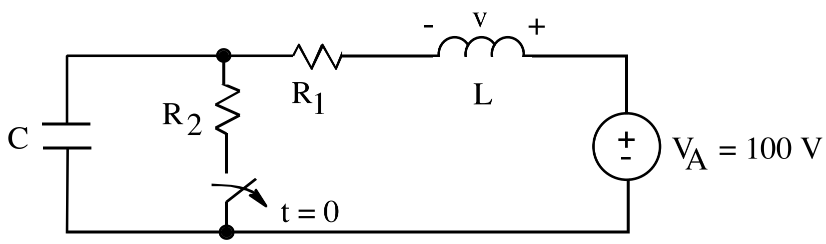
ECE 2270

PRACTICE FINAL EXAM

1. (50 points)



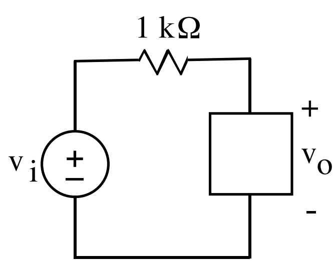
After having been open for a long time, the switch is closed at t = 0.

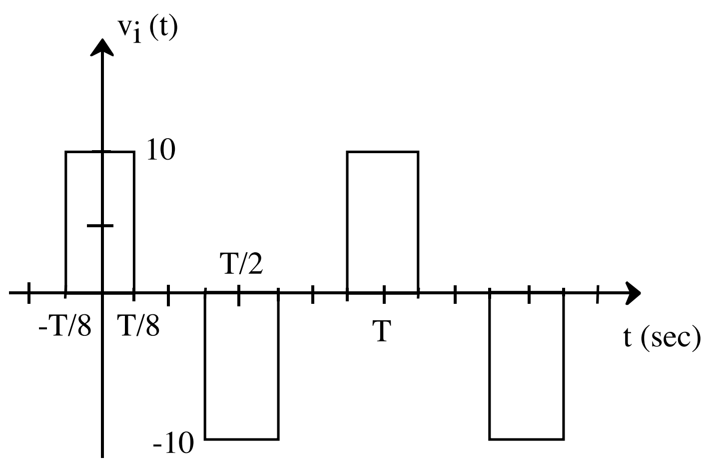
$R_1 = 12.5\Omega$ $R_2 = 12.5\Omega$ $L = 6.25\ \mu H$

a. Two capacitances are available: 2 nF and 250 nF. Specify the value of C that will make v(t) overdamped.

b. Using the value of C found in (a), write a time-domain expression for v(t).

2. (50 points)





$\omega_o = 1\ \text{M rad/sec}$

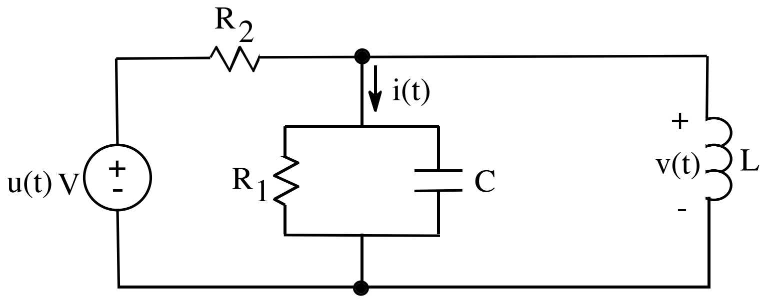
a. Determine the coefficients of the Fourier series, a_v, a_n, and b_n, for the periodic waveform $v_i(t)$. Also, use these Fourier coefficients to find the coefficients of the first five terms of the Fourier series written in terms of inverse phasors:

$$v_1(t) = a_v + \sum_{n=1}^{\infty} A_n \cos\left(n\omega_o t + \theta_n\right)$$

Note any symmetry properties of the waveform that you use to determine coefficients.

b. The circuit on the left is a filter with output $v_o(t)$. Design a circuit to be placed in the box such that the filter rejects the fundamental frequency of $v_i(t)$ and has a bandwidth of 10,000 rad/sec. Specify the component values. Show how the components are connected in the circuit.

3. (50 points)



The initial energy stored in the circuit is zero.

$R_2 = 500\ \Omega$ $\qquad\qquad$ $L = 200\text{ mH}$

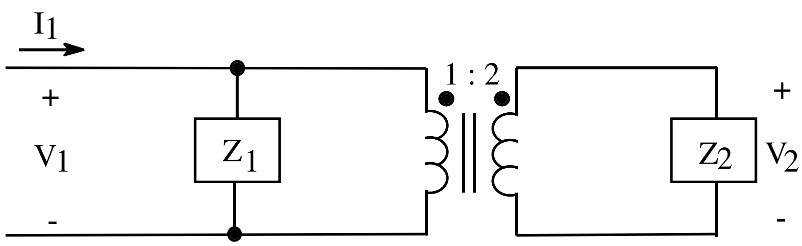
a. Choose values of R_1 and C to accomplish the following:

(1) v(t) and i(t) are decaying sinusoids 90° out of phase with each other.

(2) $1/\alpha = T$, where α is the exponential decay constant and T is the period of oscillation of the decaying sinusoid.

b. With the component values you chose in the circuit, write numerical expressions for v(t) and i(t).

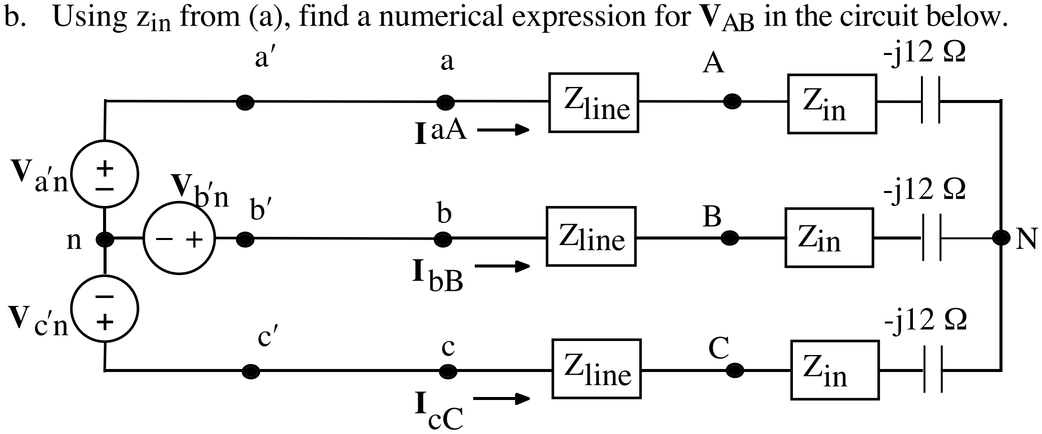
4. (50 points)



$Z_1 = (5 - j5)\Omega$ $\qquad\qquad$ $Z_2 = (20 + j20)\Omega$

a. Find the input impedance, $z_{in} = \mathbf{V}_1/\mathbf{I}_1$, for the above circuit.

b. Using z_{in} from (a), find a numerical expression for $\mathbf{V}_{AB}$ in the circuit below.



Balanced three-phase system.

$\mathbf{V}_{an} = 52 \angle 0°\text{V}$ $\qquad$ $\mathbf{V}_{bn} = 52 \angle -120°\text{A}$ $\qquad$ $z_{line} = j12\ \Omega$