the root locus plot apply all the rules except for rule 7. Apply rule 6 for finding the departure angles from the poles at the origin.

Q3) The open loop transfer function of a system is given by the formula $G_o(s)=K\dfrac{1}{(s+10)^2(s+x)}$. 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.
b) Find the root locus plot with all the details (rules 6 and 7 are not valid for this root locus plot).

Q4) a polynomial is given by the formula $p(s)=s^4+5s^3+3s^2+2s-1$. Using Routh Hurwitz method find the number of roots of p(s) in the open right half plane.

Q5) For a control system the reference signal and error relation in Laplace domain is given by the formula $E(s) = \frac{1}{G(s)C(s)+1} R(s)$, where E(s) is the error signal, r(s) is the reference signal, G(s) is the plant transfer function and C(s) is the controller transfer function. The open loop transfer function of the control system is given by the formula $C(s)G(s) = G_o(s) = K\frac{(s+2)}{s(s+1)(s+5)}$.

a) if $R(s) = \frac{1}{s}$ (unit step function represented in Laplace domain). Find the steady state error $e_{ss} = \lim_{t\to\infty} e(t) = \lim_{s\to 0} sE(s)$.

b) a) if $R(s) = \frac{1}{s^2}$ (unit step function represented in Laplace domain). Find the steady state error $e_{ss} = \lim_{t\to\infty} e(t) = \lim_{s\to 0} sE(s)$.

Q6) 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-negative).
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 integrator blocks ($\frac{1}{s}$), constant gain terms (example: K=1, K=5, K=-2 ect.) and summation blocks.
c) Obtain the state flow diagram of the non-linear model in time domain. In the diagram there can be summation blocks, integrator blocks (representation in time domain) and nonlinear operation blocks.

Q7) A transfer function is given by the formula

$$H(s) = \frac{1-10s}{1-20s}$$

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)
b) Find the phase response $\angle H(jw)$ in Degrees and plot approximately in logarithmic scale (obtain the Bode plot for phase response)