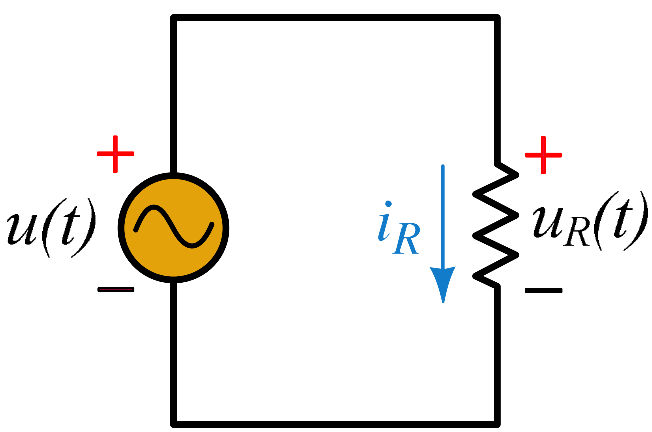
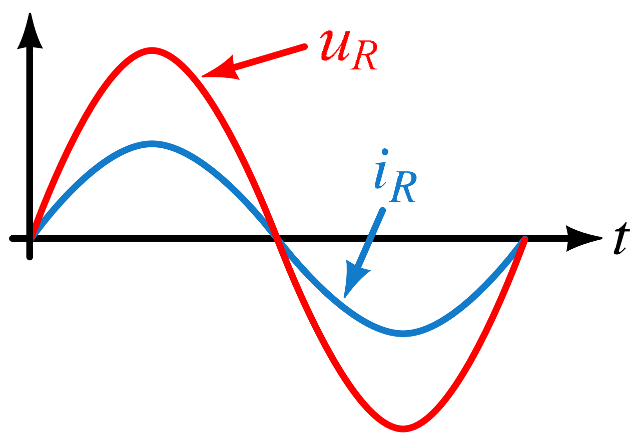
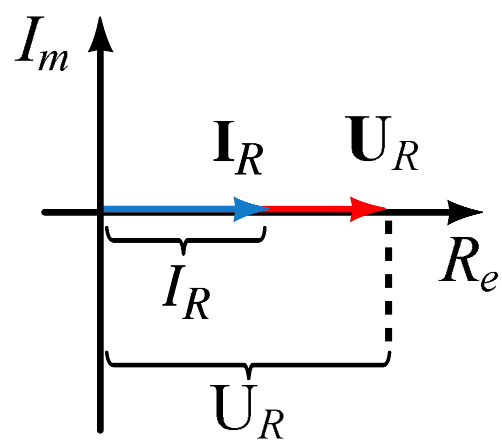
Otpornost R u kolu naizmjenične struje

- Pretpostavimo da je **otpornik R** priključen na prostoperiodični napon: $u(t) = U_m \sin(\omega t)$
- Po Omovom zakonu pad napona na otporniku je: $u_R(t) = R \cdot i(t)$
- Struja kroz otpornik ima vrijednost: $i_R(t) = \dfrac{U_m}{R} \sin(\omega t) = I_m \sin(\omega t)$

Struja kroz otpornik *i_R (t)* u fazi je sa naponom na otporniku *u_R (t)*







Otpornost R u kolu naizmjenične struje

Primjer:

EXAMPLE 16–11 For the circuit of Figure 16–18(a), if $R = 5\ \Omega$ and $i_R = 12 \sin(\omega t - 18)$ A, determine v_R.

Solution $v_R = Ri_R = 5 \times 12 \sin(\omega t - 18°) = 60 \sin(\omega t - 18°)$ V. The waveforms are shown in Figure 16–20.

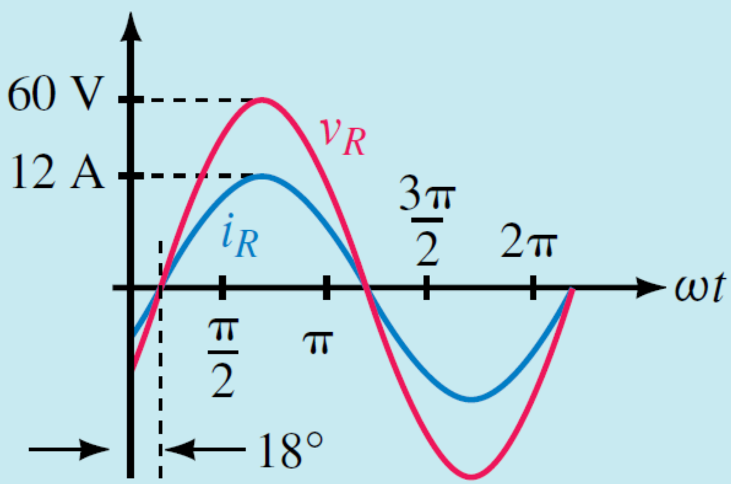


FIGURE 16–20

Otpornost R u kolu naizmjenične struje

Primjer:

1. If $v_R = 150 \cos \omega t$ V and $R = 25$ kΩ, determine i_R and sketch both waveforms.
2. If $v_R = 100 \sin(\omega t + 30°)$ V and $R = 0.2$ MΩ, determine i_R and sketch both waveforms.

Answers:

1. $i_R = 6 \cos \omega t$ mA. v_R and i_R are in phase.
2. $i_R = 0.5 \sin(\omega t + 30°)$ mA. v_R and i_R are in phase.

Zavojnica L u kolu naizmjenične struje

- Pretpostavimo da je **zavojnica L** priključena na prostoperiodični napon:

$$u(t) = U_m \sin(\omega t)$$

- Napon zavojnice $u_L\ (t)$ i struja zavojnice $i_L\ (t)$ povezani su izrazom:

$$u_L(t) = L\frac{di_L}{dt}$$

- Struja zavojnice $i_L\ (t)$ je:

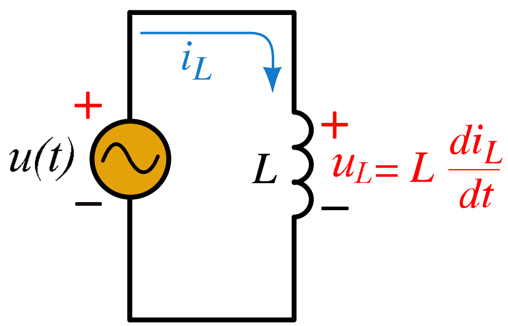
$$i_L(t) = \frac{1}{L}\int U_m \sin(\omega t) = -\frac{U_m}{\omega L}\cos(\omega t)$$

