3-1 *Given the sinusoid* $10\ \sin(10\pi t - 45^0)$, *calculate its amplitude, rms value, angular frequency, period, frequency and phase angle.*

3-2 *Find the phase angle between* $u_1(t) = 200\sqrt{2}\ \sin(5t + 30^0)$ *and* $u_2(t) = 50\cos(5t)$. *Does* u_1 *leads or lags* u_2*?*

3-3 *Find the phase angle between* $i_1(t) = -4\ \sin(417t + 30^0)$ *and* $i_2(t) = -7\cos(417t - 35^0)$. *Does* i_1 *leads or lags* i_2*?*

3-4 *Given* $i_1(t) = 2\sqrt{2}\ sin(\omega t + 45^0)\ A$ *and* $i_2(t) = 2\sqrt{2}\, cos(\omega t - 45^0)\ A$, *find their sum* $i(t) = i_1(t) + i_2(t)$.

3-5 *Given* $u_1(t) = 20\sqrt{2}\ sin(\omega t + 45^0)\ V$ *and* $u_2(t) = -10\sqrt{2}\, cos(\omega t - 30^0)\ V$, *find their sum* $u(t) = u_1(t) + u_2(t)$.

3-6 *Find the sinusoids corresponding to these phasors: a)* $\underline{U} = -10\ e^{j30^0}$ V*; b)* $\underline{I} = 2\sqrt{2}(\cos 45^0 - j\sin 45^0)$ A*; c)* $\underline{I} = j(5 - j12)$ A.

3-7 *Using the phasor approach, determine the current i(t) in a circuit described by the integrodifferential equation*

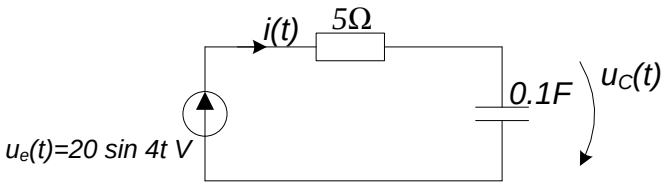
$$4i(t) + 8\int i(t)dt - 3\frac{di(t)}{dt} = 50\sqrt{2}\sin(2t + 75^0).$$

3-8 *Find the voltage u(t) in a circuit described by the integrodifferential equation*

$$2\sqrt{2}\,\frac{du(t)}{dt} + 5\sqrt{2}\,u(t) + 10\sqrt{2}\int u(t)dt -= 50\sqrt{2}\sin(5t - 30^0)$$

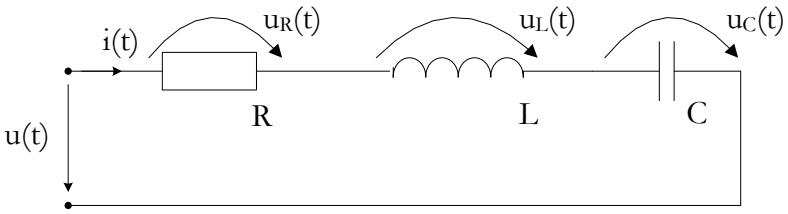
using the phasor approach.

3-9 *Find the circuit current, i(t), and capacitor-voltage, $u_C(t)$, for the circuit below.*



Problem 3-9

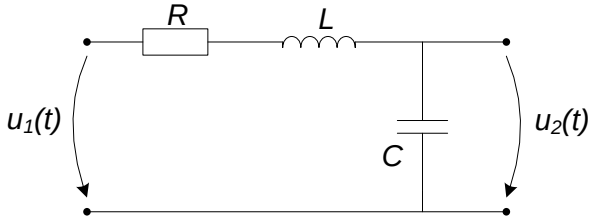
3-10 *The circuit parameters for the RLC series circuit below are R=20Ω, $L = 40mH$, $C = 50\mu F$, and the supplying voltage: $u(t) = 200\ sin(1000t - 30^0)\ V$. Calculate: a) the inductive and capacitive reactances and the circuit impedance, X_L, X_C, Z; b) the rms and the instantaneous value of the current, I, i(t); c) the rms and the instantaneous value of resistance-voltage, U_R, $u_R(t)$; d) the rms and the instantaneous value of inductance-voltage, U_L, $u_L(t)$; e) the rms and the instantaneous value of capacitance-voltage, U_C, $u_C(t)$. Draw the circuit diagram.*



Problem 3-14

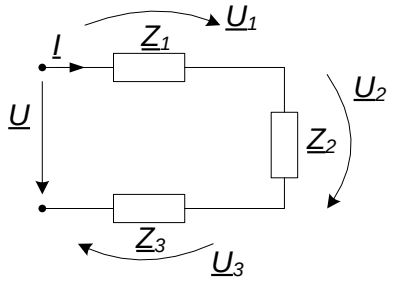
3-11 *For an RLC series circuit we khow* $\mathrm{R} = 30\Omega, \mathrm{X_L} = \omega\mathrm{L} = 80\Omega, \mathrm{X_C} = \frac{1}{\omega\mathrm{C}}40\Omega$ *and the supplying voltage $u(t) = 100\sqrt{2}\ sin(100\pi t - 60^0)\ V$. Calculate: a) the impedance in phasor form and the circuit impedance, $\underline{Z}$, Z; b) the rms and the instantaneous value of circuit current, I, i(t); c) the active, reactive and apparent power, P, Q, S. Verify the conservation of the active and the reactive power. Draw the circuit diagram.*

