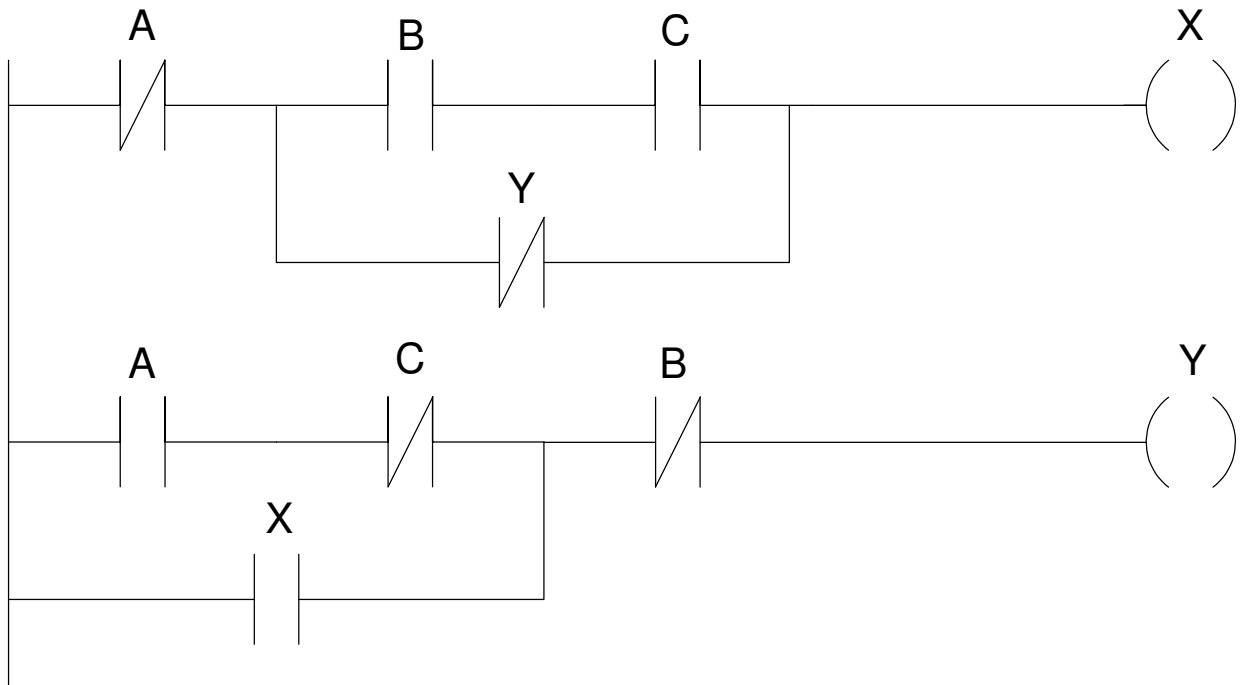


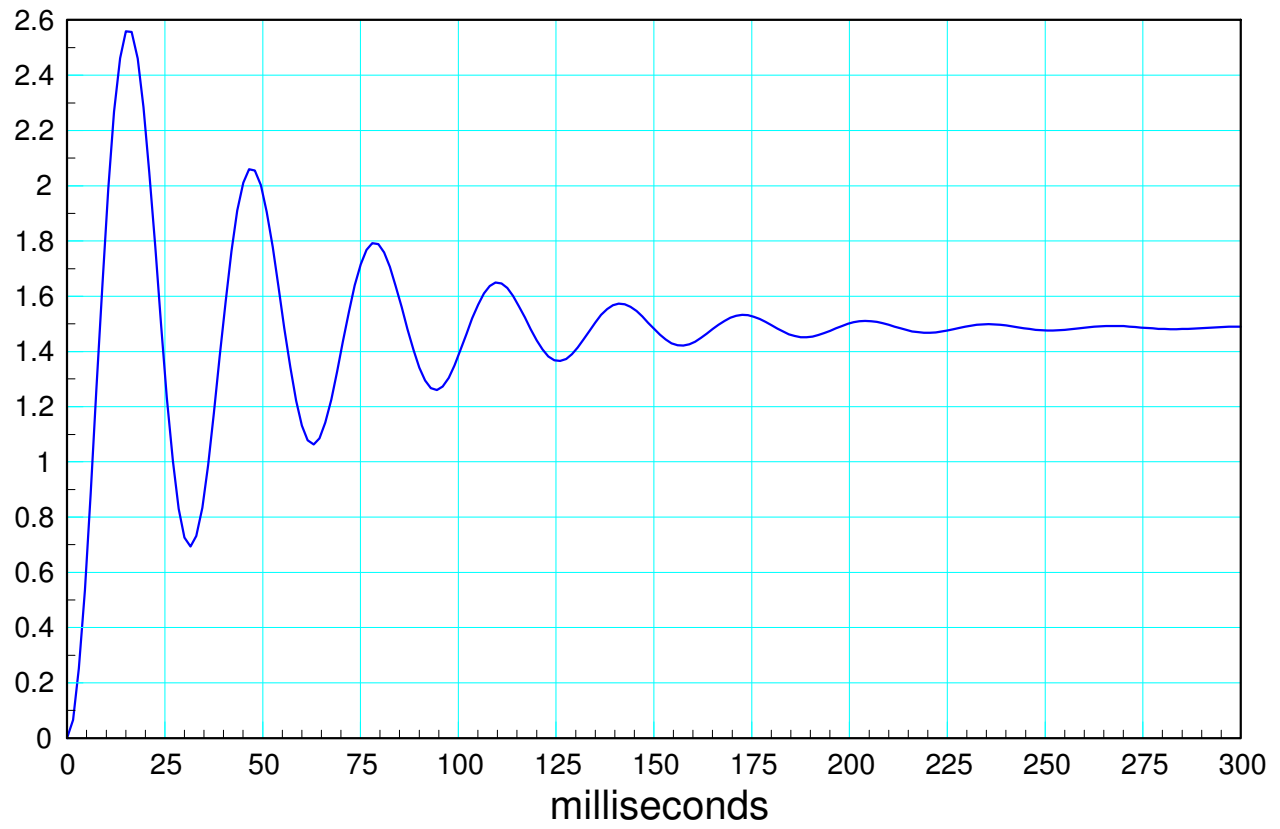
ECE 461/661 - Test #1: Name _____

Fall 2023