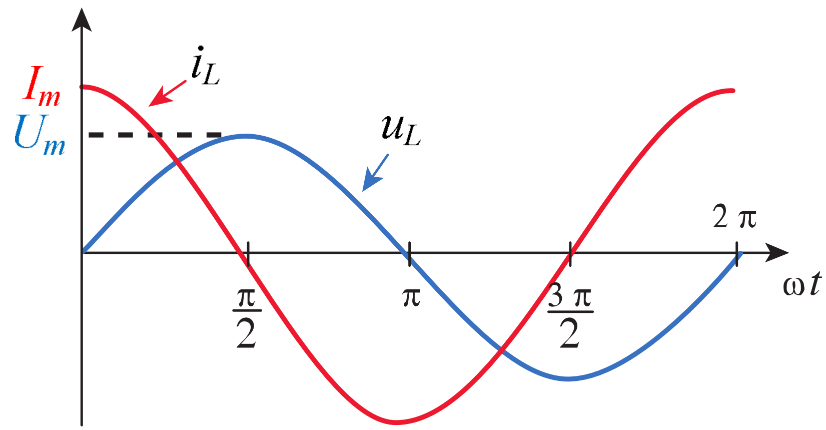
$$i_L(t) = I_m \sin\left(\omega t - \frac{\pi}{2}\right)$$

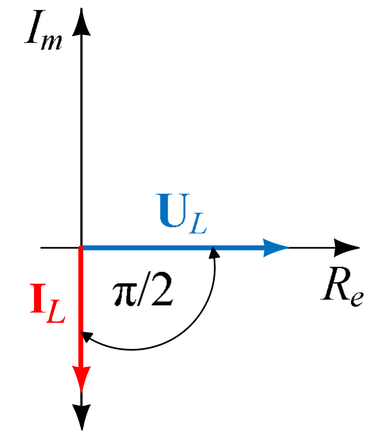
Struja zavojnice $i_L\ (t)$ fazno zaostaje za ugao π/2 u odnosu na napon zavojnice $u_L\ (t)$

Napon na zavojnici $u_L\ (t)$ fazno prednjači za ugao π/2 u odnosu struju zavojnice $u_L\ (t)$

Zavojnica L u kolu naizmjenične struje







- Maksimalna vrijednosti napona U_L i struje zavojnice I_L povezane su izrazom:

$$\frac{U_m}{I_m} = \omega L$$

- Veličina ωL naziva se induktivna reaktansa i označava se sa X_L i izražava se u omima (Ω)

$$X_L = \omega L\ [\Omega]$$

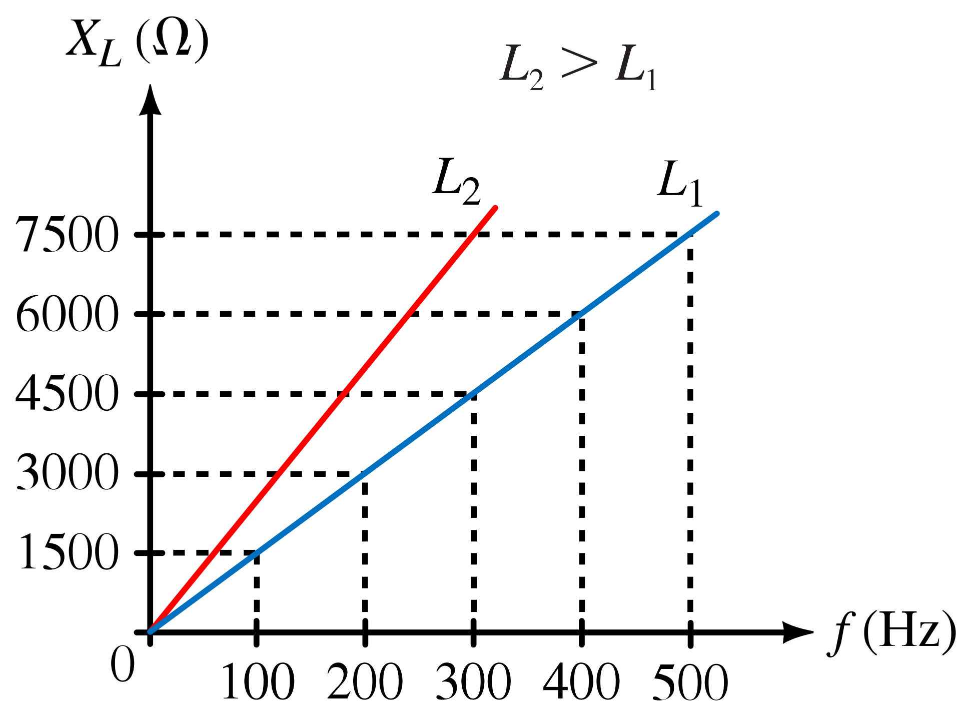
- Prema Omovom zakonu važe jednakosti:

$$I_L = \frac{U_L}{X_L}; \quad U_L = I_L \cdot X_L; \quad X_L = \frac{U_L}{I_L}$$

Zavojnica L u kolu naizmjenične struje

Induktivna reaktansa X_L predstavlja otpor zavojnice proticanju (promjeni) struje I_L kroz sebe.

- Pošto je $X_L = \omega L = 2\pi f L$ može se zaključiti da je vrijednost induktivne reaktanse direktno proporcionalna frekvenciji **f**
- Ako se frekvencija udvostruči udvostruči se i induktivna reaktansa i obrnuto



Zavojnica L u kolu naizmjenične struje

Primjer:

EXAMPLE 16–12 The voltage across a 0.2-H inductance is $v_L = 100 \sin(400t + 70°)$ V. Determine i_L and sketch it.

Solution $\omega = 400$ rad/s. Therefore, $X_L = \omega L = (400)(0.2) = 80\ \Omega$.

$$I_m = \frac{V_m}{X_L} = \frac{100\ \text{V}}{80\ \Omega} = 1.25\ \text{A}$$

The current lags the voltage by 90°. Therefore $i_L = 1.25 \sin(400t - 20°)$ A as indicated in Figure 16–25.

