332:221 Principles of Electrical Engineering I – Fall 2007

The Assigned Home-work problems for Chapter 9 from 7-th edition of the book.

9.1 to 9.3: To get familiar with sinusoidal signals. (*Solutions to these problems will not be posted.*)

9.12 and 9.13: Behavior of inductance and capacitance in the Frequency Domain.

9.14 to 9.20: Phasor domain analysis of simple circuits.

9.35 $\Delta - Y$ transformations in phasor domain.

9.39 Series parallel combinations and phasor domain analysis.

9.42 and 9.43: Thevenin and Norton equivalent circuits in phasor domain.

9.51 and 9.56: Node voltage method in phasor domain.

9.54 and 9.59 Mesh current method in phasor domain.

~~9.66 Mutual inductance problem.~~

9.1 A sinusoidal voltage is given by the expression

$$v = 10\cos(3769.91t - 53.13°).$$

Find (a) f in hertz; (b) T in milliseconds; (c) V_m; (d) $v(0)$; (e) ϕ in degrees and radians; (f) the smallest positive value of t at which $v = 0$; and (g) the smallest positive value of t at which $dv/dt = 0$.

9.3 Consider the sinusoidal voltage

$$v(t) = 40\cos(100\pi t + 60°)\ \text{V}.$$

a) What is the maximum amplitude of the voltage?

b) What is the frequency in hertz?

c) What is the frequency in radians per second?

d) What is the phase angle in radians?

e) What is the phase angle in degrees?

f) What is the period in milliseconds?

g) What is the first time after $t = 0$ that $v = -40$ V?

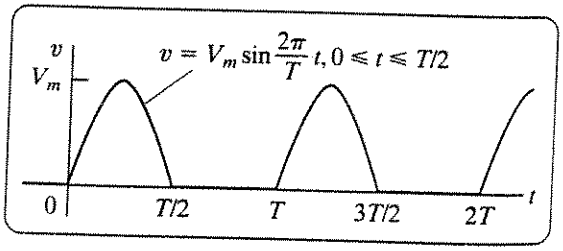
h) The sinusoidal function is shifted 10/3 ms to the right along the time axis. What is the expression for $v(t)$?

i) What is the minimum number of milliseconds that the function must be shifted to the right if the expression for $v(t)$ is $40\sin 100\pi t$ V?

j) What is the minimum number of milliseconds that the function must be shifted to the left if the expression for $v(t)$ is $40\cos 100\pi t$ V?

9.2 Find the rms value of the half-wave rectified sinusoidal voltage shown.

Figure P9.2



9.12 A 1000 Hz sinusoidal voltage with a maximum amplitude of 200 V at $t = 0$ is applied across the terminals of an inductor. The maximum amplitude of the steady-state current in the inductor is 25 A.

a) What is the frequency of the inductor current?

b) What is the phase angle of the voltage?

c) What is the phase angle of the current?

d) What is the inductive reactance of the inductor?

e) What is the inductance of the inductor in millihenrys?

f) What is the impedance of the inductor?

9.13 A 50 kHz sinusoidal voltage has zero phase angle and a maximum amplitude of 10 mV. When this voltage is applied across the terminals of a capacitor, the resulting steady-state current has a maximum amplitude of 628.32 μA.

a) What is the frequency of the current in radians per second?

b) What is the phase angle of the current?

c) What is the capacitive reactance of the capacitor?

d) What is the capacitance of the capacitor in microfarads?

e) What is the impedance of the capacitor?

9.14 A 10 Ω resistor and a 5 μF capacitor are connected in parallel. This parallel combination is also in parallel with the series combination of a 8 Ω resistor and 300 μH inductor. These three parallel branches are driven by a sinusoidal current source whose current is $922\cos(20{,}000t + 30°)$ A.

a) Draw the frequency-domain equivalent circuit.

b) Reference the voltage across the current source as a rise in the direction of the source current, and find the phasor voltage.

c) Find the steady-state expression for $v(t)$.

