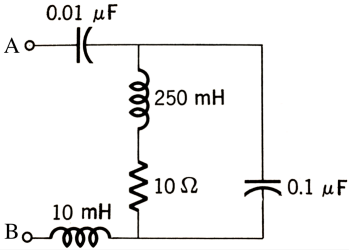
Phys2610 (2019) Assignment 3
Due Tuesday, 26 Feb 2018

1. Design a low-pass RC filter that will attenuate a 5.6 kHz sinusoidal signal by 3 dB. Sketch the gain in dB vs the log(frequency) for the circuit.

2. (a) Determine the resonant frequency and the Q-factor for a series LRC circuit with R = 560 Ω, L = 100 mH, and C = 33 nF.
(b) Show that the frequency for the peak capacitor voltage is given by $\sqrt{{\omega_0}^2 - \frac{R^2}{2L^2}}$, and evaluate the frequency for the given values.
(c) Find the magnitude and phase of the impedance of the circuit for a frequency of 1.0 kHz.

3. Calculate the equivalent impedance of the circuit below (between A and B) at a frequencies of 100 Hz and 1000 Hz. Find the rms current in the 10 Ω resistor for a sinusoidal input with an amplitude of 8 V and a frequency of 1000 Hz.



4. A series RLC circuit is subjected to an applied pulse. The resulting voltage waveform across the capacitor is shown in the figure. The horizontal scale is in μs and the vertical scale is in volts. The general solution for the transient response of the capacitor voltage, with small damping is: $v_C = V_C e^{-\alpha t} \sin(\omega t + \varphi)$.
(a) Using the graph below, determine the values for the constants V_c, α, ω, and φ.
(b) Find component values for R, L, and C that could produce such a response.
(c) What is the resonant frequency $\omega_0 = 1/\sqrt{LC}$? Is the condition for small damping satisfied?