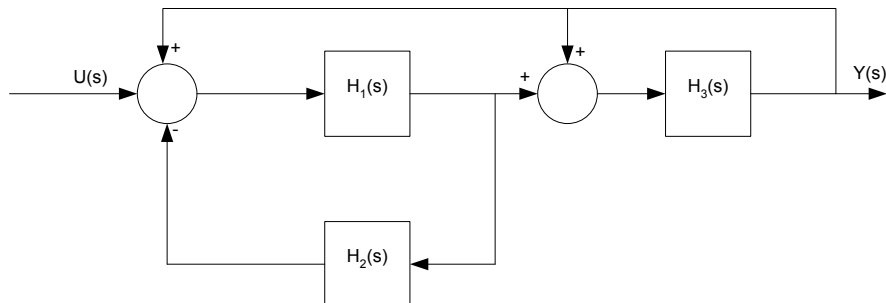


ECE 386 Midterm

Q-1- The input-output relation for a system is given by the following flow diagram in Laplace Domain ($U(s)$ is the input and $Y(s)$ is the output) . Find the transfer function of this system. **(15 points)**



Q-2- The representation of a non-linear system with is given by the formula

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} x_1^2 - \sqrt{x_2} \\ x_1^2 - 5 + x_2^3 + u \end{bmatrix}$$

$$y = x_2^2$$

where x_1 and x_2 are the states y is the output and u is the input.

- The set points (for the output) of the system is given as $y_{sp}=0$. Compute the set point for the input u_{sp} and for the states x_{1sp} and x_{2sp} . **(5 points)**
- Linearize the system and obtain the state-space representation of this non-linear system around the set point. **(10 points)**

Q-3- A polynomial is given by the formula $x(s) = s^4 + 5s^3 + 6s^2 - 4s - 8$. Using Routh-Hurwitz method find the number of roots of this polynomial in OPEN RIGHT HALP PLANE (roots of the polynomial with real parts greater than 0). **(15 points)**

Q-4- The open loop transfer function a system is given by the formula $G_0(s) = \frac{K}{(s+5)(s+15)}$.

Draw the root-locus of this system with all details. **(25 points)**

Q-5- The open loop transfer function a system is given by the formula $G_0(s) = \frac{Ks}{(s-1)^2}$. Draw

the root-locus of this system with all details. **(30 points)**