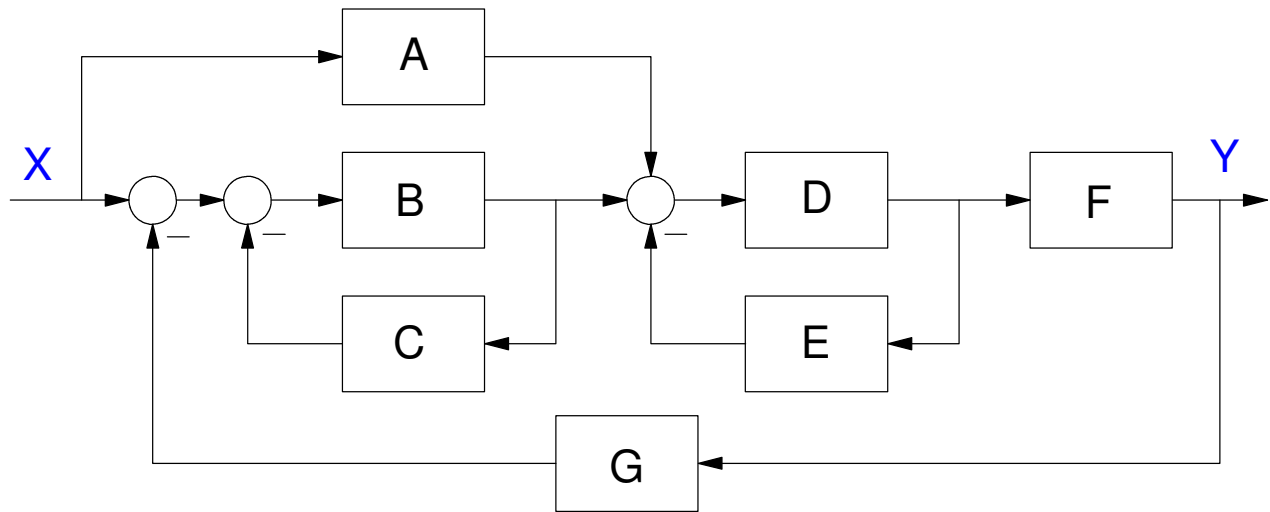
1) Determine the functions for X and Y according to the following ladder diagram. (you don't need to simplify)