Zavojnica L u kolu naizmjenične struje

Primjer:

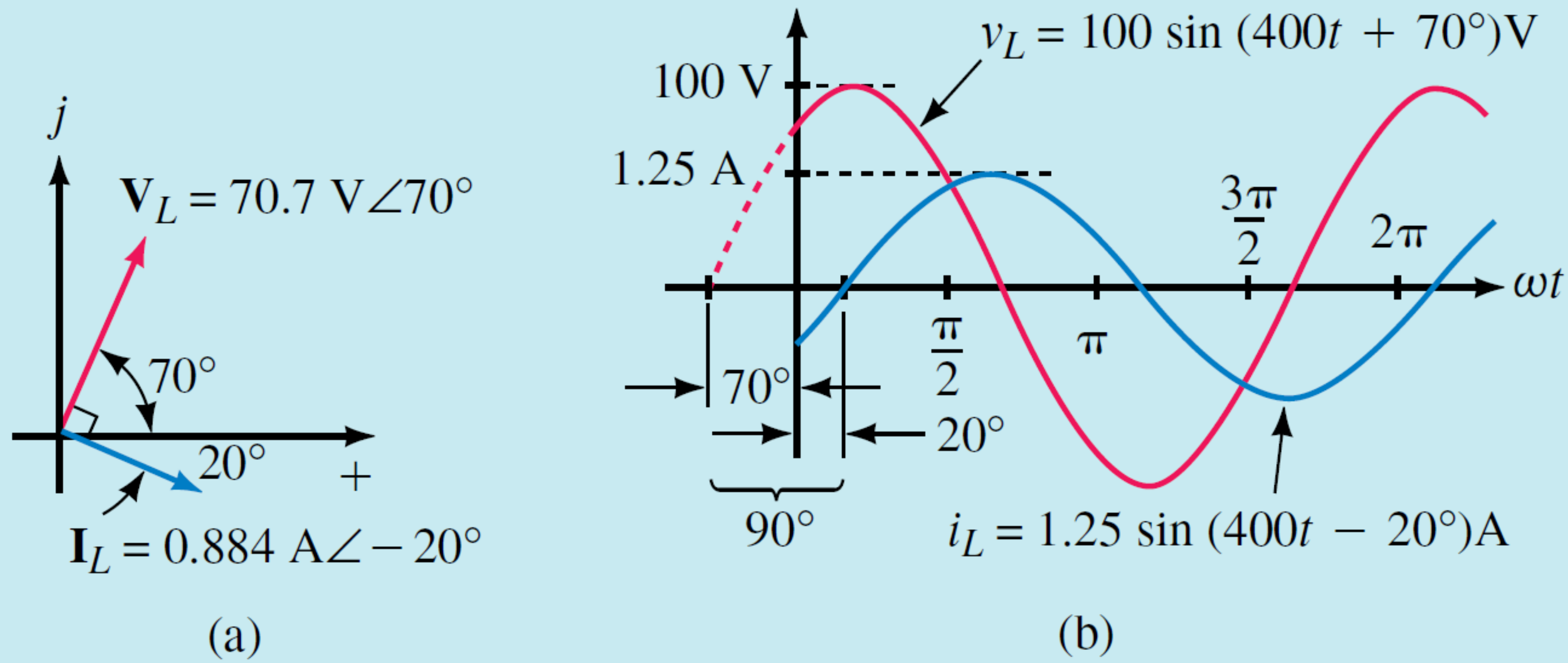


FIGURE 16–25 With voltage $\mathbf{V}_L$ at 70°, current $\mathbf{I}_L$ will be 90° later at −20°.

Zavojnica L u kolu naizmjenične struje

Primjer:

EXAMPLE 16–13 The current through a 0.01-H inductance is $i_L = 20 \sin(\omega t - 50°)$ A and $f = 60$ Hz. Determine v_L.

Solution

$$\omega = 2\pi f = 2\pi(60) = 377 \text{ rad/s}$$

$$X_L = \omega L = (377)(0.01) = 3.77\ \Omega$$

$$V_m = I_m X_L = (20\text{ A})(3.77\ \Omega) = 75.4\text{ V}$$

Voltage leads current by 90°. Thus, $v_L = 75.4 \sin(377t + 40°)$ V as shown in Figure 16–26.

Zavojnica L u kolu naizmjenične struje

Primjer:

