دانشگاه سمنان

دانشکده مهندسی مکانیک

Semnan University
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دانشکده مهندسی مکانیک

تمرین درس مبانی برق ۱

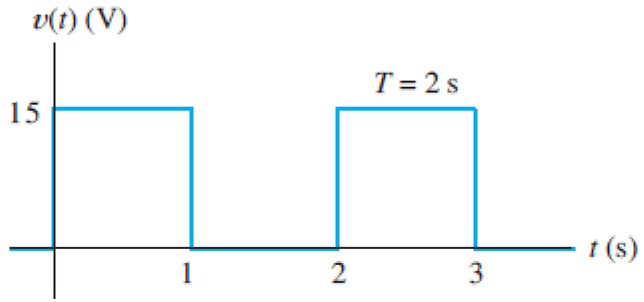
نام و شماره دانشجویی:

Introduction to Electrical Engineering Exercises

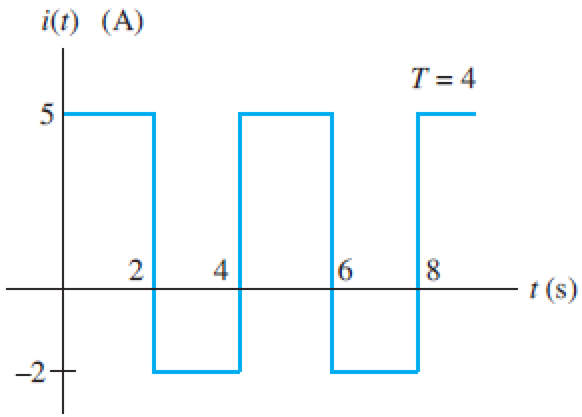
Chapter 5 – Steady-State Sinusoidal Analysis

***P5.6.** A sinusoidal voltage $v(t)$ has an rms value of 20 V, a period of 100 μs, and reaches a positive peak at $t = 20\ \mu$s. Write an expression for $v(t)$.

***P5.12.** Find the rms value of the voltage waveform shown in Figure P5.12.



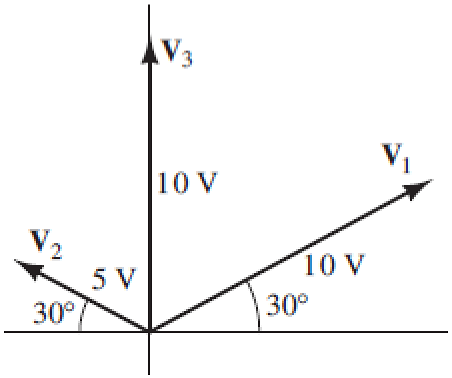
***P5.13.** Find the rms value of the current waveform shown in Figure P5.13.



***P5.23.** Reduce $5\cos(\omega t + 75°) - 3\cos(\omega t - 75°) + 4\sin(\omega t)$ to the form $V_m \cos(\omega t + \theta)$.

***P5.24.** Suppose that $v_1(t) = 100\cos(\omega t)$ and $v_2(t) = 100\sin(\omega t)$. Use phasors to reduce the sum $v_s(t) = v_1(t) + v_2(t)$ to a single term of the form $V_m \cos(\omega t + \theta)$. Draw a phasor diagram, showing $\mathbf{V}_1$, $\mathbf{V}_2$, and $\mathbf{V}_s$. State the phase relationships between each pair of these phasors.

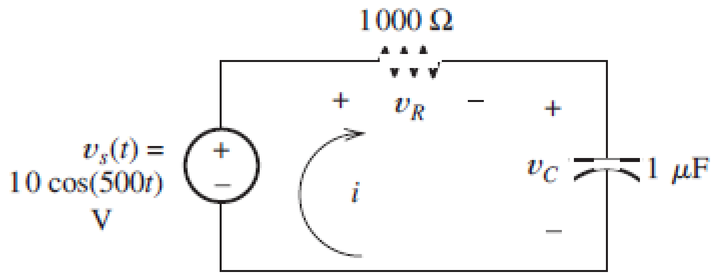
***P5.25.** Consider the phasors shown in Figure P5.25. The frequency of each signal is $f = 200$ Hz. Write a time-domain expression for each voltage in the form $V_m \cos(\omega t + \theta)$. State the phase relationships between pairs of these phasors.



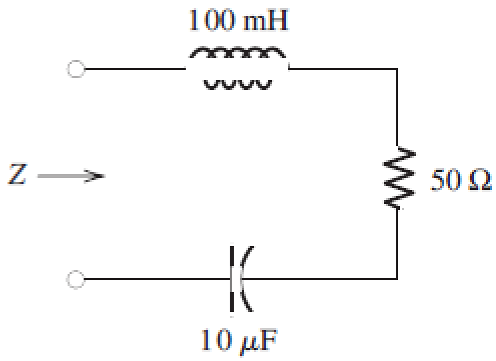
***P5.35.** A voltage $v_L(t) = 10\cos(2000\pi t)$ is applied to a 100-mH inductance. Find the complex impedance of the inductance. Find the phasor voltage and current, and construct a phasor diagram. Write the current as a function of time. Sketch the voltage and current to scale versus time. State the phase relationship between the current and voltage.