2) Give the transfer function for a system with the following response to a unit step input:

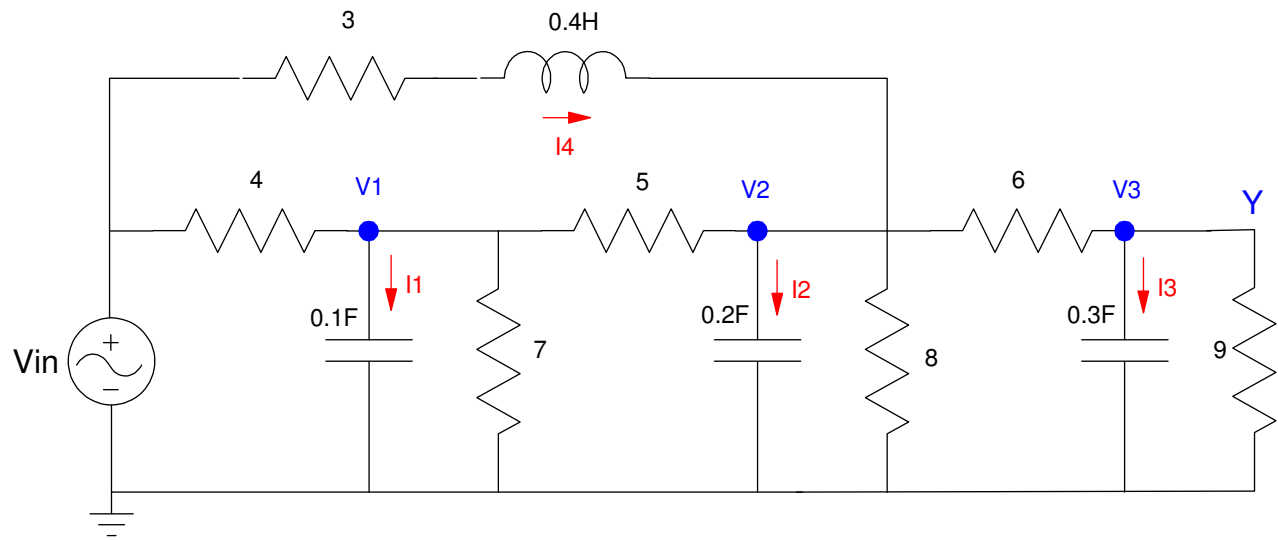


3) Find the transfer function from X to Y



4) For the following RLC circuit:

- Write the dynamics of this system as four coupled differential equations in terms of $\{V_{in}, V_1, V_2, V_3, I_4\}$
- You don't need to solve or put in state-space form (that's a different problem on the test)



5) Assume the dynamics of a mass-spring system are as follows.

$$(2s^2 + 4s + 8)x_1 - (10s + 12)x_2 = F$$

$$(5s^2 + 15s + 30)x_2 - (2s + 6)x_1 = 0$$

- Give the state-space representation for the dynamics.
- Assume the output is $Y = x_1 - x_2$

$$s \begin{bmatrix} x_1 \\ x_2 \\ s x_1 \\ s x_2 \end{bmatrix} = \begin{bmatrix} \text{---} & \text{---} & \text{---} & \text{---} \\ \text{---} & \text{---} & \text{---} & \text{---} \\ \text{---} & \text{---} & \text{---} & \text{---} \\ \text{---} & \text{---} & \text{---} & \text{---} \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ s x_1 \\ s x_2 \end{bmatrix} + \begin{bmatrix} \text{---} \\ \text{---} \\ \text{---} \\ \text{---} \end{bmatrix} F$$

$$Y = \begin{bmatrix} \text{---} & \text{---} & \text{---} & \text{---} \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ s x_1 \\ s x_2 \end{bmatrix} + \begin{bmatrix} \text{---} \end{bmatrix} F$$