3-12 *For the circuit below we know* $\mathrm{R} = 10\Omega$, $\mathrm{X_L} = \omega\mathrm{L} = 5\Omega$, $\mathrm{X_C} = \frac{1}{\omega\mathrm{C}} = 15\Omega$ *and the voltage $u_1(t) = 100\sqrt{2}\ sin\ 100\pi t\ V$. Find the output voltage, $u_2(t)$.*



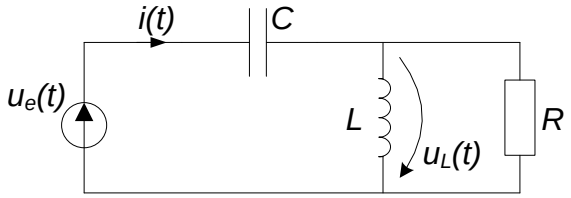
Problem 3-16

3-13 *For the circuit below we know* $\underline{Z}_1 = 3 + j4$, $\underline{Z}_2 = -j6$, $\underline{Z}_3 = 6 + j8$ *and the rms current* $I = 2A$. *Find: a) the rms voltage on each impedance, U_1, U_2, U_3; the rms value of the supplying voltage, u(t); c) the active, reactive and apparent power, P, Q, S.*



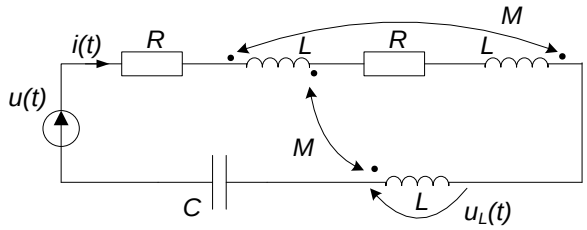
Problem 3-17

3-14 *For the circuit below we know* $R=10\Omega$, $L = \frac{3}{10\pi}H$, $C = \frac{1}{2.1\pi}mF$, and the supplying voltage: $u_e(t) = 100\sqrt{2}\ \sin(100\pi t - 60^0)\ V$. *Calculate: a) the equivalent impedance and the circuit impedance regarding the source terminals, Z, Z; b) the rms value of the current, I; c) the instantaneous value of the inductor-voltage, $u_L(t)$; d) the active, reactive and apparent power, P, Q, S. Verify the active and reactive power conservation.*



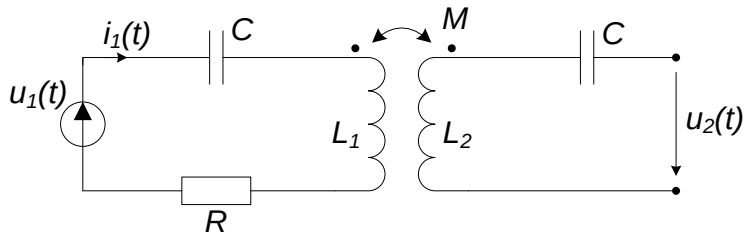
Problem 3-18

3-15 *For the circuit below we know* $R = 15\Omega$, $X_L = \omega L = 30\Omega$, $X_M = \omega M = 20\Omega$, $X_C = \frac{1}{\omega C} = 50\Omega$, *and supplying voltage* $u(t) = 100\sqrt{2}\ sin(100\pi t + 60^0)\ V$ *Determine: a) the phasor form of the equivalent impedance and the circuit impedance, Z, Z; b) the rms and the instantaneous value of the current, I, i(t); the rms and the instantaneous voltage indicated in figure, U_L, $u_L(t)$.*



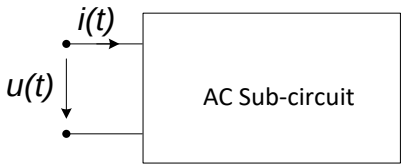
Problem 3-20

3-16 *Determine the instantaneous value of current, $i_1(t)$, and the rms output-voltage U_2 for the circuit below. The circuit parameters are:* $R = 40\Omega$, $X_{L1} = X_{L2} = 60\Omega$, $X_M = 30\Omega$, $X_C = 20\Omega$ *and the supplying voltage* $u_1(t) = 400\sin(500t - 30^0)\ V$.



