Homework 5

Due date: Nov. 25th, 2021

Turn in your homework in class

Rules:

- Work on your own. Discussion is permissible, but extremely similar submissions will be judged as plagiarism.

- Please show all intermediate steps: a correct solution without an explanation will get zero credit.

- Please submit on time. No late submission will be accepted.

- Please prepare your submission in English only. No Chinese submission will be accepted.

- If needed, round the number to the nearest hundredths, i.e., rounding it to 2 decimal places.

1. (a) For the following pairs of sinusoids, determine which one leads and by how much.

   (a) $v(t) = 10 \cos(4t - 60°)$ and
       $i(t) = 4 \sin(4t + 50°)$

   (b) $v_1(t) = 4 \cos(377t + 10°)$ and
       $v_2(t) = -20 \cos 377t$

   (c) $x(t) = 13 \cos 2t + 5 \sin 2t$ and
       $y(t) = 15 \cos(2t - 11.8°)$

(b) Transform the following sinusoids into phasors:

   (a) $-20 \cos(4t + 135°)$ (b) $8 \sin(20t + 30°)$
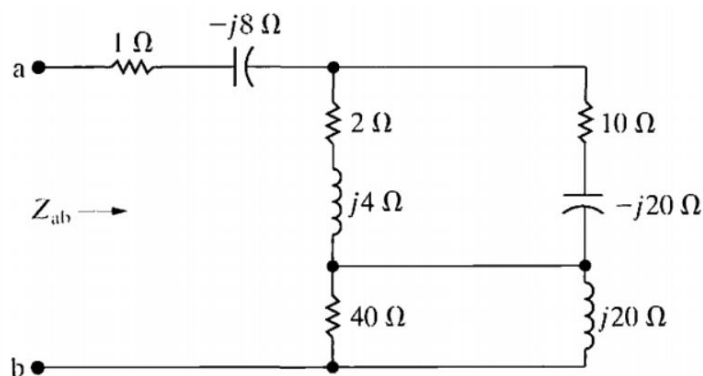
   (c) $20 \cos(2t) + 15 \sin(2t)$

2. For the circuit below:

    1) Calculate the equivalent impedance Z_{ab};
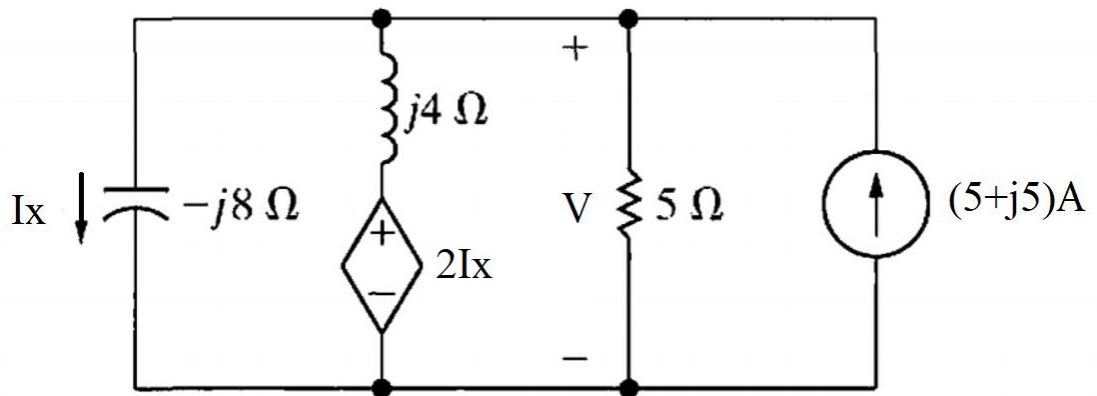
    2) If $V_{ab} = 20\ sin\ (5t + 105°)$,

        i. Calculate current through the 10 Ω resistor, and indicate the reference direction in the circuit diagram;

        ii. Calculate voltage over the j20 Ω inductor and indicate the reference direction in the circuit diagram.

