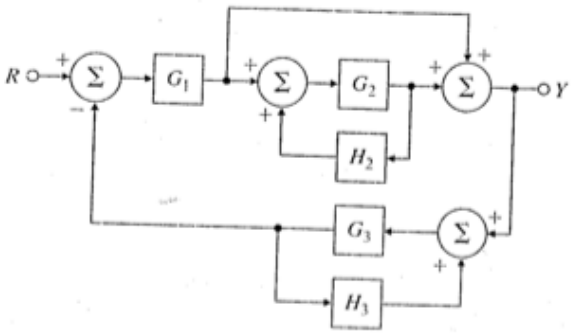
ECE 486, FALL 2023 **PROBLEM SET 2** **Due Friday, Oct 20**

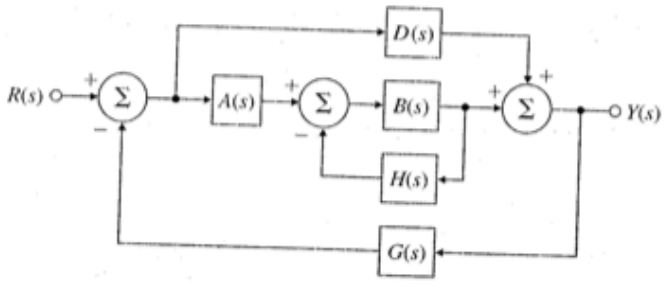
Reading: FPE (Franklin, Powell, Emami-Naeini, 6th or 7th edition), Sections Sections 3.1 and 3.2. Sections 3.3–3.6.

Problems:

1. Using techniques for block diagram reduction discussed in class, find the transfer functions of the systems shown below (p156 from the textbook, 3rd edition)



(a)



(b)

2. Consider the following state-space model (so-called "observer canonical form"):

$$\begin{pmatrix} \dot{x}_1 \\ \dot{x}_2 \end{pmatrix} = \begin{pmatrix} 0 & -a_0 \\ 1 & -a_1 \end{pmatrix} \begin{pmatrix} x_1 \\ x_2 \end{pmatrix} + \begin{pmatrix} b_0 \\ b_1 \end{pmatrix} u, \qquad y = \begin{pmatrix} 0 & 1 \end{pmatrix} \begin{pmatrix} x_1 \\ x_2 \end{pmatrix}.$$

Build an all-integrator diagram for this system.

3. Consider the plant with transfer function $L(s) = \dfrac{1}{s^2 + 2s + K}$ where K is a positive parameter you can tune.

a) Consider the settling time spec $t_s \leq 4$. Give some value (or range of values) of K for which the system meets this spec. Justify your choice.

b) Consider the rise time spec $t_r \leq 1$. Give some value (or range of values) of K for which the system meets this spec.

c) Consider the overshoot spec $M_p \leq 0.1$. Give some value (or range of values) of K for which the system meets this spec. Justify your choice.