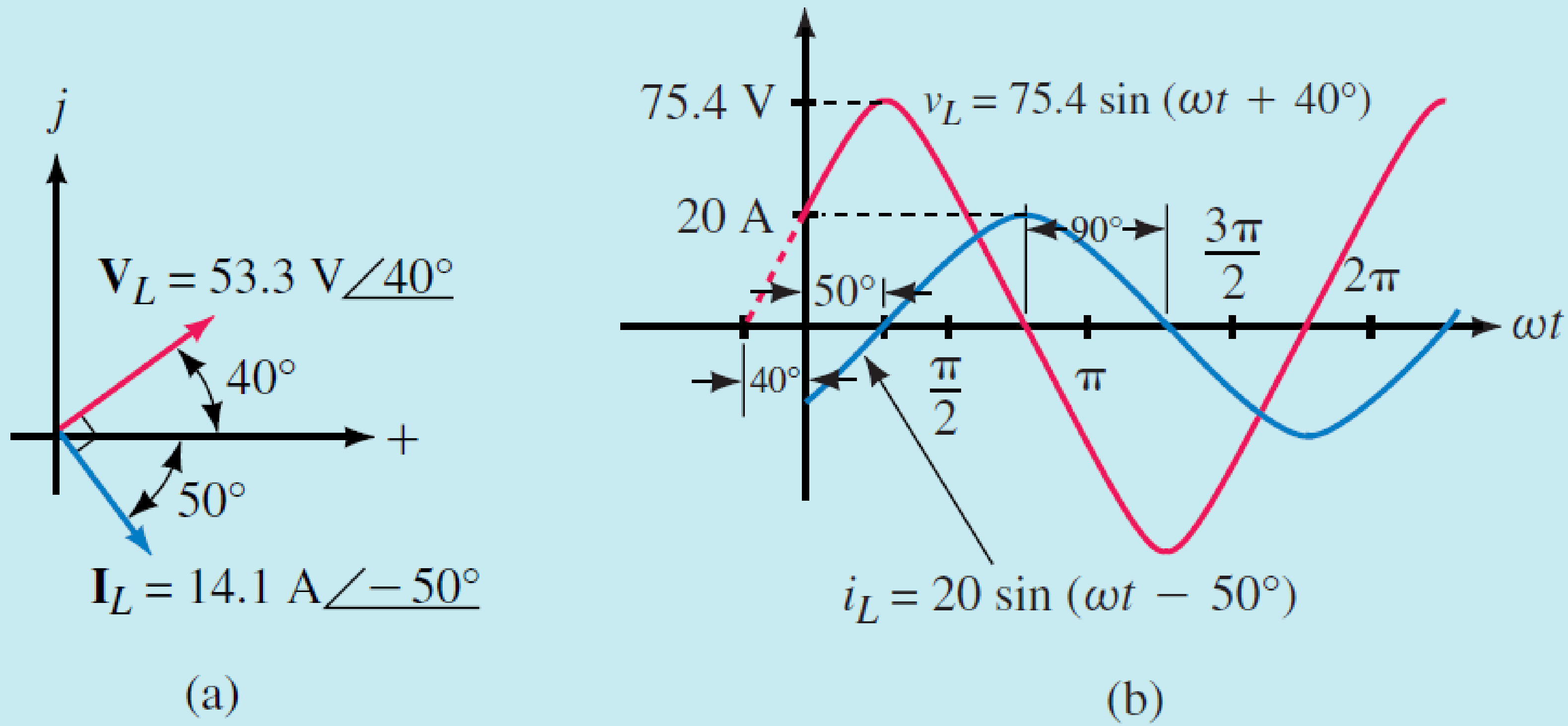


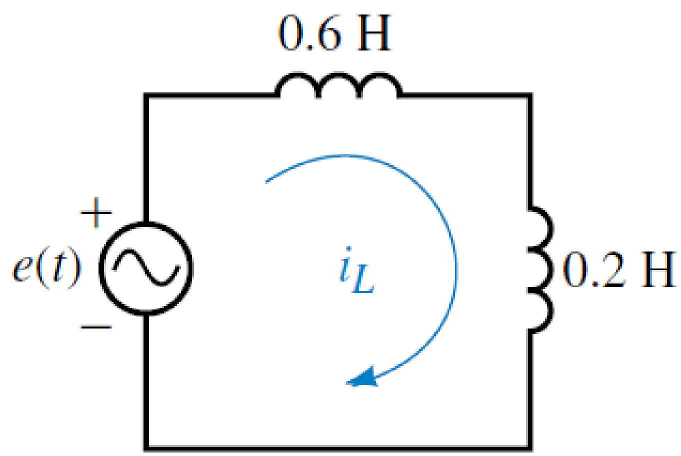
FIGURE 16–26

Zavojnica L u kolu naizmjenične struje

Primjer:

1. Two inductances are connected in series (Figure 16–27). If $e = 100 \sin \omega t$ and $f = 10$ kHz, determine the current. Sketch voltage and current waveforms.

FIGURE 16–27



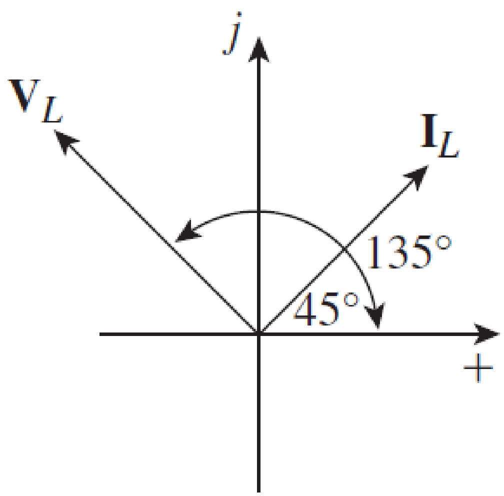
2. The current through a 0.5-H inductance is $i_L = 100 \sin(2400t + 45°)$ mA. Determine v_L and sketch voltage and current phasors and waveforms.

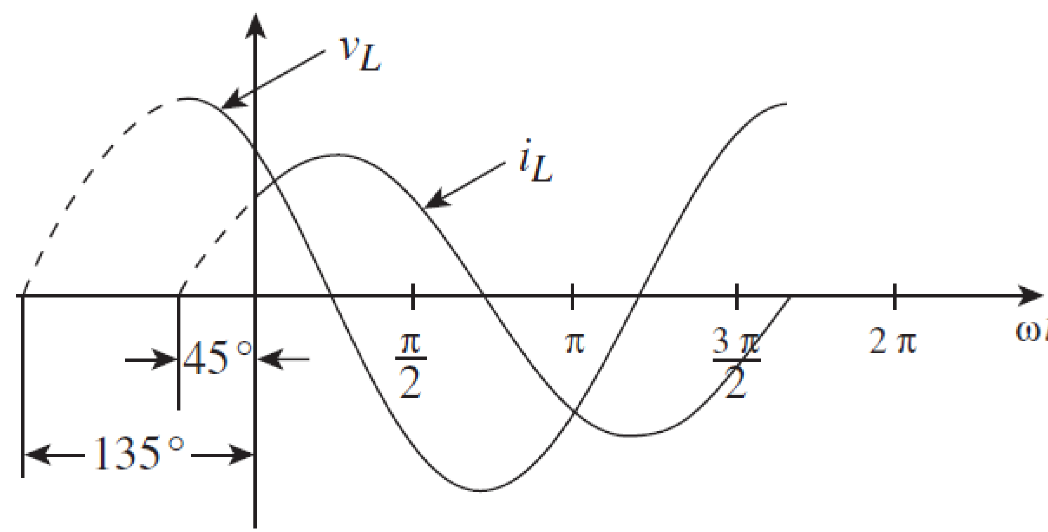
Zavojnica L u kolu naizmjenične struje

Primjer:

Answers:

1. $i_L = 1.99 \sin(\omega t - 90°)$ mA. Waveforms same as Figure 16–24.
2. $v_L = 120 \sin(2400t + 135° \text{ V})$. See following art for waveforms.





