EE 327 Signals and Systems 1
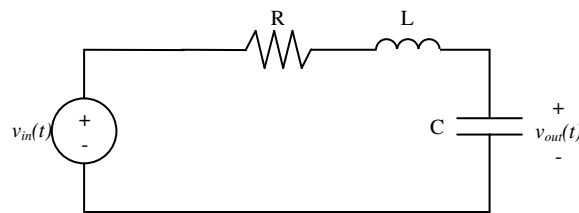MATLAB Assignment 3
5 Points

Objective
To design a filter and verify its performance using MATLAB.

Filter Design
You are to design a continuous-time, second-order, lowpass filter that has the following specifications.
- Corner frequency of 1Mrad/sec (159kHz)
- $Q = 5$
- Passband gain of 1

In your filter design, use the following circuit.

You are given a 10mH inductor. Design the resistor and capacitor sizes. You must list the theoretical values for the
- Time constant
- Gain at the corner frequency
- Percent overshoot

based upon the transfer function of your resulting system.

Bode Plot
Verify your filter design by using MATLAB to plot the frequency response. Use the `bode` function in MATLAB for the frequency response. Determine (1) the passband gain, (2) the corner frequency, and (3) the gain at the corner frequency (*AQ*) from the resulting frequency-response plots. Indicate how you found these values either on the plots themselves or by using Matlab code to evaluate the results of the `bode` function.

Step Response
Verify your filter design by using MATLAB to plot the step response. Use the `step` function in MATLAB. Determine the (1) time constant, (2) percent overshoot, and (3) rise time from the resulting step-response plot. Indicate how you found these values either on the plots themselves or by using Matlab code to evaluate the results of the `step` function.

What to Turn In
Turn in your values for R, L, and C, along with the method for deriving these values (this may be hand-written). Turn in your answers for the theoretical values of the time constant, gain at the corner frequency, and the percent overshoot. Also, turn in the resulting two plots (Bode plot and step-response plot). Finally, turn in whatever plots/code/techniques you used to determine the required values (passband gain, corner frequency, and *Q* from the Bode plot as well as time constant, percent overshoot, and rise time from the step-response plot). Write a *brief* explanation of your methodology for *how* you determined all the appropriate values from the resulting plots. Clearly present all of your resulting

numerical answers (a table may be the simplest way to present this information, but I leave it to your discretion to *clearly* present the information).

Helpful Hints
- Useful commands
  - o ` bode`
  - o ` step`
- You can write the results of these functions to analyze the data instead of just simply plotting the data
- You can get help on any function by typing `help function_name`
- Do not forget axis labels and titles on your plots
- Do not forget the cover sheet as described on the MATLAB assignments webpage