Problem 1: Transfer Function
a) Find the voltage gain transfer function for the circuit below.
b) How many zeros does this circuit have? How do you determine this?
c) How many poles does this circuit have? How do you determine this?

Problem 2: Transfer Function
Using the circuit from problem 1, but exchanging the location of the capacitor and inductor:

a) Find the voltage gain transfer function for the circuit.
b) How many zeros does this circuit have? How do you determine this?
c) How many poles does this circuit have? How do you determine this?

Problem 3: Transfer function, zeros and poles & Resonance
a) Find the transfer function for the circuit below, with $V_o$ across the RCL parallel combination.
b) Factor the denominator, $D(s)$.
   a. Note that you can factor a polynomial in Matlab with the command ‘roots.’
   b. Look at the very beginning of section 14.5 – think about, and very briefly comment on, what it means to have roots (zeros or poles in our new vocabulary) that are complex conjugate pairs.
c) Identify the frequencies that are zeros and poles.
d) Determine the resonant frequency for this circuit.
e) Identify the type of filter this circuit represents, demonstrating how you determine this by evaluating the amplitude of the transfer function at the important frequencies.
Problem 4: Frequency Response & Bode Plot from a Circuit

For the circuit below

a) Find the voltage gain transfer function
   a. Identify the frequencies that contribute a zero to the transfer function
   b. Identify the frequencies that contribute a pole to the transfer function
   c. Identify the gain of the transfer function

b) Construct the Bode plot (amplitude and phase)
   a. Label all important points and elements on the Bode plot
   b. Useful graph paper is linked on the course webpage, along with a link to make your own graph paper (linked with Lab 7)

c) Observe which frequencies are ‘passed’ through to the output, and state which type of filter this circuit represents (high pass? low pass? band pass? notch? other?)
   a. Demonstrate your analysis of the type of filter by showing the value of the transfer function amplitude for important values of frequency.

\[ H(s) = \frac{250(s + 1)}{s(s^2 + 10s + 25)} \]

Problem 5: Frequency Response & Bode Plot starting with \( H(s) \)

Draw and fully label the Bode Plot for the following transfer function, following all the steps from problem 4 above (including identifying the type of filter).