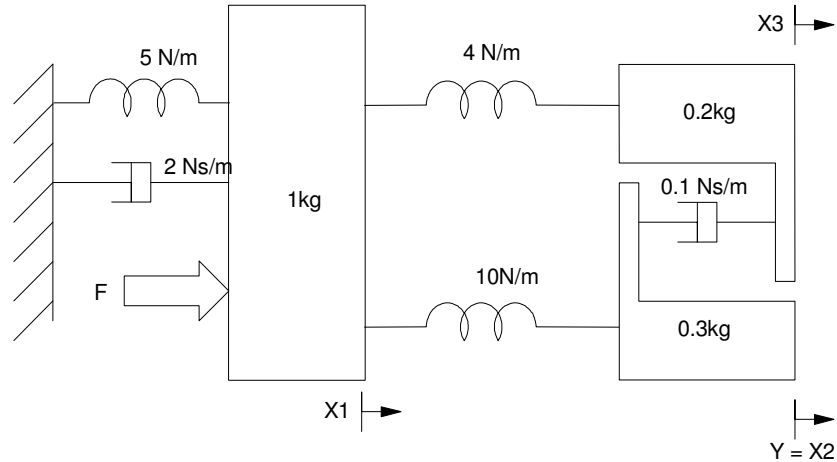# Homework #5: ECE 461/661

Mass-Spring Systems, Rotational Systems.   Due Monday, September 28th

Mass Spring systems

1) 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
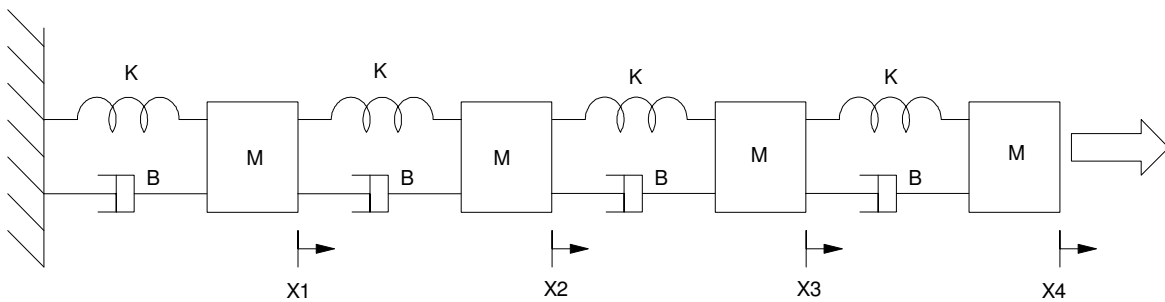- Plot the step response from F to X2

Problem 1

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

- Express the dynamics in state-space form
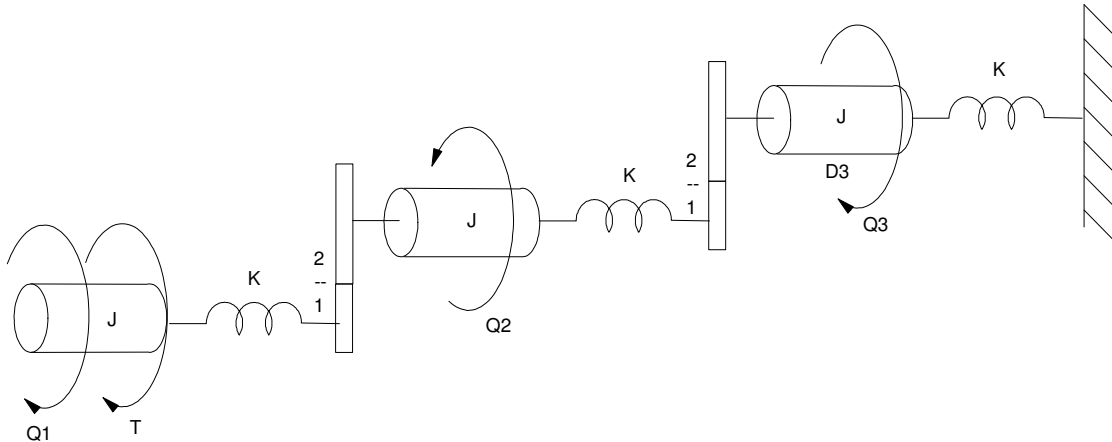- Find the transfer function from F to X4

Plot the step response from F to X4

Problem 6: M = 0.5kg, B = 0.3 Ns/m, K = 7 N/m

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 = 0.1 Kg m / s^2. K = 5 Nm/rad, D3 = 0.4 Nms/ rad

Motors

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

http://www.regalbeloit.com.my/pdfs/motors/TA_Servo_DC_Baldor.pdf

Baldor MT4525-BTYCN: 1100W DC Servo Motor (1.5hp)

- $649ea
- Kt = 0.61 Nm/A
- Ra = 1.99 Ohms
- La = 9.0mH
- J = 0.0016 kg m2
- Mechanical time constant = 8.43ms
- Electrical time constant = 4.520ms
- Weight 7.0kg

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

- Motor speed @ 20mph = 2500 rpm
- Gear (wheel) used to convert 2500 rpm to 20mph
- Bicycle weight = 100kg

What is the gear reduction (wheel diameter) to convert 5000rpm 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?