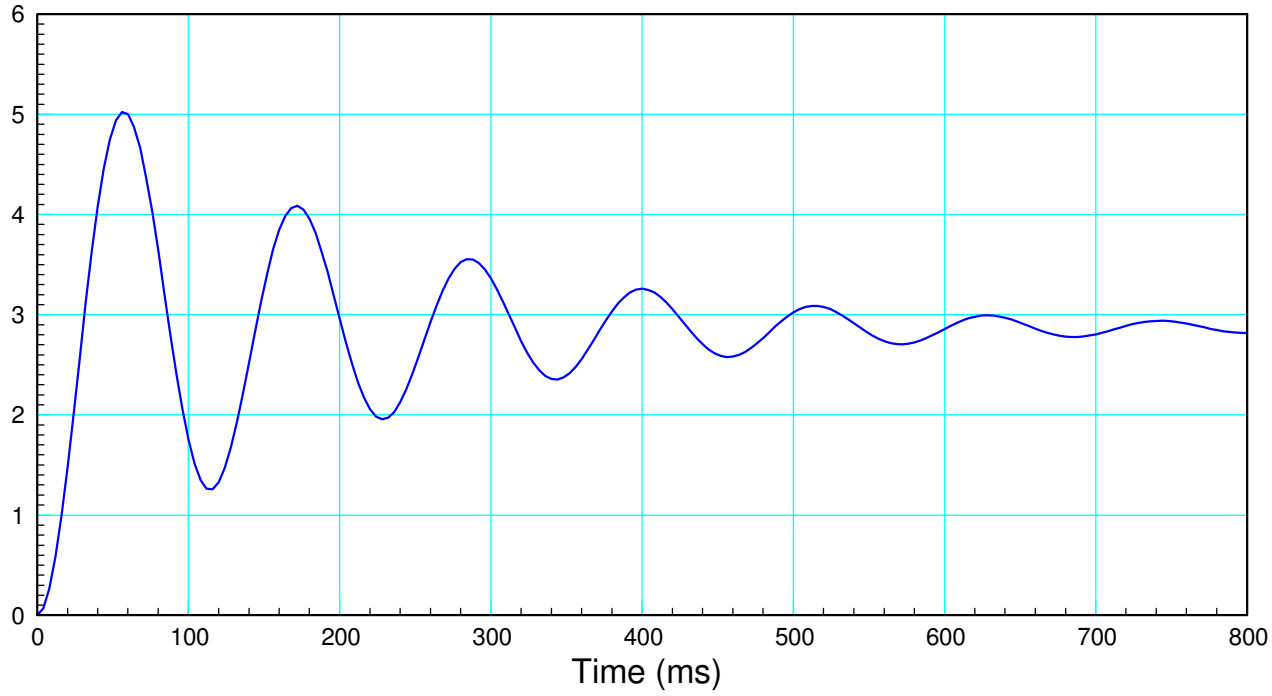
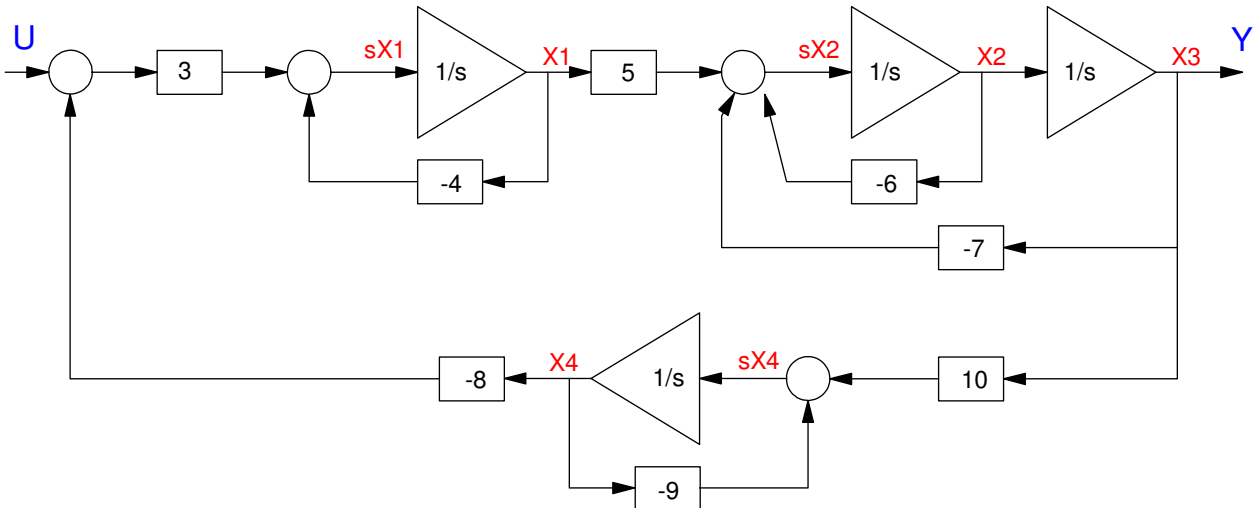
CE 463/663: Test #1. Name _____