***P5.37.** A voltage $v_C(t) = 10\cos(2000\pi t)$ is applied to a 10-μF capacitance. Find the complex impedance of the capacitance. Find the phasor voltage and current, and construct a phasor diagram. Write the current as a function of time. Sketch the voltage and current to scale versus time. State the phase relationship between the current and voltage.

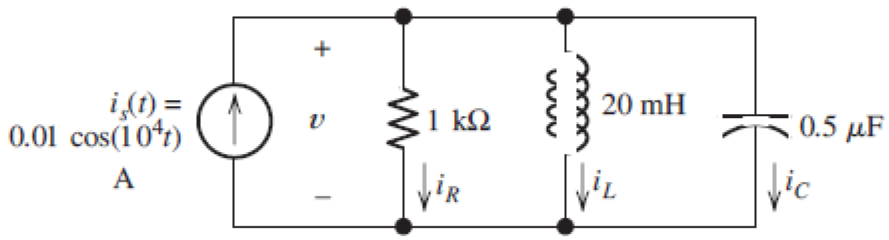
***P5.44.** Find the phasors for the current and the voltages for the circuit shown in Figure P5.44. Construct a phasor diagram showing $\mathbf{V}_s$, $\mathbf{I}$, $\mathbf{V}_R$, and $\mathbf{V}_C$. What is the phase relationship between $\mathbf{V}_s$ and $\mathbf{I}$?



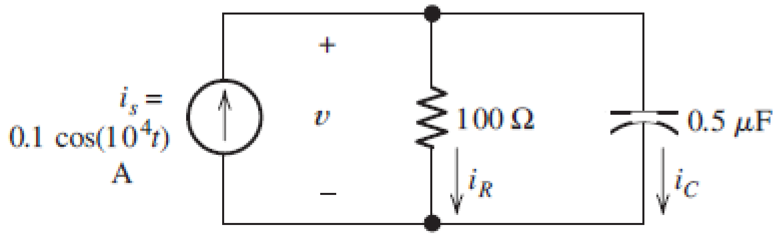
*__P5.46.__ Find the complex impedance in polar form of the network shown in Figure P5.46 for $\omega = 500$. Repeat for $\omega = 1000$ and $\omega = 2000$.



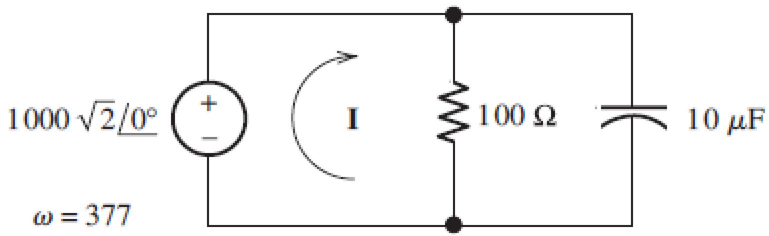
***P5.49.** Consider the circuit shown in Figure P5.49. Find the phasors $\mathbf{I}_s$, $\mathbf{V}$, $\mathbf{I}_R$, $\mathbf{I}_L$, and $\mathbf{I}_C$. Compare the peak value of $i_L(t)$ with the peak value of $i_s(t)$. Do you find the answer surprising? Explain.



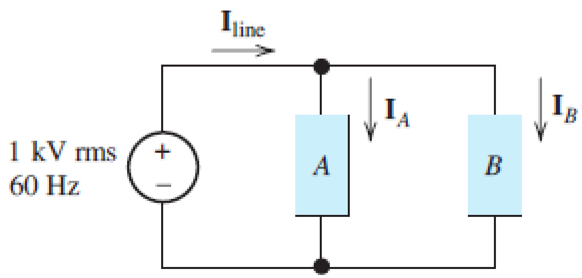
*__P5.52.__ Find the phasors for the voltage and the currents for the circuit shown in Figure P5.52. Construct a phasor diagram showing $\mathbf{I}_s$, $\mathbf{V}$, $\mathbf{I}_R$, and $\mathbf{I}_C$. What is the phase relationship between $\mathbf{V}$ and $\mathbf{I}_s$?



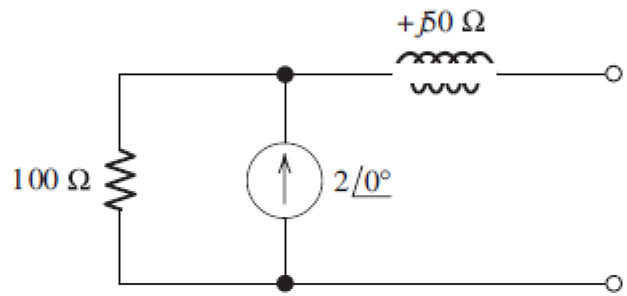
***P5.67.** Consider the circuit shown in Figure P5.67. Find the phasor current **I**. Find the power, reactive power, and apparent power delivered by the source. Find the power factor and state whether it is lagging or leading.