Kondenzator C u kolu naizmjenične struje

- Pretpostavimo da je **kondenzator C** priključen na prostoperiodični napon:

$$u(t) = U_m \sin(\omega t)$$

- Struja kondenzatora ***i_C (t)*** i napon kondenzatora ***u_C (t)*** povezani su izrazom:

$$i_C(t) = C\frac{du_C}{dt}$$

- Struja kondenzatora ***i_C (t)*** je:

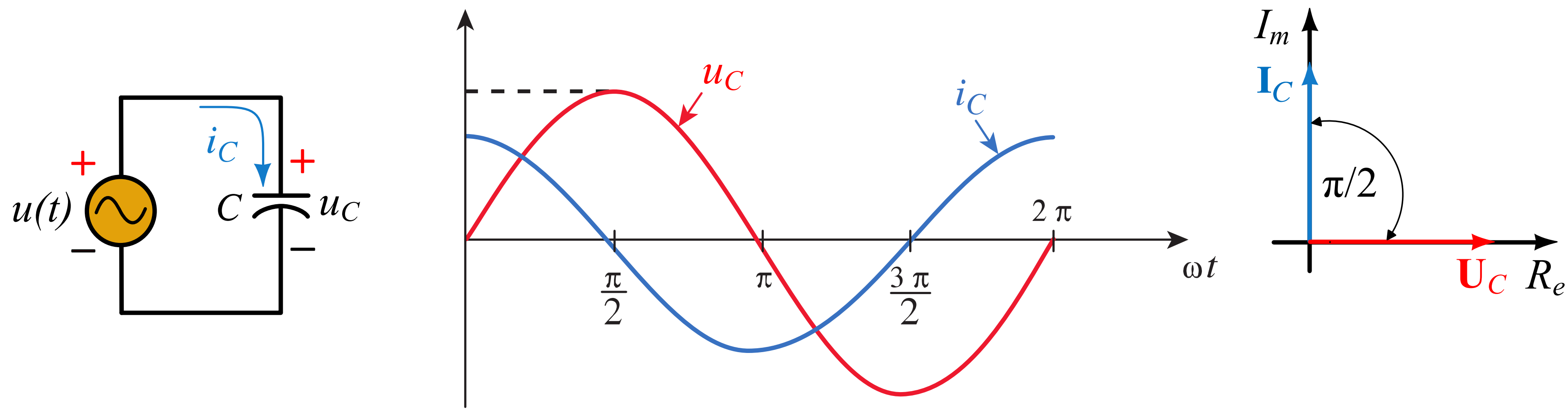
$$i_C(t) = C\frac{d}{dt}\left[U_m \sin(\omega t)\right] = \omega C \cdot U_m \cos(\omega t)$$

$$i_C(t) = I_m \sin\left(\omega t + \frac{\pi}{2}\right)$$

Struja kondenzatora *i_C (t)* fazno prednjači za ugao π/2 u odnosu na napon kondenzatora *u_C (t)*

Napon kondenzatora *u_C (t)* fazno kasni za ugao π/2 u odnosu struju kondenzatora *u_C (t)*

Kondenzator C u kolu naizmjenične struje



- Maksimalna vrijednosti napona U_C i struje kondenzatora I_C povezane su izrazom:

$$\frac{U_m}{I_m} = \frac{1}{\omega C}$$

- Veličina $1/\omega C$ naziva se kapacitivna reaktansa, označava se sa X_C i izražava se u omima (Ω)

$$X_C = \frac{1}{\omega C}\ [\Omega]$$

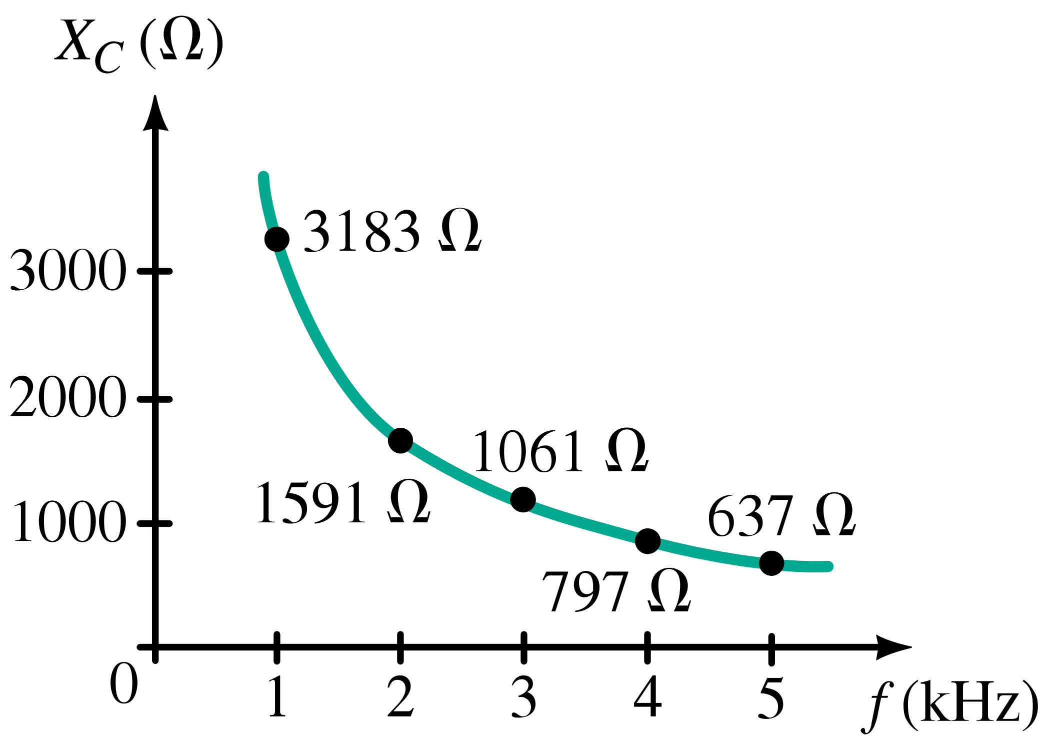
- Prema Omovom zakonu važe jednakosti:

$$I_C = \frac{U_C}{X_C}; \quad U_C = I_C \cdot X_C; \quad X_C = \frac{U_C}{I_C}$$

Kondenzator C u kolu naizmjenične struje

Kapacitivna reaktansa X_C predstavlja otpor kondenzatora promjeni napona U_C na svojim krajevima

- Pošto je $X_C=1/\omega C=1/2\pi fC$ može se zaključiti da je vrijednost kapacitivne reaktanse obrnuto proporcionalna frekvenciji **f**
- Pri većim frekvencijama **f** manja je kapacitivna reaktansa X_C i obrnuto
- U jednosmjernim kolima (**f=0**) kapacitivna reaktansa je beskonačna



Kondenzator C u kolu naizmjenične struje

Primjer:

EXAMPLE 16–14 The voltage across a 10-μF capacitance is $v_C = 100 \sin(\omega t - 40°)$ V and $f = 1000$ Hz. Determine i_C and sketch its waveform.