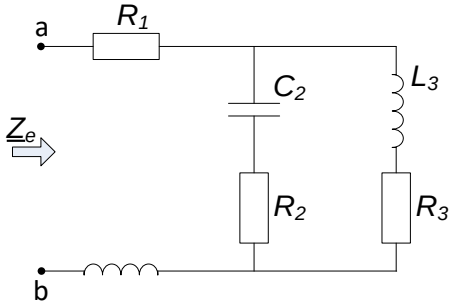
Problem 3-22

3-17 *The voltage and the current absorbed by the sub-circuit below are:* $u(t) = 200\sqrt{2}\ sin(500t - 30^0)\ V$ *and* $i(t) = 5\sin(500t + 60^0)\ A$. *Write the voltage and current phasor operator,* $\underline{U}$, $\underline{I}$. *Find the impedance phasor operator,* $\underline{Z}$, *the circuit impedance, Z, the active power, P, and the reactive power, Q, removed by the sub-circuit.*



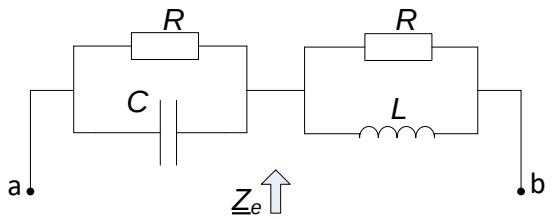
Problem 3-25

3-18 *For the circuit below find the equivalent impedance* $\underline{Z}_e$, *regarding terminals a and b. The circuit parameters are* $R_1 = R_2 = R_3 = 10\Omega$, $\mathrm{L}_3 = \frac{20}{\pi}\mathrm{mH}$, $\mathrm{C}_2 = \frac{5}{\pi}\mathrm{mF}$, *and* $f = 50Hz$.



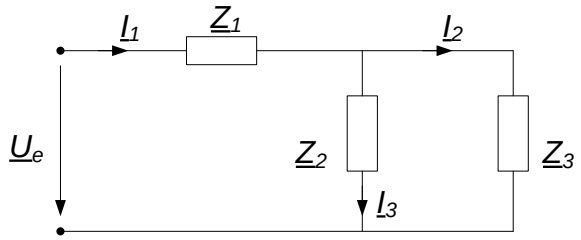
Problem 3-30

3-19 *For the circuit below find the equivalent impedance* $\underline{Z}_e$, *regarding terminals a and b. The circuit parameters are* $\mathrm{R}=10\Omega$, $\mathrm{L} = \frac{100}{\pi}\mathrm{mH}$, $\mathrm{C} = \frac{1}{\pi}\mathrm{mF}$, *and* $f = 50Hz$.



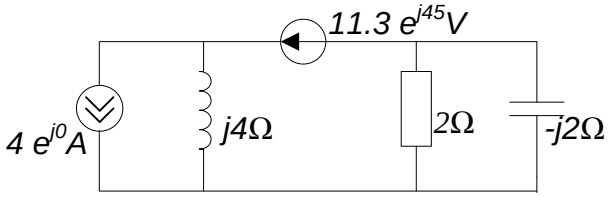
Problem 3-31

3-20 *For the circuit below we know* $\underline{Z}_1 = 10 + \mathrm{j}40, \underline{Z}_2 = 20 - \mathrm{j}20, \underline{Z}_1 = 20 + \mathrm{j}20$ *and rms current* $\mathrm{I} = 4\mathrm{A}$. *Find: a) the equivalent impedance regarding the source terminals; b) the rms and instantaneous value of supplying voltage,* U_e, $u_e(t)$; *the active, reactive and apparent power, P,Q, S.*



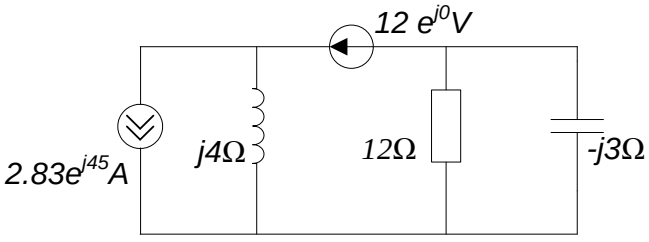
Problem 3-33

3-21 *For the circuit below find the potentials of the circuit nodes. Calculate the circuit currents.*



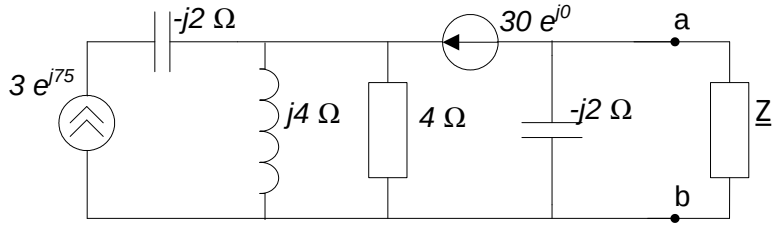
Problem 3-37

3-22 *For the circuit below find the potentials of the circuit nodes. Calculate the circuit currents.*



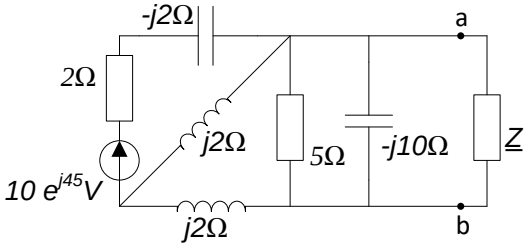
Problem 3-39

3-23 *For the circuit below determine the impedance value Z which will absorb the greatest power from the circuit.*



Problem 3-43

3-24 *For the circuit below determine the impedance value Z which will absorb the greatest power from the circuit.*



Problem 3-44