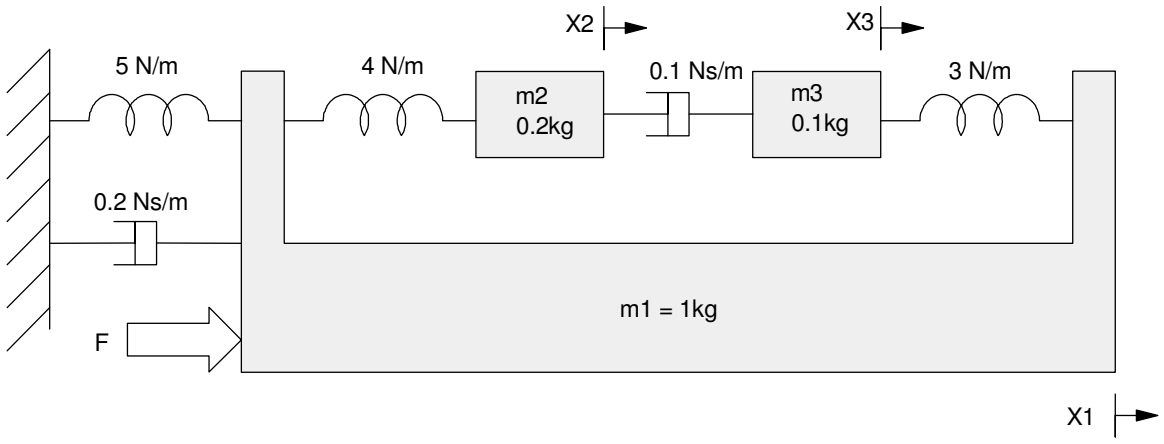
Homework #6: ECE 461/661

Mass-Spring Systems, Rotational Systems, DC Motors. Due Monday, September 26th

Mass Spring systems

1) (20pt) Draw the circuit equivalent for the following mass-spring systems.

- Express the dynamics in state-space form
- Find the transfer function from F to X2
- Plot the step response from F to X2

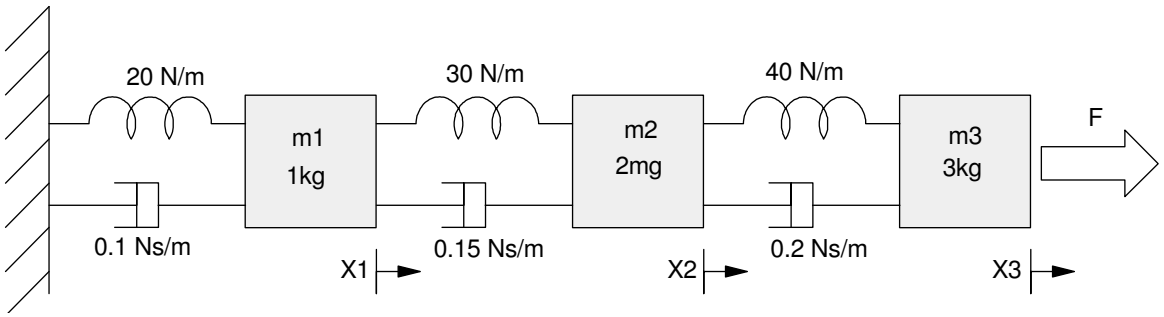


Problem 1

2) (20pt) Draw the circuit equivalent for the following mass-spring systems.

- Express the dynamics in state-space form
- Find the transfer function from F to X3

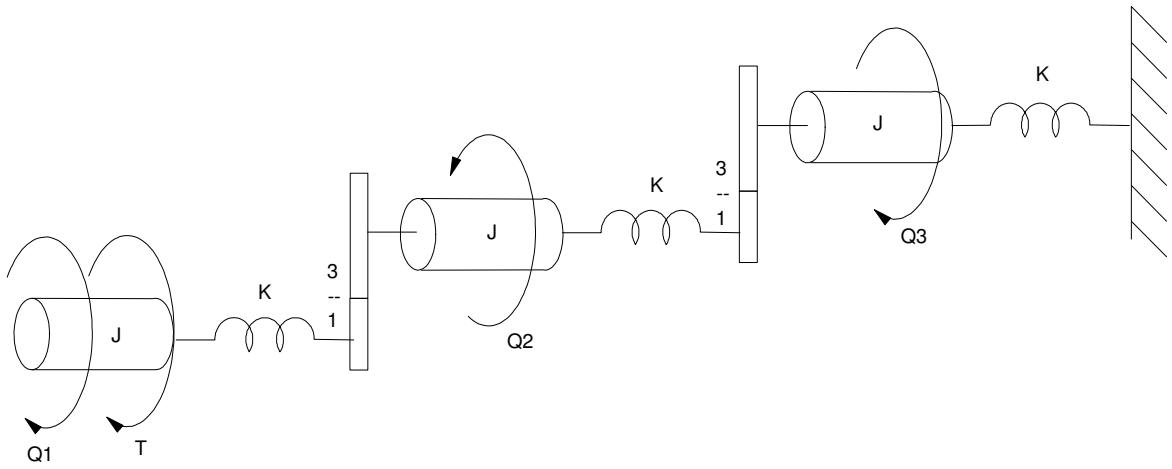
Plot the step response from F to X3



Rotational Systems

3) Draw the circuit equivalent for the following rotational system.

- Express the dynamics in state-space form
- Find the transfer function from T to Q1
- Plot the step response from T to Q1



Problem 3: J = 0.5 Kg m / s^2. K = 10 Nm/rad

Motors

4) Find the transfer function for the following DC servo motor

http://www.baldor.com/catalog/CDP3335

Allen Bradley CDP3335: 1/2 HP DC Servo Motor

- $1243 ea
- Armature Resistance = Ra = 0.664 Ohms
- Armature Inductance = La = 5.119mH
- Armature Inertia = J = 6.318 lb-ft2
- 4.6A @ 2426 rpm @ 1 ft-lb load
- Weight 26.0 lb

5) Assume this motor is used to power an electric bicycle at 20mph

- Motor speed @ 20mph = 2426 rpm
- Gear (wheel) used to convert 2426 rpm to 20mph
- Bicycle weight = 100kg

What is the gear reduction (wheel diameter) to convert 2426rpm to 20mph?

What is the inertia relative to the DC servo motor (bring the 100kg mass back to the motor through a gear)

What is the transfer function (dynamics) for the bicycle / servo motor combination?