Solution

$$\omega = 2\pi f = 2\pi(1000 \text{ Hz}) = 6283 \text{ rad/s}$$

$$X_C = \frac{1}{\omega C} = \frac{1}{(6283)(10 \times 10^{-6})} = 15.92\ \Omega$$

$$I_m = \frac{V_m}{X_C} = \frac{100 \text{ V}}{15.92\ \Omega} = 6.28 \text{ A}$$

Since current leads voltage by 90°, $i_C = 6.28 \sin(6283t + 50°)$ A as indicated in Figure 16–32.

Kondenzator C u kolu naizmjenične struje

Primjer:

Since current leads voltage by 90°, $i_C = 6.28 \sin(6283t + 50°)$ A as indicated in Figure 16–32.

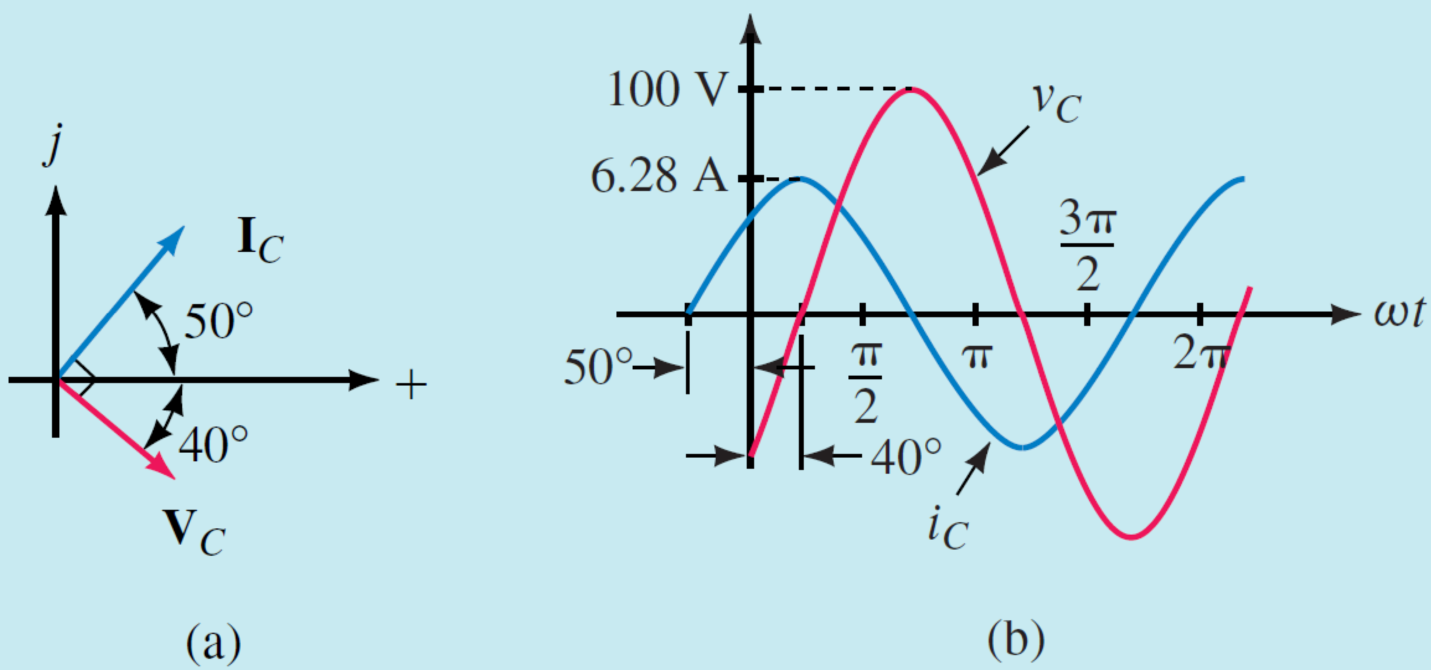


FIGURE 16–32 Phasors are not to scale with waveform.

Kondenzator C u kolu naizmjenične struje

Primjer:

EXAMPLE 16–15 The current through a 0.1-μF capacitance is $i_C = 5 \sin(1000t + 120°)$ mA. Determine v_C.

Solution

$$X_C = \frac{1}{\omega C} = \frac{1}{(1000 \text{ rad/s})(0.1 \times 10^{-6}\ F)} = 10 \text{ k}\Omega$$

Thus, $V_m = I_m X_C = (5 \text{ mA})(10 \text{ k}\Omega) = 50$ V. Since voltage lags current by 90°, $v_C = 50 \sin(1000t + 30°)$ V. Waveforms and phasors are shown in Figure 16–33.

Kondenzator C u kolu naizmjenične struje

Primjer:

