EENG307: Intro to Feedback Control

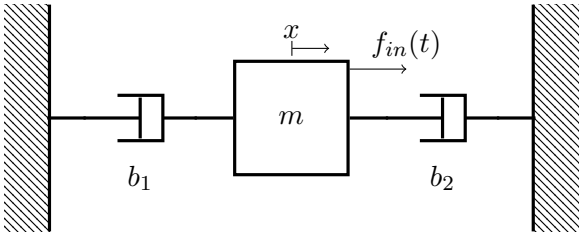
Fall 2020

Homework Assignment #1

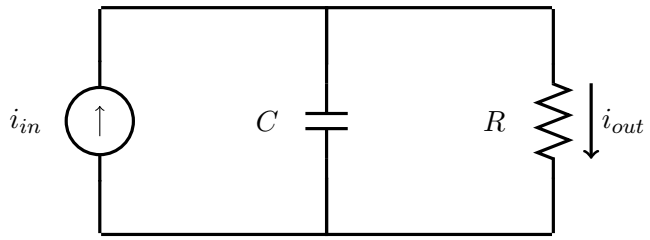
Due: 11:59pm, Monday, Aug 31st, 2020.

1. Plot the following complex numbers in the complex plane, and convert to polar form, writing in exponential form $re^{j\theta}$, where θ is in radians between $-\pi$ and π.
   (a) $s = 1 + j$
   (b) $s = -1 + 2j$
   (c) $s = -1 - j$
   (d) $s = 1 - 2j$

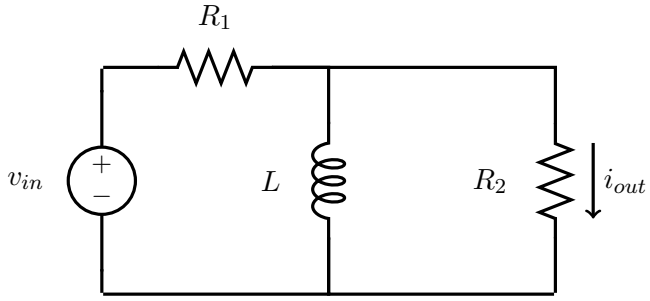
2. Find the differential equation that describes the system. Put all terms involving x on the left side of the equal sign, and all terms involving f_{in} on the right:



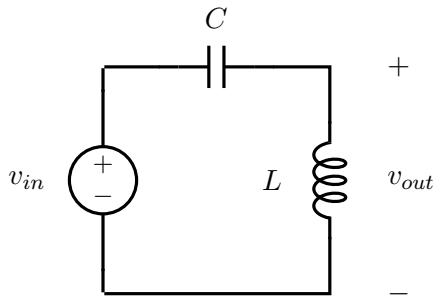
3. Find a differential equation that describes the circuit that includes only i_{in} and i_{out} as variables. Put all terms involving i_{in} on one side of the equal sign, and all terms involving i_{out} on the other.



4. Find a differential equation that describes the circuit that includes only v_{in} and i_{out} as variables. Put all terms involving v_{in} on one side of the equal sign, and all terms involving i_{out} on the other.

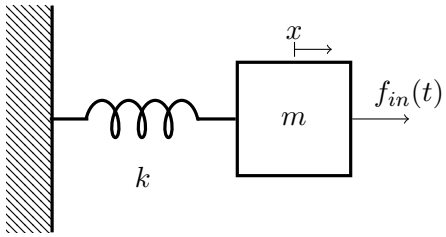


5. Find a differential equation that describes the circuit that includes only v_{in} and v_{out} as variables.



6. Quiz Question Friday: Evaluate each of the following to a complex number in polar form
   (a) $(1+j)(-1+2j)$
   (b) $\frac{-1-j}{1-2j}$

7. Quiz Question Monday: Find the differential equation that describes the following system. Put all terms involving x on the left side of the equal sign, and all terms involving f_{in} on the right.



8. To help us get to know you, please edit your Canvas profile to add a profile picture in which we can see your face. For help, see https://community.canvaslms.com/docs/DOC-10599-4212710334.

9. As part of the course, we will be using MATLAB as a tool for doing numerical calculations and displaying results. If you are not familiar with MATLAB, please go through the Matlab on-ramp tutorial https://www.mathworks.com/training-schedule/matlab-onramp.html. At the completion of the tutorial, you can generate a certificate indicating your completion. As part of your homework, either submit the certificate, or submit a statement "I am already very familiar with Matlab and take responsibility for knowing what was covered in the Matlab on-ramp tutorial."

Solutions:

1. (a) $\sqrt{2}e^{j\pi/4} = \sqrt{2}e^{j0.785}$
   (b) $\sqrt{5}e^{j2.03}$
   (c) $\sqrt{2}e^{-j3\pi/4} = \sqrt{2}e^{-j2.36}$
   (d) $\sqrt{5}e^{-j1.11}$
2. $m\ddot{x} + (b_1 + b_2)\dot{x} = f_{in}$
3. $RC\frac{di_{out}}{dt} + i_{out} = i_{in}$
4. $\frac{R_1R_2}{L}i_{out} + (R_1 + R_2)\frac{di_{out}}{dt} = \frac{dV_{in}}{dt}$
5. $LC\frac{d^2V_{in}}{dt^2} = LC\frac{d^2V_{out}}{dt^2} + V_{out}$