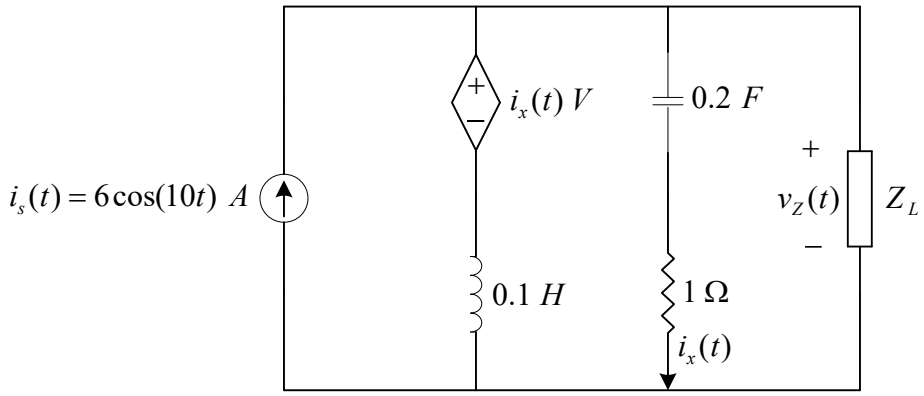
A few sample problems from previous finals

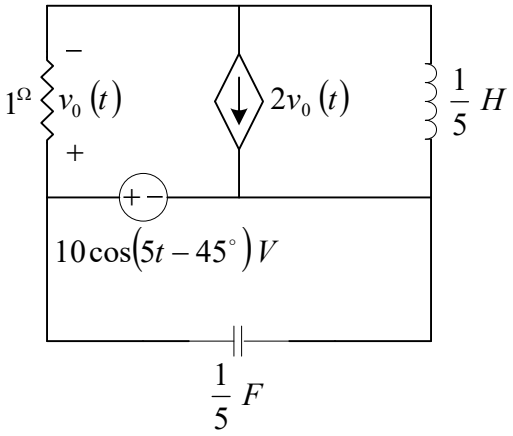
Problem 1: (25 Points)

In the following circuit, find the impedance Z_L such that it would absorb maximum power, the maximum power it absorbs, and $v_z(t)$.



Problem 2: (30 Points)

Use phasors, redraw the circuit in phasor domain, solve the following circuit using any method you want, and find the average power absorbed by the 1^{Ω} resistor.



Problem 3: (30 Points)

An industrial load consists of a balanced three-phase Y-connected load with phase impedance $Z_Y = 8 - 4I$ in parallel with a balanced three-phase Δ-connected load with phase impedance $Z_\Delta = 6 + 12I$.

a. Calculate phase impedance of the Y-connected load that is the equivalent of this industrial load.
b. The current in the line supplying this industrial load is *50 A* (rms). Take the current phasor as your reference and find the phase voltage and the line voltage at the load terminal.
c. Calculate the complex power that the load is consuming.

d. Calculate the load power factor.
e. To increase the power factor to one (unity power factor) a three phase Y-connected capacitor bank is connected in parallel to this load. Calculate the value of the capacitance per phase. Take frequency to be the national grid frequency, *f=60 Hz*.

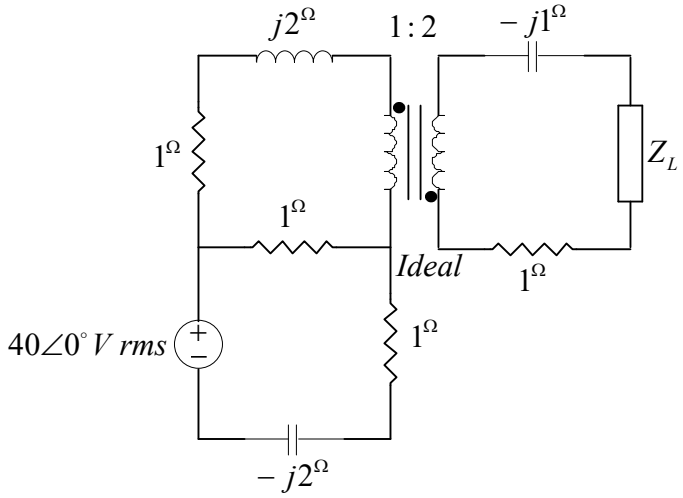
Problem 4: (25 Points)

A balanced three phase source supplies a balanced load via a transmission line with negligible impedance. The magnitude of the source voltage is maintained at constant value. The load consumes 120 kW with pf=0.8, lagging. The magnitude of the line current is $|I_{line}| = 25\ A\,rms$. ($f = 60\ Hz$)

a. Find the load's phase voltage and take it as reference, i.e., set its phase angle to zero.
b. Calculate load's line-line voltage and the line current.
c. Find the value of the capacitance of each phase of a three phase Y-connected capacitor bank that when connected in parallel with the load will correct the load power factor to one.
d. Calculate the current in the line after the insertion of the capacitor bank and the line-line voltage of the source.

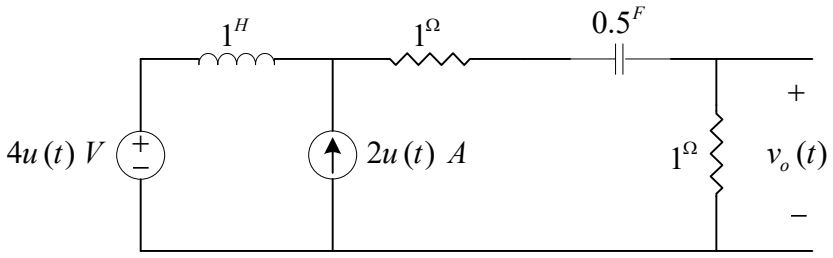
Problem 5: (25 Points)

In the following circuit, find the impedance Z_L such that it would absorb maximum power and the maximum power it absorbs.



Problem 6: (30 Points)

Use Laplace transform, redraw the circuit shown below in s-domain, and determine the voltage $v_o(t)$ and its initial and final values.



Problem 7: (30 Points)

In the semi-log papers provided, draw the magnitude and the phase Bode plot for the following network function.

$$H(s) = \frac{100(s+1)}{s(s+10)} \qquad s = j\omega$$

Problem 8: (25 Points)

In the following circuit, $i_s(t) = 12 + 8\cos(4t) + 10\cos(8t)$ find;

a. The rms value of $i_s(t)$
b. $i_0(t)$
c. The average power consumed by the resistor.