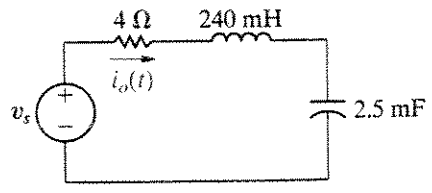
9.15 A 40 Ω resistor, a 5 mH inductor, and a 1.25 μF capacitor are connected in series. The series-connected elements are energized by a sinusoidal voltage source whose voltage is $600\cos(8000t + 20°)$ V.

a) Draw the frequency-domain equivalent circuit.

b) Reference the current in the direction of the voltage rise across the source, and find the phasor current.

c) Find the steady-state expression for $i(t)$.

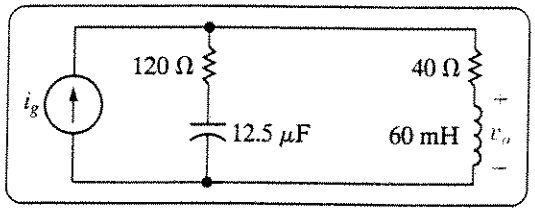
9.16 Find the steady-state expression for $i_o(t)$ in the circuit in Fig. P9.16 if $v_s = 100\sin 50t$ mV.



9.17 Three branches having impedances of $3 + j4$ Ω, $16 - j12$ Ω, and $-j4$ Ω, respectively, are connected in parallel. What are the equivalent (a) admittance, (b) conductance, and (c) susceptance of the parallel connection in millisiemens? (d) If the parallel branches are excited from a sinusoidal current source where $i = 8\cos\omega t$ A, what is the maximum amplitude of the current in the purely capacitive branch?

9.18 Find the steady-state expression for v_o in the circuit of Fig. P9.18 if $i_g = 0.5\cos 2000t$ A.

Figure P9.18



9.19 The expressions for the steady-state voltage and current at the terminals of the circuit seen in Fig. P9.19 are

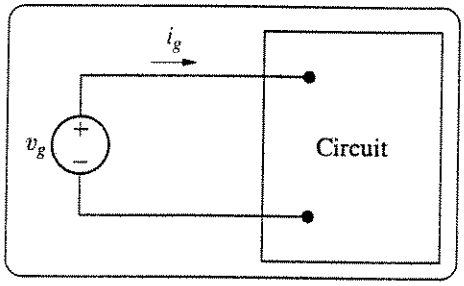
$$v_g = 300\cos(5000\pi t + 78°)\text{ V},$$

$$i_g = 6\sin(5000\pi t + 123°)\text{ A}$$

a) What is the impedance seen by the source?

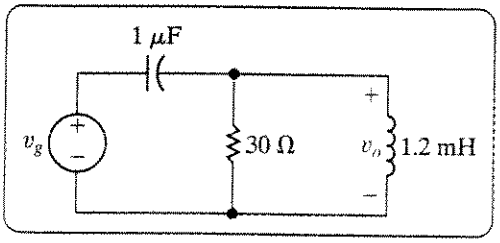
b) By how many microseconds is the current out of phase with the voltage?

Figure P9.19



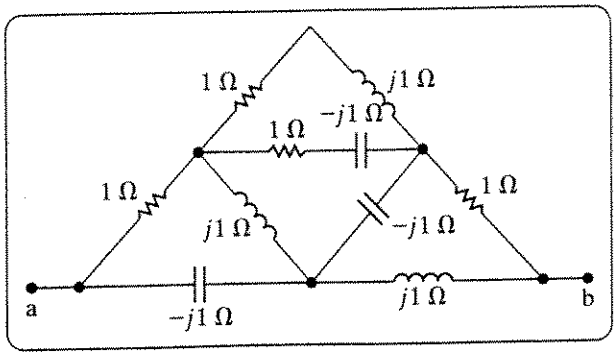
9.20 The circuit in Fig. P9.20 is operating in the sinusoidal steady state. Find the steady-state expression for $v_o(t)$ if $v_g = 40\cos 50{,}000t$ V.

Figure P9.20



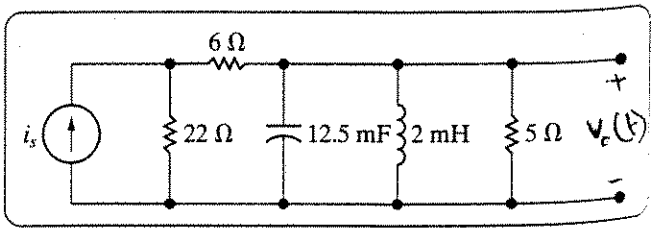
9.35 Find Z_{ab} for the circuit shown in Fig P9.35.