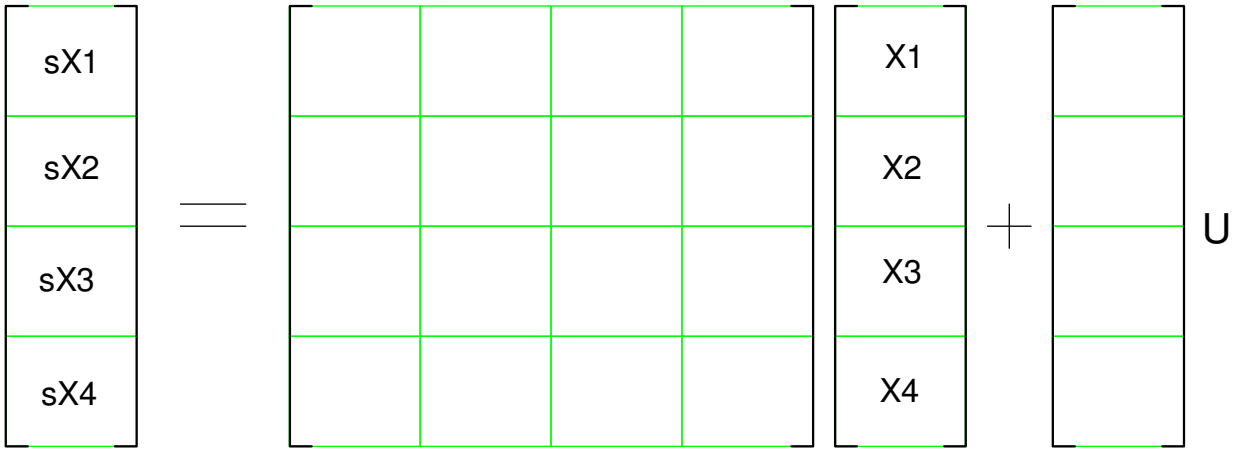
Spring 2021. Open Book, Open Notes. Calculators & Matlab allowed. Individual Effort