3. For the circuit below, given ω= 2 rad/s
    1) Use nodal analysis to find *Ix(t), V(t)*
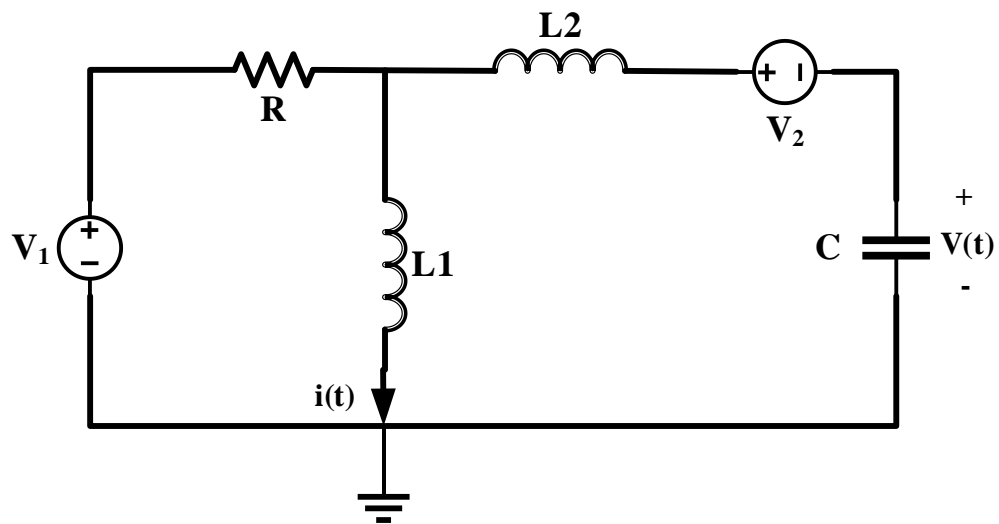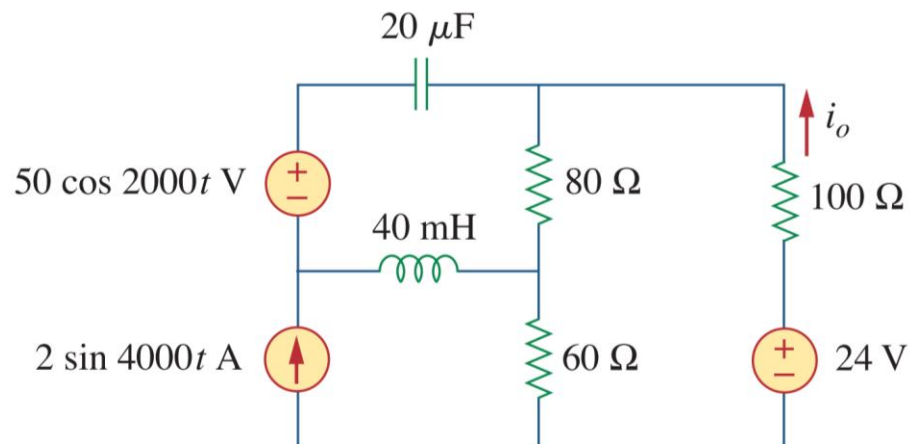   2) Use mesh analysis to find *Ix(t), V(t)*

4. For the circuit below:

   R=10Ω, L1=10mH, L2=20mH, C=200nF,

 $V_1(t) = 10\sin(5t + 30°), \quad V_2(t) = 4\cos(5t)$

   Use superposition theorem to solve the i(t) and V(t)

5. Find $i_o(t)$ by using superposition method.

6. For the circuit below. The circuit is working in sinusoidal, single frequency ($\omega= 2$ rad/s), and steady state.

   1) Find the Thevenin AND Norton equivalent circuit at the terminals a and b.
   2) Consider an inductor L=5H is connected to the terminal a and b. Find the current through L $i_L(t)$ and indicate the reference direction in the circuit diagram.
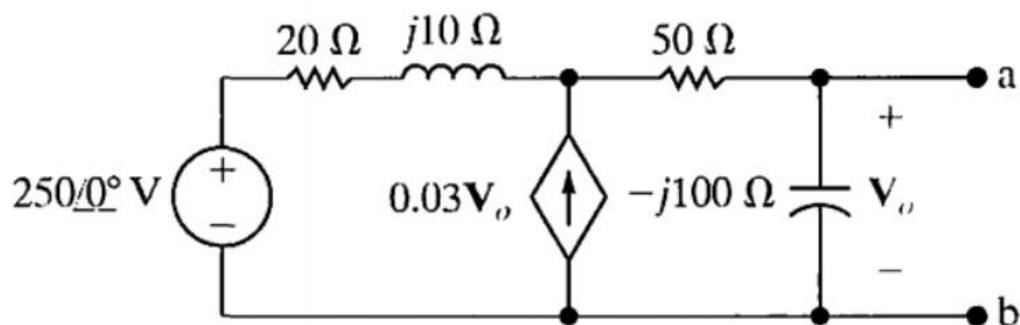
7. For the circuit below. Suppose v_s is a sinusoidal voltage source with the angular frequency ω. Suppose the Op-amp is working in the linear mode. Find the expression for v_o/v_s.