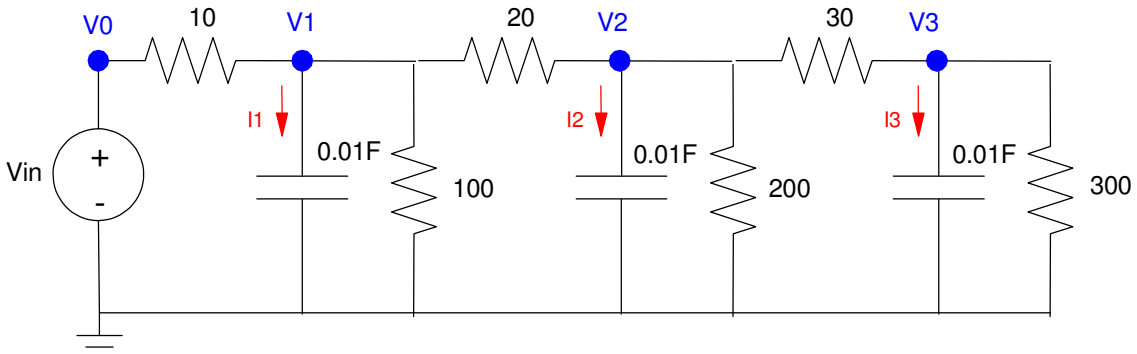
Homework #6: ECE 461/661

Electric Circuits, Mass-Spring Systems, Rotational Systems. Due Monday, September 29th

RC Ciruits

1) Express the dynamics of the following circuit in state-space form
   - Find the transfer function from Vin to V3

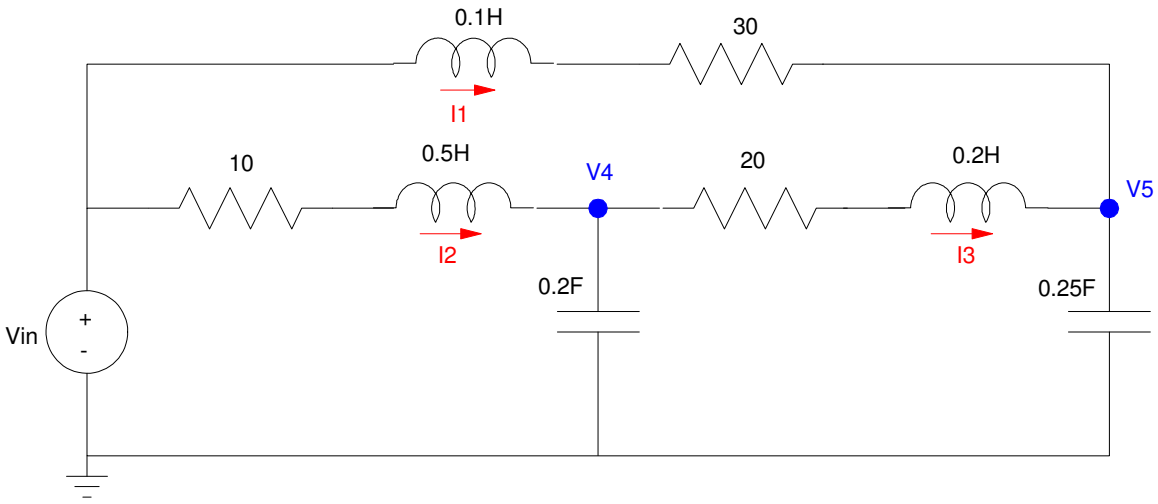


Problem #1

RLC Ciruits

2) Express the dynamics of the following circuit in state-space form
   - Find the transfer function from Vin to V5

3) Assime Vin = 0. Specify the initial conditions so that the total energy at t = 0 is 1.0 Joules and
   - The transients decay as slow as possible
   - The transients decay as fast as possible