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



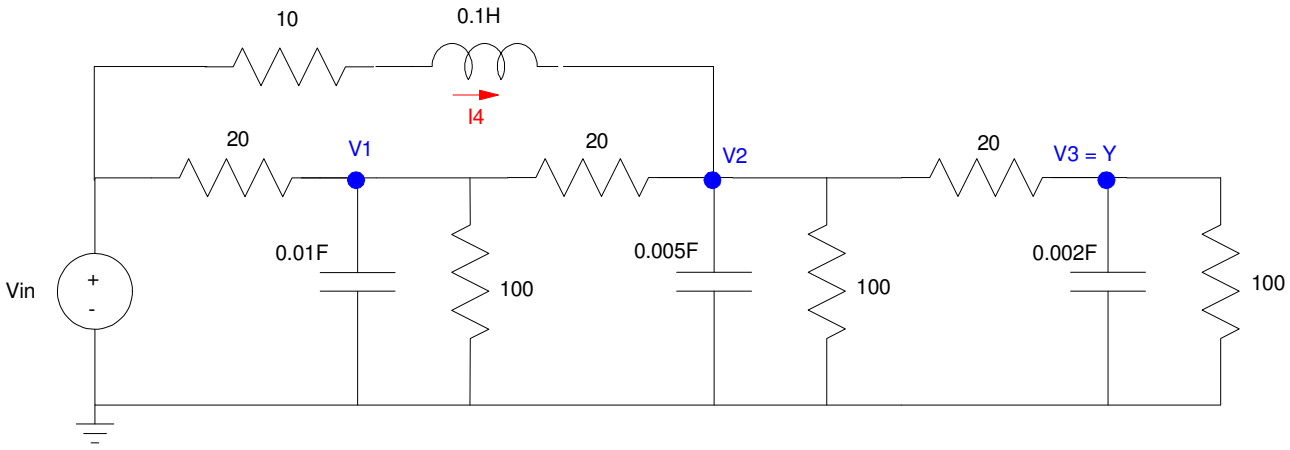
2) Give {A and B} for the the state-space model for the following system



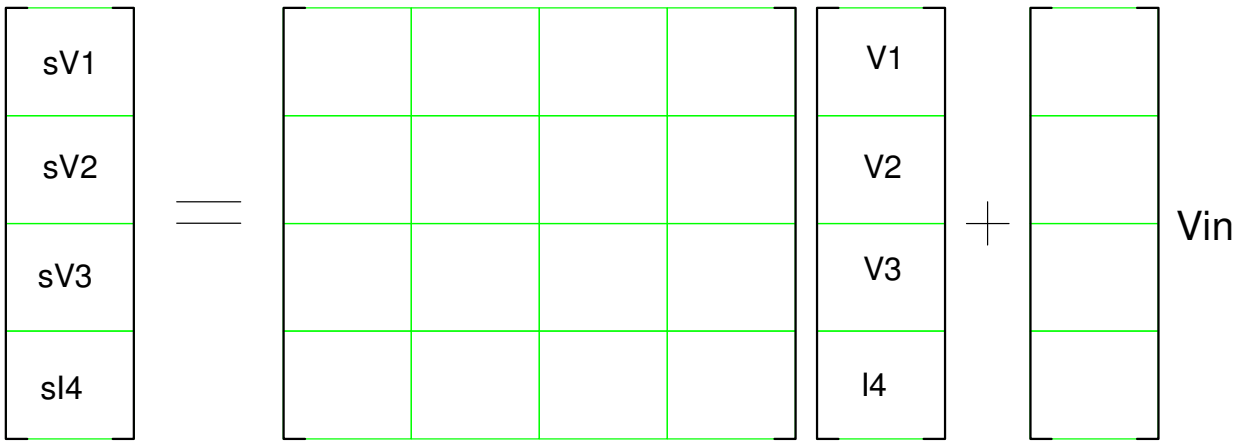


Problem 3) Option #1 (you may work either problem #3 - electrical or mechanical)

