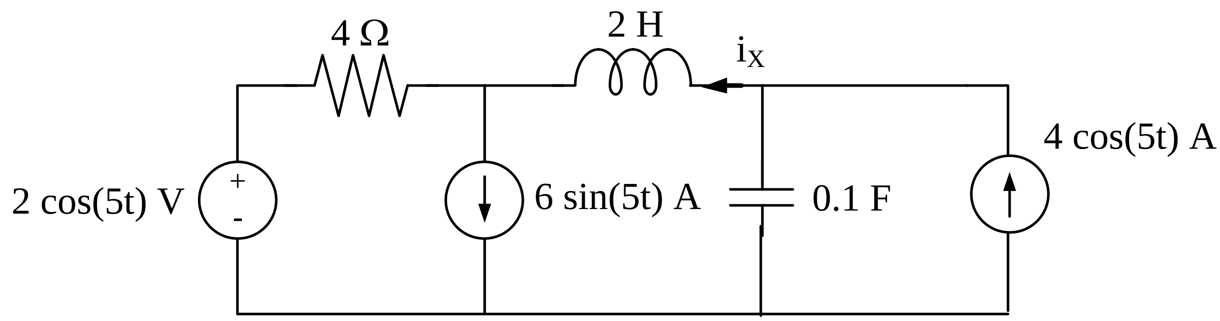
1. AC Circuit Analysis

Consider the following circuit in the time domain.



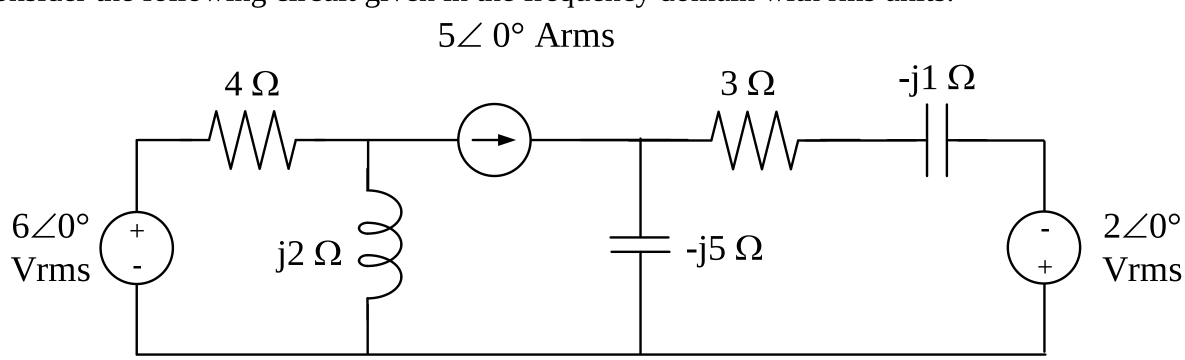
(a) Convert the circuit from the time domain to the frequency domain (redraw circuit below)

(b) Solve the circuit using any method you like and find the phasor current, $\mathbf{I_X}$

(c) Find the real part of the time domain current, $i_X(t)$

2. AC Power

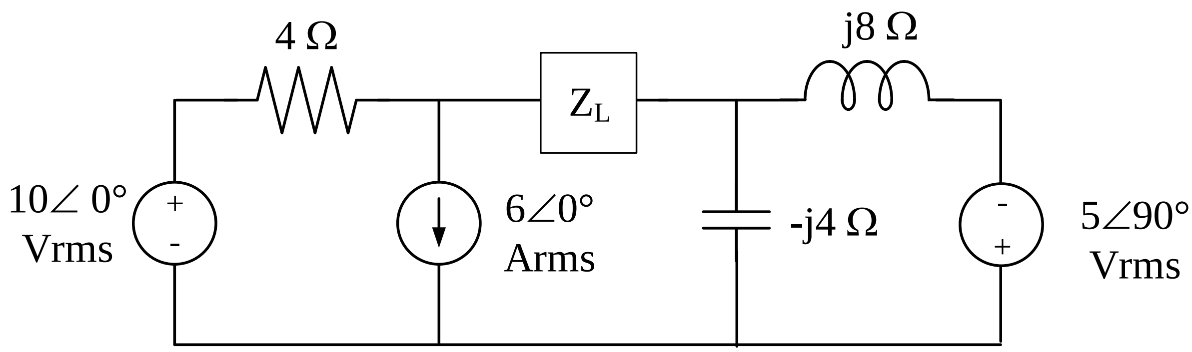
Consider the following circuit given in the frequency domain with rms units.



Using any method you like (probably nodal or mesh), solve the circuit. Then find the complex power, **S,** delivered by each source and absorbed by each impedance. The complex power may be given in Cartesian or Polar forms.

3. Load Design 1 – Maximum Power Transfer

Consider the following circuit given in the frequency domain with rms units.



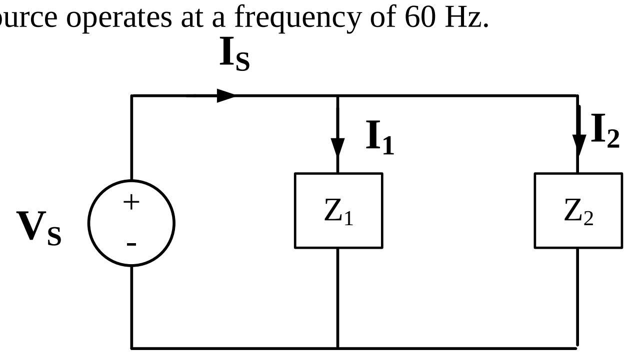
(a) [15 points] Draw the circuit network and find the open-circuit voltage, $\mathbf{V_{OC}}$.

(b) [10 points] Find the Thevenin Equivalent impedance, Z_{TH}. Design the load, Z_L.

(c) Find the maximum average power that is absorbed by Z_L.

4. Load Design 1 – Compensating Load for Power Factor Correction

A voltage source provides 100 Vrms to 2 loads. The source operates at a frequency of 60 Hz. The details of the loads are given below.



Z_1: P_1 = 20 kW with pf_1=0.5 lagging
Z_2: $\mathbf{S_2}$=10∠63° kVA

(a) Find the load currents $\mathbf{I_1}$ and $\mathbf{I_2}$.

(b) What is the source current, $\mathbf{I_S}$ and the average power delivered by the source.

(c) What is the impedance of each load?

(d) Design a corrective load to make the combined power factor of all loads equal to 0.95 lagging. What is the impedance of this load? What is the element value of this new load assuming a 60Hz operating frequency?

(e) Instead of the corrective load you designed from part (d), you asked to design a corrective load that reduces the source current magnitude to 15% of the original value. Is this load possible? Why or why not?