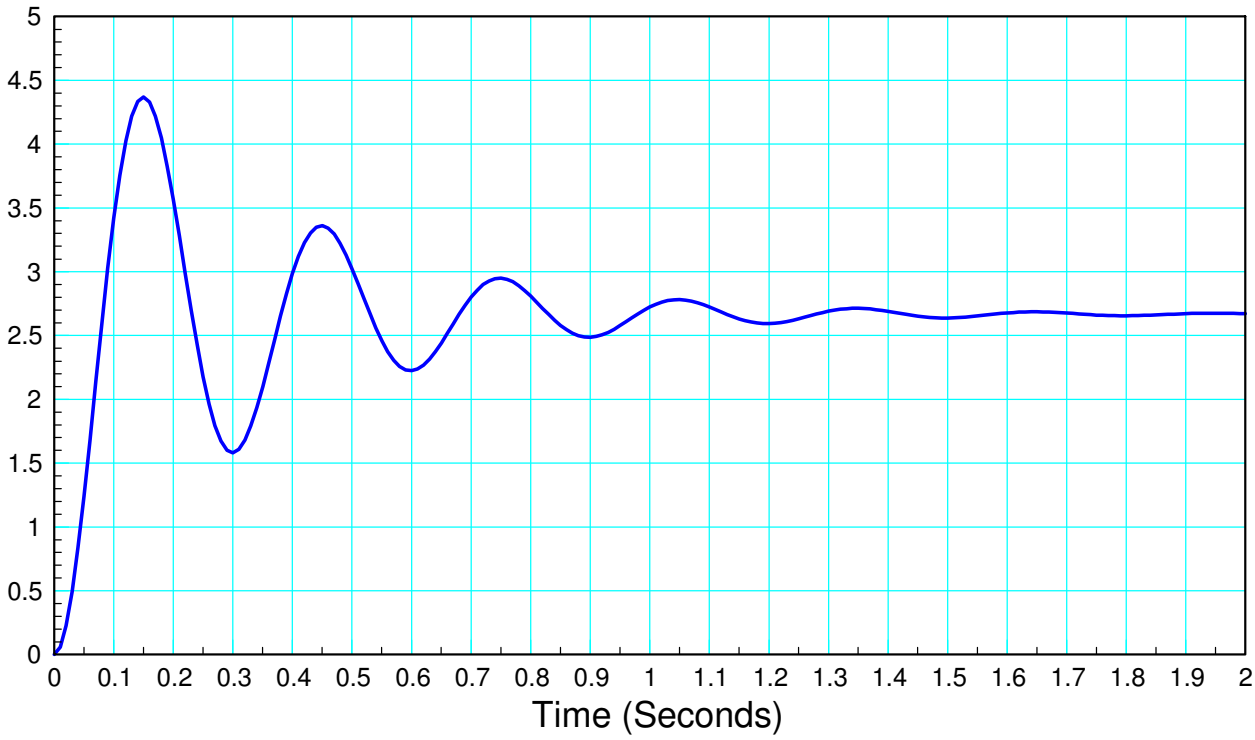
ECE 463/663: Test #1. Name _____

Spring 2023. Calculators allowed. Individual Effort

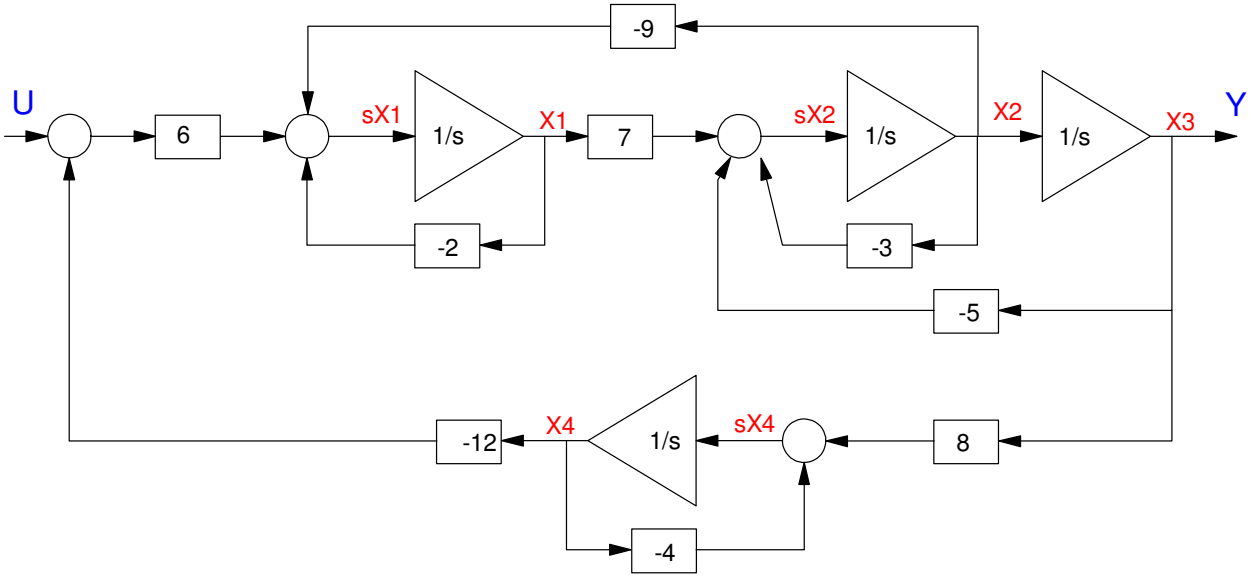
1) Find the transfer funciton for a system with the following step response