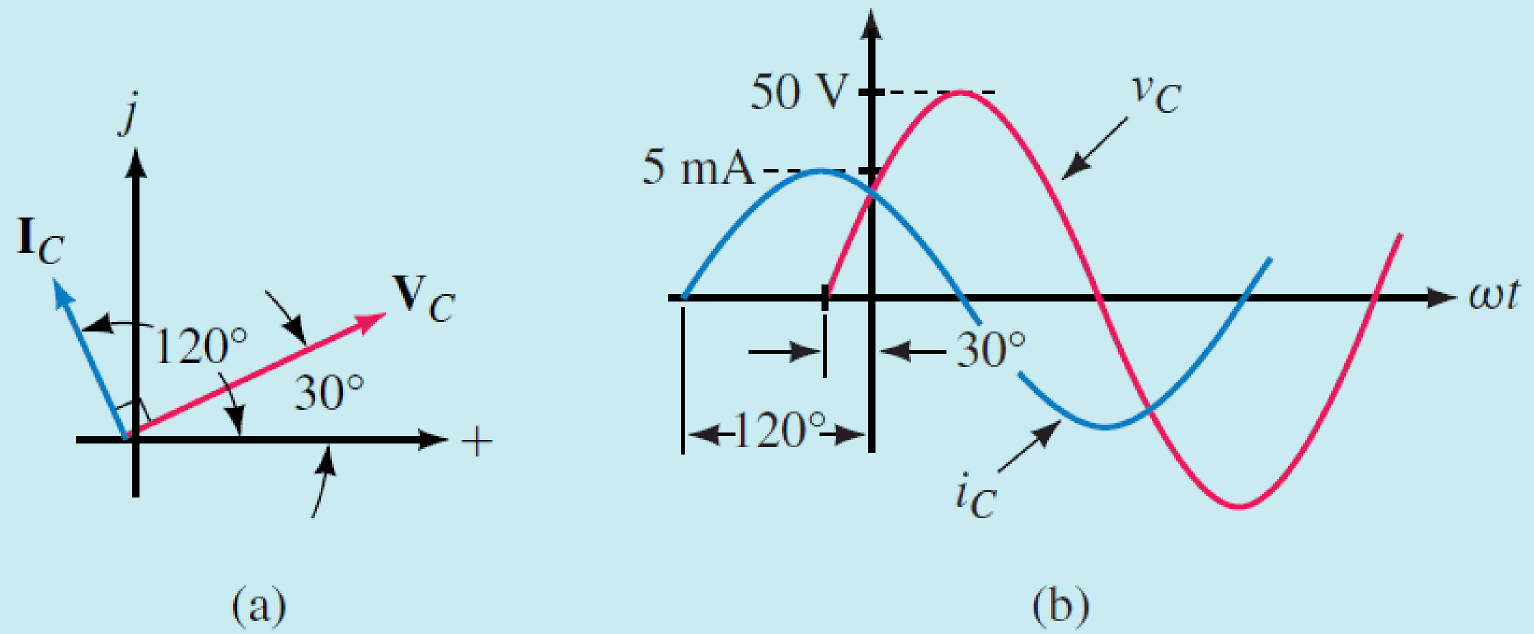


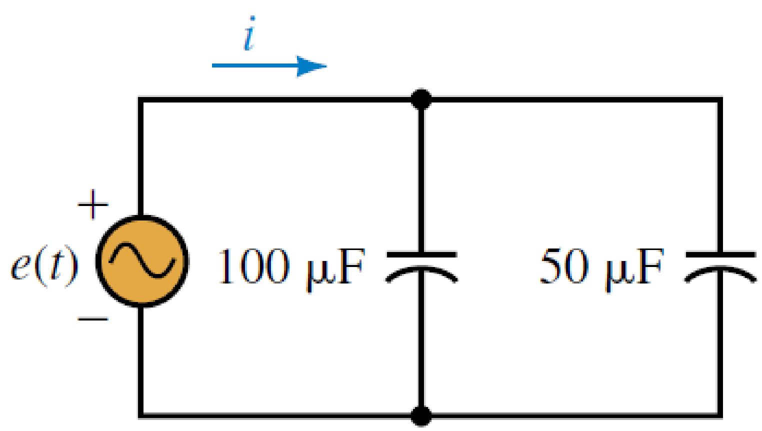
FIGURE 16–33 Phasors are not to scale with waveform.

Kondenzator C u kolu naizmjenične struje

Primjer:

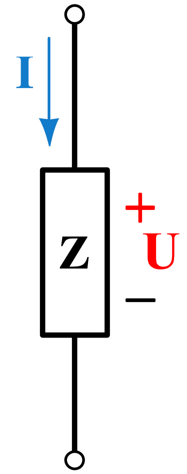
Two capacitances are connected in parallel (Figure 16–34). If $e = 100 \sin \omega t$ V and $f = 10$ Hz, determine the source current. Sketch current and voltage phasors and waveforms.

FIGURE 16–34



Answer: $i = 0.942 \sin(62.8t + 90°) = 0.942 \cos 62.8t$ A
See Figure 16–29(b) and (c).

Pojam impedanse Z



- Mjera opiranja elemenata kola R,L i C proticanju naizmjenične struje u fazorskom domenu označena je kao **impedansa Z**
- Pošte se fazori predstavljaju kompleksnim brojevima to je i impedansa kompleksan broj
- Modul impedanse *Z* jednak je količniku efektivnih vrednosti napona i struje potrošača
- Argument impedanse θ^o jednak je faznoj razlici napona i struje potrošača

$$\bar{Z} = \frac{\bar{U}}{\bar{I}} [\Omega]$$

$$\bar{Z} = \frac{\bar{U}}{\bar{I}} = \frac{U}{I} = Z\angle\theta^o$$

$$Z = \frac{U}{I}$$

$$\theta = arctg \frac{I_m}{R_e}$$

Grafička prezentacija impedanse Z

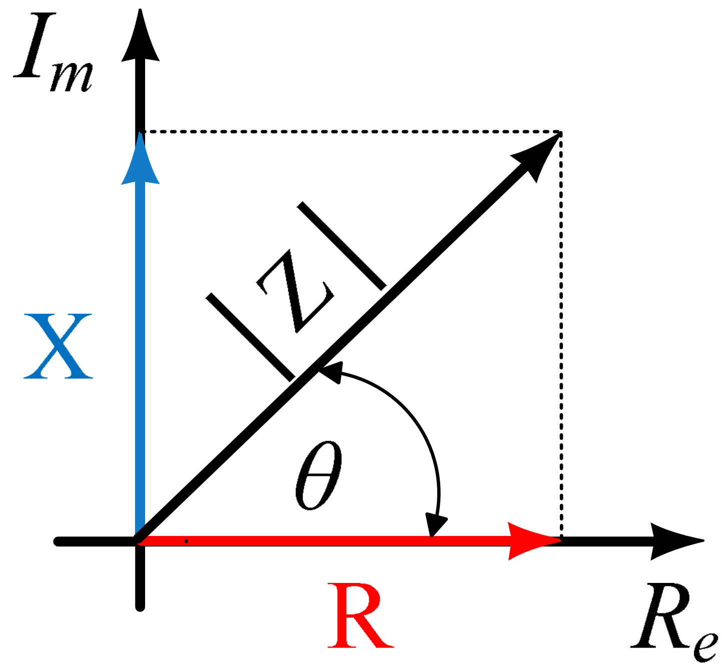
- Impedansa Z se može rastaviti na realni i imaginarni dio: $\overline{Z} = R + jX$
- Realni dio impedanse Z naziva se rezistansa R: $R = \mathrm{Re}\{\overline{Z}\}$
- Imaginarni dio impedanse naziva se reaktansa X: $X = \mathrm{Im}\{\overline{Z}\}$
- U algebarskom, eksponencijalnom i trigonometrijskom obliku izrazi za kompleksnu impedansu glase:

