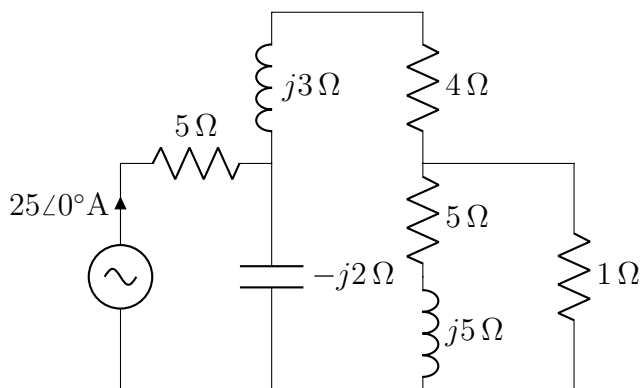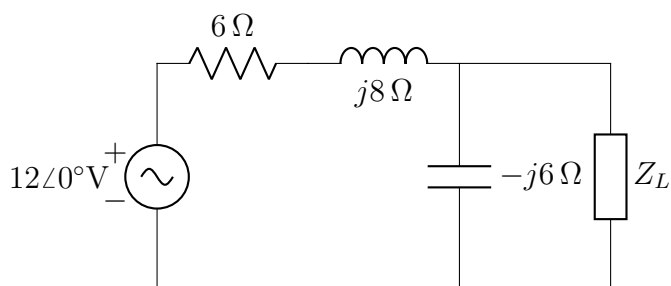# PH3104 Problem Set 4

Q 1) For the circuit shown below, determine the current through the $1\,\Omega$ resistor using Thévenin's theorem


Q 2) For the circuit shown below, determine the value of the load that will maximize the power delivered to the load Z_L. Also calculate the maximum power.

Q 3) For the circuit shown below, use the Laplace transform method to determine the complete solution (transient as well as steady state behavior) for the current as a function of time. Assume zero charge across the capacitor before switching.
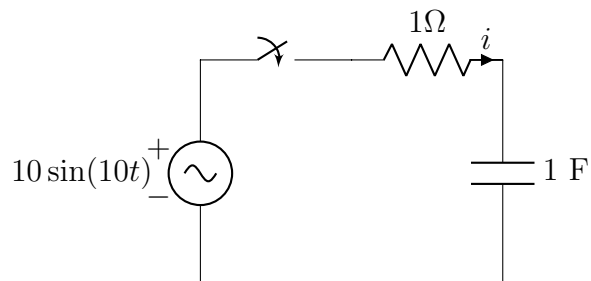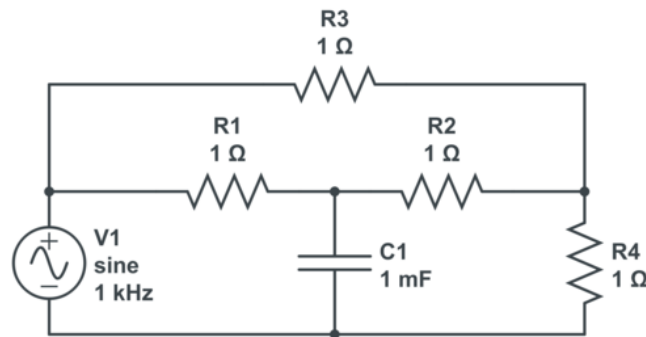

Q 4) Determine the differential equation obeyed by the current i in the circuit below:
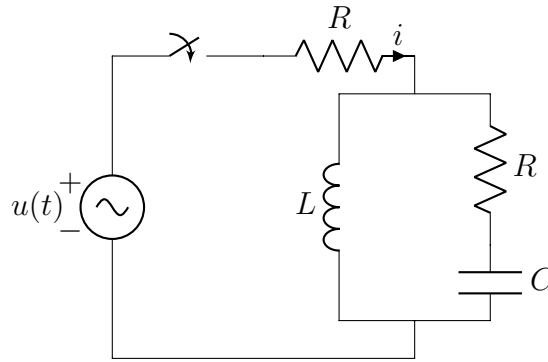
Solve for the current $i(t)$, if $u(t)$ is a constant voltage source, $u(t) = E_0$ and if the currents in the circuit and the charge on the capacitor is zero immediately before $t = 0$, when the key is switched on.

Q 5) Use the extra element theorem to find the impedance seen by the source in the circuit below

Hint: treat the capacitor as the extra element.

Q 6) In lecture 6 we study the "symmetric" lead-lag network. Determine the resonant frequency and the quality factor for the more "general" network below
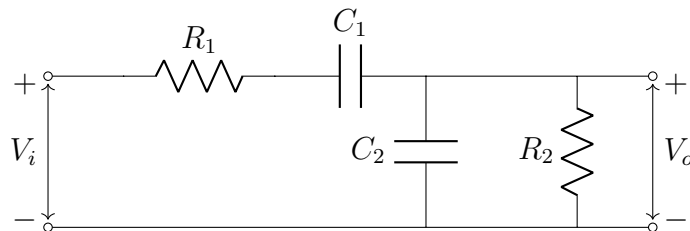
Q 7) Consider a parallel resonant circuit with resonant frequency $\omega_0 = 1800$ Hz and quality factor $Q = 5.0$. Write a program that will help you draw a graph of the output waveform when the input is a square wave with the following frequencies

(a) 2000 Hz, (b) 1800 Hz, (c) 1600 Hz, (d) 900 Hz, (e) 450 Hz, (f) 200 Hz

Repeat the same problem for a different parallel resonant circuit with the same resonant frequency and $Q = 1.0$.

Remember : a square wave is a sum of sine functions - and you know how the circuit responds to a sine function input.

Q 8) Discuss the nature of the output versus input voltage ratio as a function of the frequency and use this to classify each of the following circuits. By classify I mean are they low-pass, high-pass, band-pass, band-stop, etc?

a) V_i — two series R resistors with two shunt C capacitors — V_o

b) V_i — two series C capacitors with two shunt R resistors — V_o

c) V_i — series R, shunt C, series C, shunt R — V_o

d) V_i — series C, shunt R, series R, shunt C — V_o