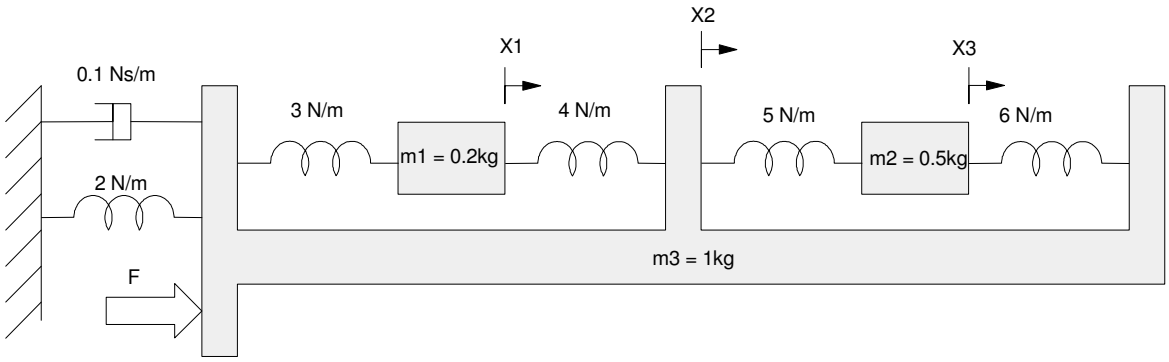
Homework #6: ECE 461/661

Mass-Spring Systems, Rotational Systems, DC Motors. Due Monday, September 25th

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

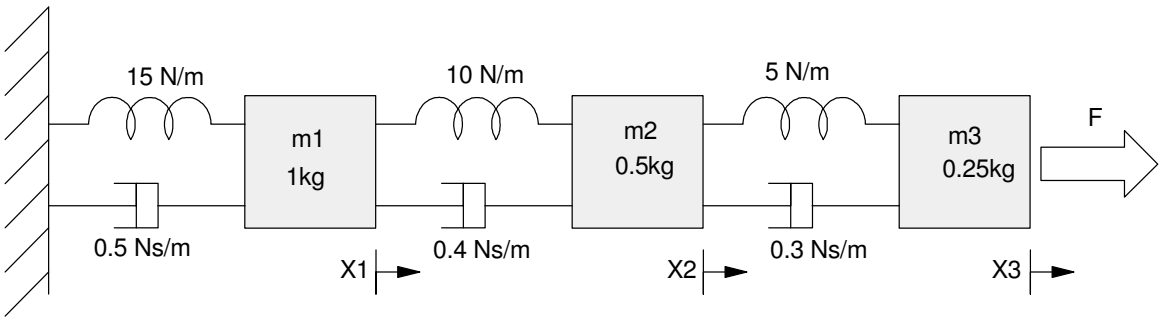


Problem 1

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

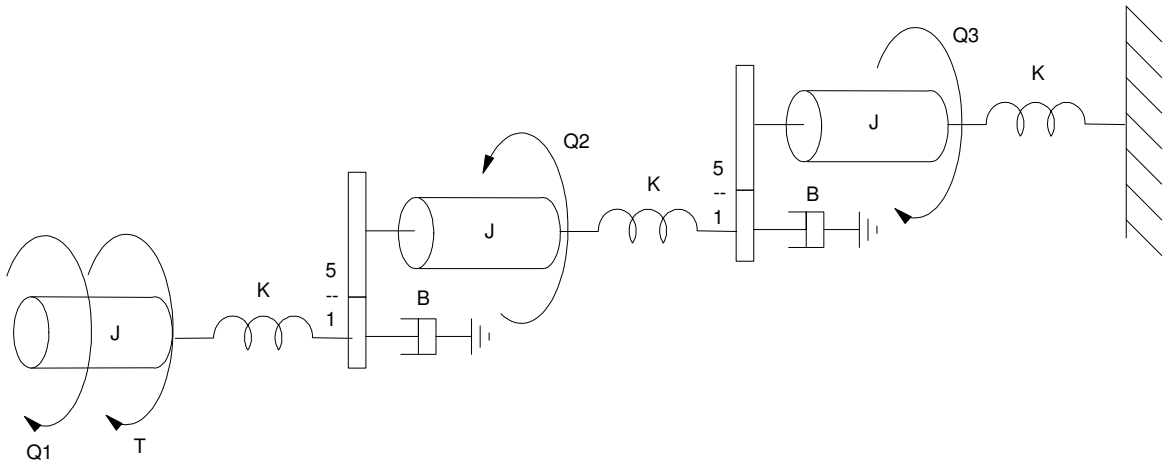
Plot the step response from F to X3



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 = 0.2 Kg m / s^2, B = 0.1 Ns/m, K = 5 Nm/rad

Motors

4) Find the dynamics for a AM80-300 DC Servo Motor. It's specs are

- V(input) = 48VDC
- Ke = 14.1 V/krpm
- Rt = 0.67 Ohs
- Io = 0.50 Amps no load current @ 3404 rpm

When driving 1.01Nm torque

- Ia = 8.00 Amps
- w = 3048 rpm
- Pout = 322 Watts

Size = 50.00mm diameter, 89.21mm long, .

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

- Motor speed @ 20mph = 3048 rpm @ 322 Watts
- Gear (wheel) used to convert 3048 rpm to 20mph
- Bicycle weight = 100kg

What is the gear reduction (wheel diameter) to convert 3048 rpm to 20 mph?

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?