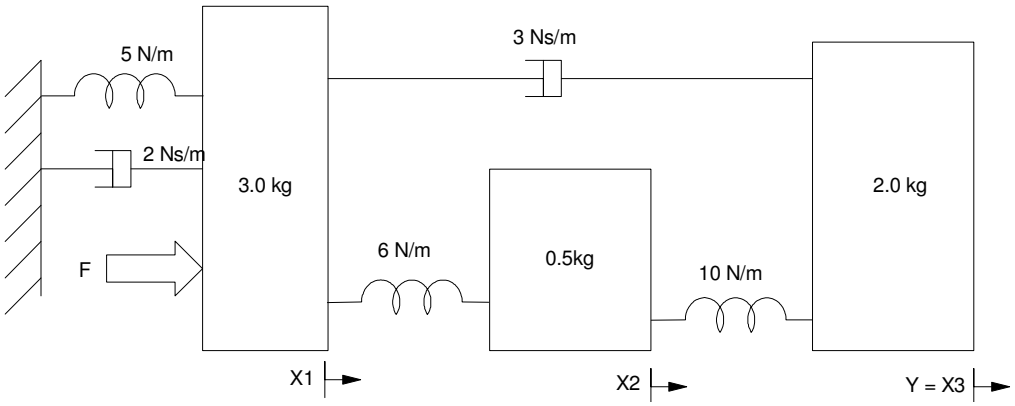


Problem #2 and #3

Mass Spring systems

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

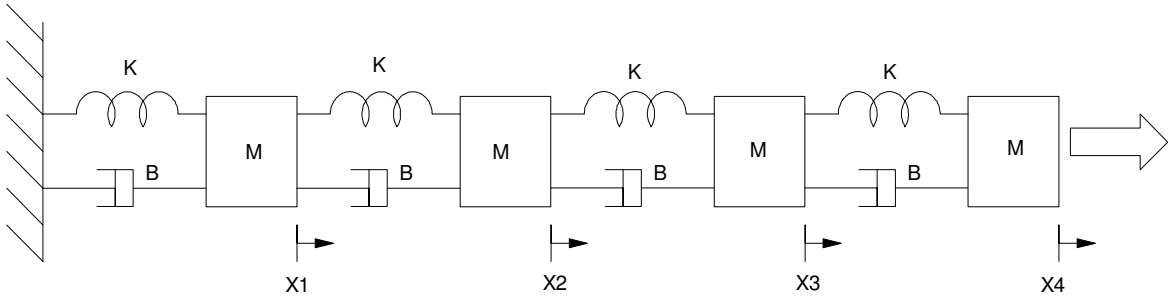
- Express the dynamics in state-space form
- Find the transfer function from F to X2
- Plot the step response from F to X2



Problem 4

5) 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

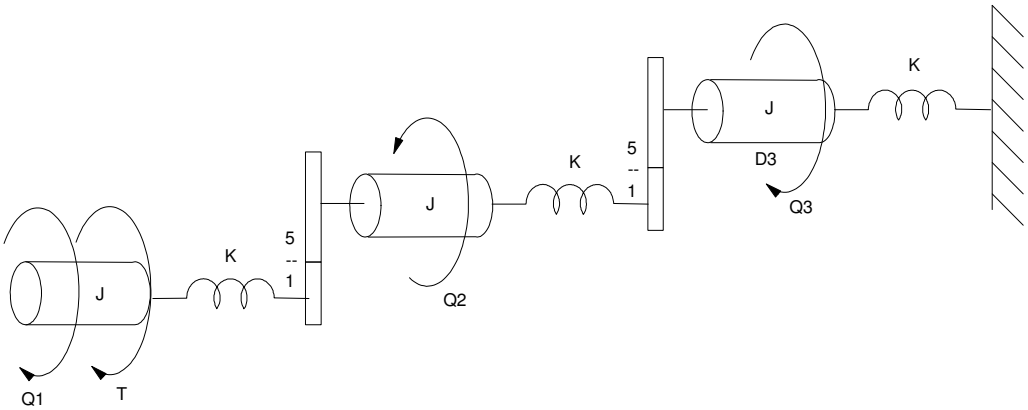


Problem 5: M = 2.0kg, B = 0.3 Ns/m, K = 10 N/m

Rotational Systems

6) 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 6: J = 2.5 Kg m / s^2. K = 20 Nm/rad, D3 = 1.5 Nms/ rad

Motors - Skip problem 7 & 8 (homework set is long enough as it is)

~~7) Find the transfer function for the following DC servo motor~~

~~http://www.baldor.com/catalog/CDP3306~~

~~Allen Bradley CDP3306: 1/4 HP Servo Motor~~

- ~~$716ea~~
- ~~Kt = 1.117 ft-lb @ 1.68A~~
- ~~Ra = 8.54 Ohms~~
- ~~La = 60.59mH~~
- ~~J = 4.680 lb-ft2~~
- ~~1.43A @ 1690rpm @ 0.945 ft-lb load~~
- ~~0.1A @ 180V @ 1830rpm @ 0 ft-lb load~~
- ~~Weight 23.0kg~~

~~8) Assume this motor is used to power an electric bicycle at 20mph~~

- ~~Motor speed @ 20mph = 1750 rpm~~
- ~~Gear (wheel) used to convert 1750 rpm to 20mph~~
- ~~Bicycle weight = 100kg~~

~~What is the gear reduction (wheel diameter) to convert 1750rpm 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?~~