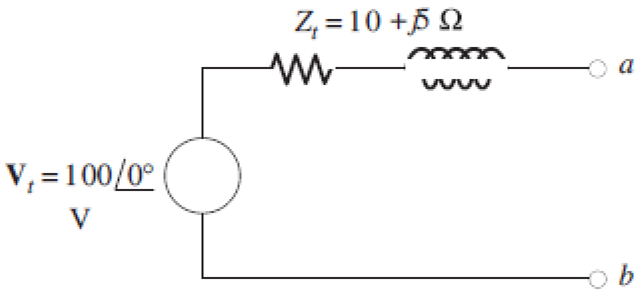
***P5.78.** Two loads, A and B, are connected in parallel across a 1-kV rms 60-Hz line, as shown in Figure P5.78. Load A consumes 10 kW with a 90 percent lagging power factor. Load B has an apparent power of 15 kVA with an 80 percent lagging power factor. Find the power, reactive power, and apparent power delivered by the source. What is the power factor seen by the source?



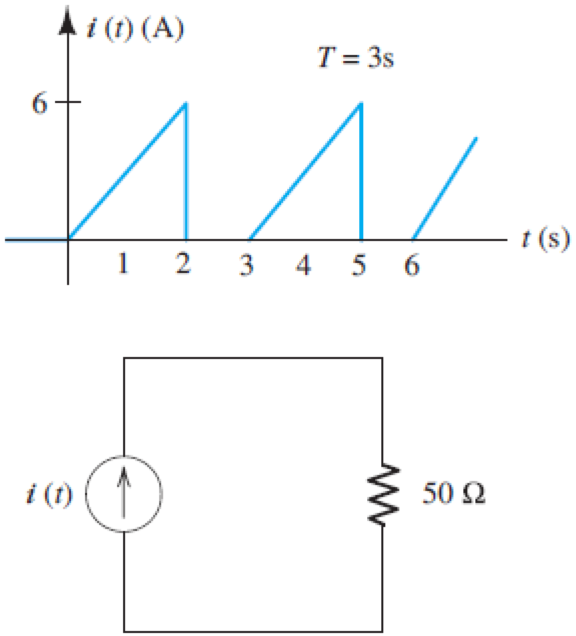
*P5.87. **a.** Find the Thévenin and Norton equivalent circuits for the circuit shown in Figure P5.87. **b.** Find the maximum power that this circuit can deliver to a load if the load can have any complex impedance. **c.** Solve (b) for the condition that the load is purely resistive.



***P5.91.** The Thévenin equivalent of a two-terminal network is shown in Figure P5.91. The frequency is $f = 60$ Hz. We wish to connect a load across terminals *a–b* that consists of a resistance and a capacitance in parallel such that the power delivered to the resistance is maximized. Find the value of the resistance and the value of the capacitance.



T5.1. Determine the rms value of the current shown in Figure T5.1 and the average power delivered to the 50-Ω resistance.



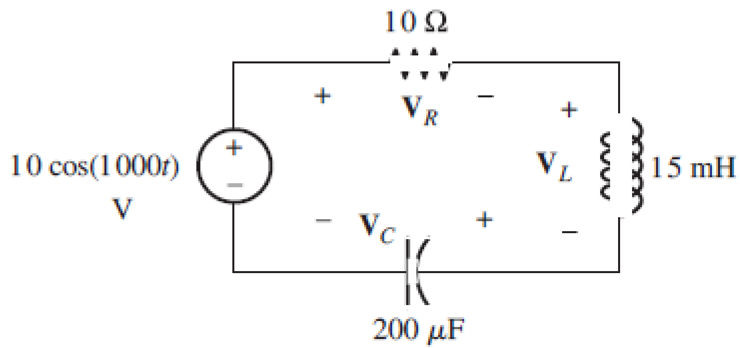
T5.2. Reduce the expression

$$v(t) = 5\sin(\omega t + 45°) + 5\cos(\omega t - 30°)$$

to the form $V_m \cos(\omega t + \theta)$.

T5.3. We have two voltages $v_1(t) = 15\sin(400\pi t + 45°)$ V and $v_2(t) = 5\cos(400\pi t - 30°)$ V. Determine (including units): **a.** the rms value of $v_1(t)$; **b.** the frequency of the voltages; **c.** the angular frequency of the voltages; **d.** the period of the voltages; **e.** the phase relationship between $v_1(t)$ and $v_2(t)$.

T5.4. Find the phasor values of $\mathbf{V}_R$, $\mathbf{V}_L$, and $\mathbf{V}_C$ in polar form for the circuit of Figure T5.4.



T5.5. Determine the complex power, power, reactive power, and apparent power absorbed by the load in Figure T5.5. Also, determine the power factor for the load.