Figure P9.35



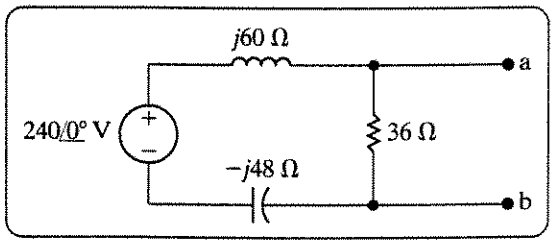
9.39 The circuit in Fig. P9.39 is operating in the sinusoidal steady state. Find $v_o(t)$ if $i_s(t) = 3\cos 200t$ mA.

Figure P9.39



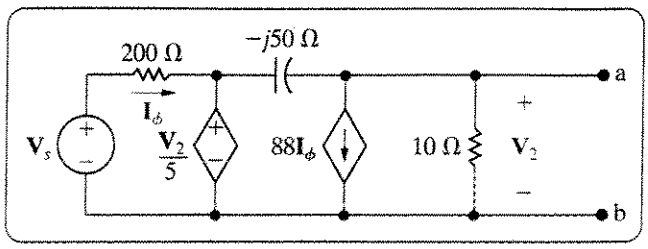
9.42 Find the Thévenin equivalent circuit with respect to the terminals a,b for the circuit shown in Fig. P9.42.

Figure P9.42



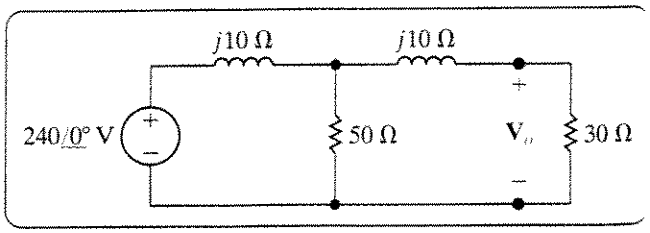
9.43 Find the Norton equivalent circuit with respect to the terminals a,b for the circuit shown in Fig. P9.43 when $\mathbf{V}_s = 5\angle 0°$ V.

Figure P9.43



9.51 Use the node-voltage method to find $\mathbf{V}_o$ in the circuit in Fig. P9.51.

Figure P9.51

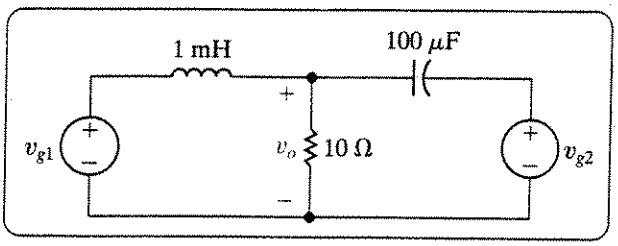


9.54 Use the mesh-current method to find the steady-state expression for $v_o(t)$ in the circuit in Fig. P9.52.

$$v_{g1} = 20\cos(2000t - 36.87°)\text{ V},$$

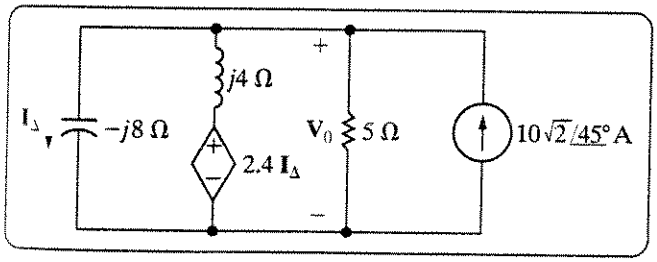
$$v_{g2} = 50\sin(2000t - 16.26°)\text{ V}.$$

Figure P9.52



9.56 Use the node-voltage method to find the phasor voltage $\mathbf{V}_o$ in the circuit shown in Fig. P9.56. Express the voltage in both polar and rectangular form.

Figure P9.56



9.59 Use the mesh-current method to find the phasor current $\mathbf{I}_g$ in the circuit shown in Fig. P9.59.

Figure P9.59