3a) Write four coupled differential equations to describe the following circuit

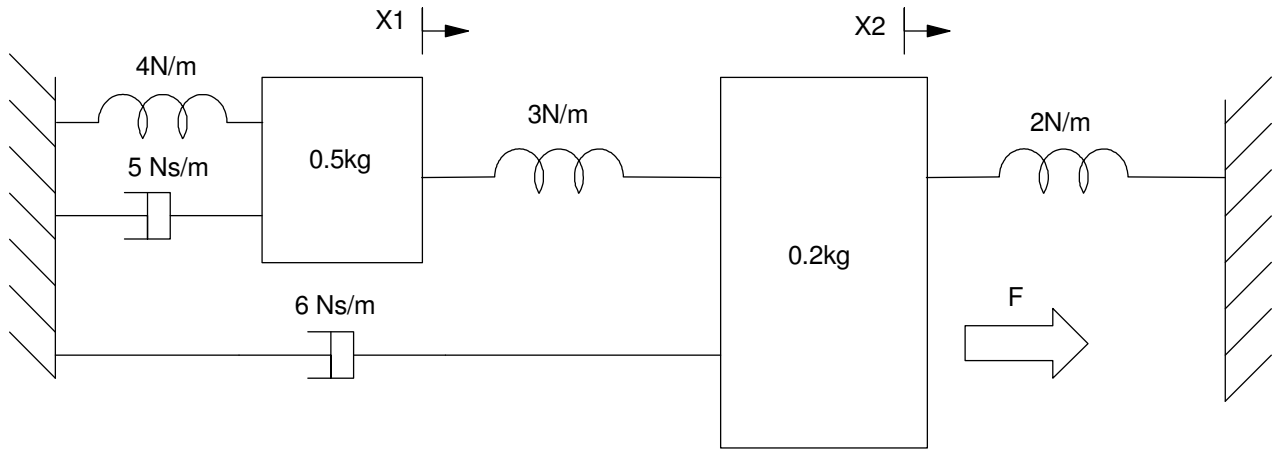


3b) Express the A and B matricies for the dynamics in state-space form

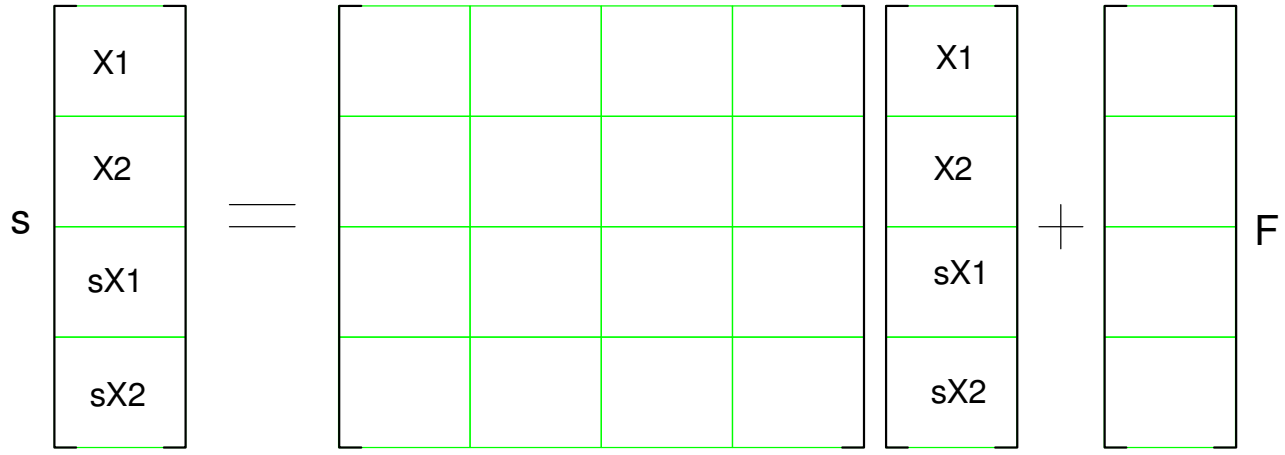


Problem 3) Option #2 (you may work either problem #3 - electrical or mechanical)

3a) Write two coupled differential equations to describe the following mass-spring system



3b) Express the A and B matricies for the dynamics in state-space form



4) A ball with a mass of 1kg is rolling on a surface with the shape

$$y = 3 + x \cdot \cos(x)$$

Determine the potential and kinetic energy of the ball in terms of x:

4a) $PE = mgy = f(x)$

4b) $KE = 0.7m\left(\dot{x}^2 + \dot{y}^2\right) = g(x, \dot{x})$

5) Assume the LaGrangian is:

$$L = 0.7\dot{x}^2\dot{\theta} + 0.5\dot{x}\dot{\theta}\sin(\theta) - gx\cos\theta$$

Determine

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