2) Determine a 2nd-order system which has approximately the same step response as the following system

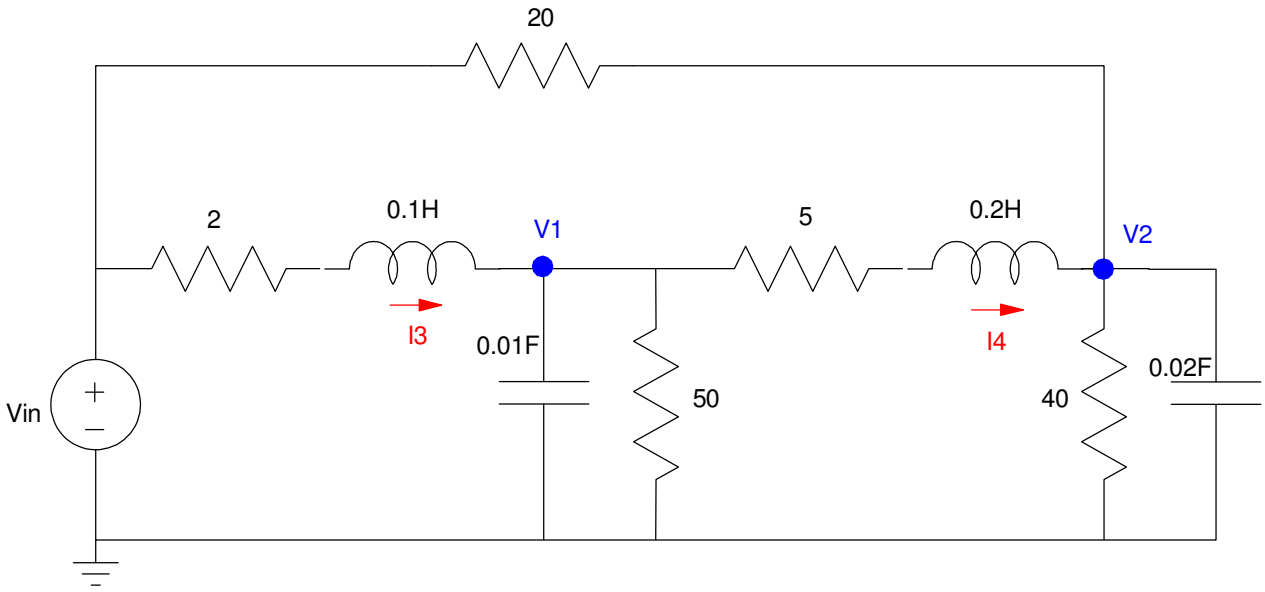
$$Y = \left(\frac{10{,}000}{(s+3)(s+4)(s+12)(s+15)(s+22)} \right) X$$

3) Give {A and B} for the the state-space model for the following system



$$\begin{bmatrix} sX1 \\ sX2 \\ sX3 \\ sX4 \end{bmatrix} = \begin{bmatrix} & & & \\ & & & \\ & & & \\ & & & \end{bmatrix} \begin{bmatrix} X1 \\ X2 \\ X3 \\ X4 \end{bmatrix} + \begin{bmatrix} \\ \\ \\ \end{bmatrix} U$$

4a) Write four coupled differential equations to describe the following circuit. Assume the states are {V1, V2, I3, I4}. Note: For capacitors: $I = C\frac{dV}{dt}$, For inductors: $V = L\frac{dI}{dt}$



5) Assume the LaGrangian is:

$$L = 3x^2\dot{x}^3\dot{\theta}^4 + 2x\sin(\theta)$$

Determine

$$F = \frac{d}{dt}\left(\frac{\partial L}{\partial \dot{x}}\right) - \left(\frac{\partial L}{\partial x}\right)$$