$$\overline{Z} = R + jX = Ze^{j\theta} = Z\sin\theta + jZ\cos\theta$$

$$R = Z\cos\theta, \quad X = Z\sin\theta$$

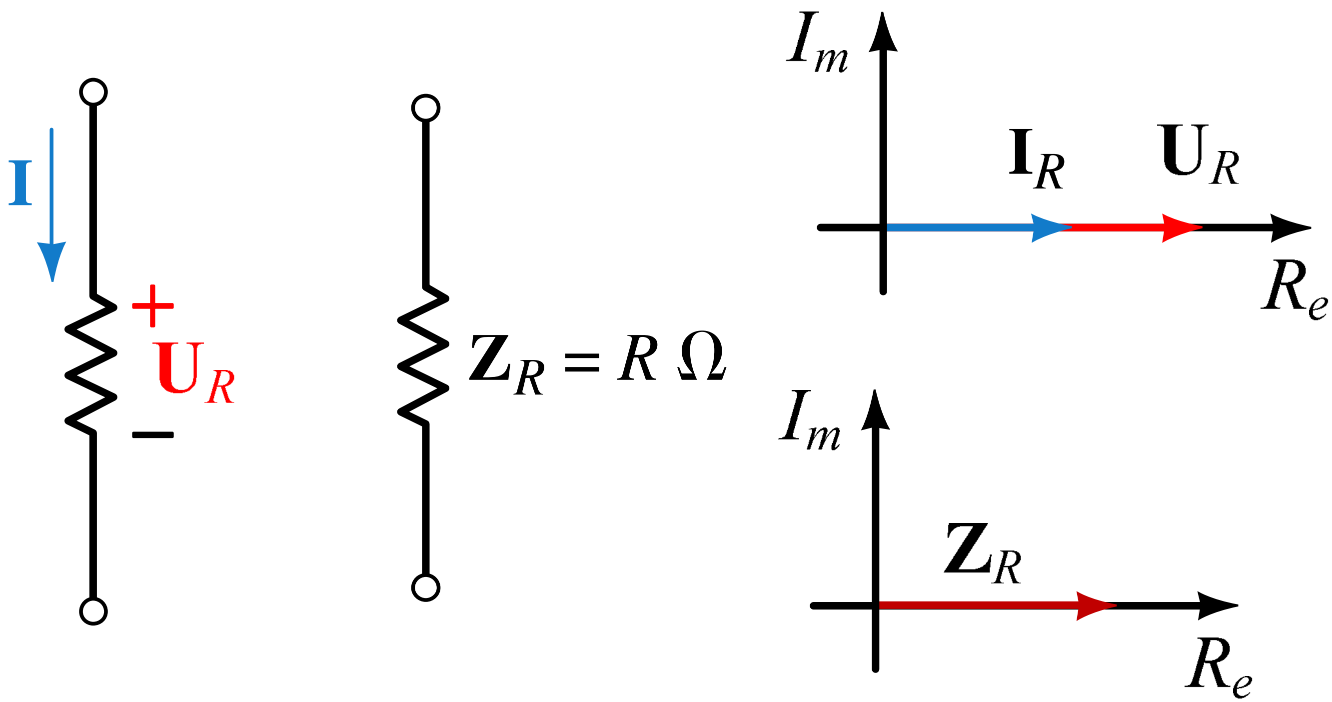
$$Z = \sqrt{R^2 + X^2}$$

$$\theta = arctg\frac{X}{R}$$



Predstavljanje otpornosti R kao impedanse

- Kod otpornosti R napon U_R i struja I_R su u fazi tj. $\theta=0^o$
- Ako napon ima neki početni ugao φ isti taj ugao će imati i struja
- Za impedansu $\mathbf{Z_R}$ u možemo napisati: $$\overline{Z}_R = \frac{\overline{U}_R}{\overline{I}_R} = \frac{U_R\angle\varphi}{I_R\angle\varphi} = \frac{U_R}{I_R}\angle 0^o = R$$

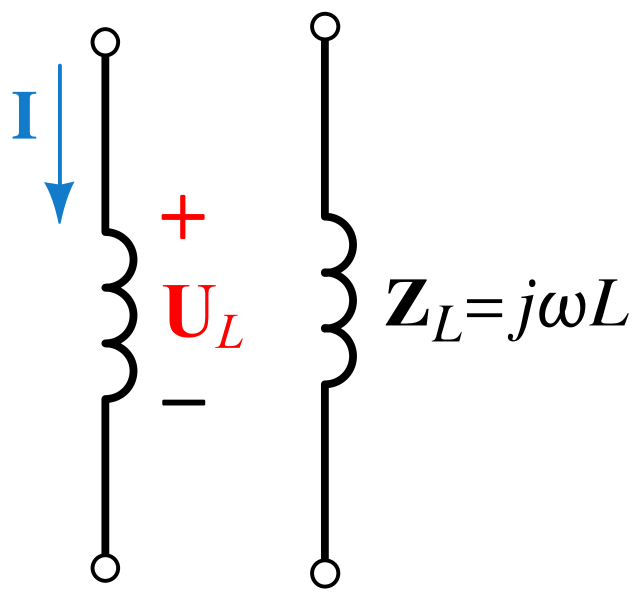


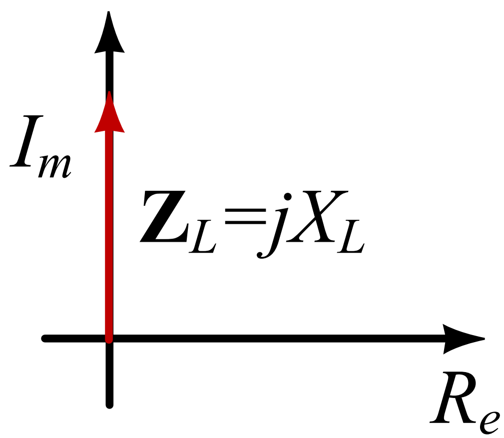
Predstavljanje zavojnice L kao impedanse

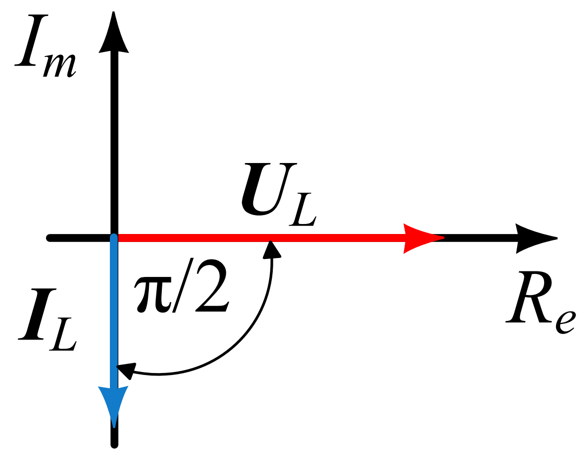
- Kod zavojnice L napon U_L prednjači struji I_L za ugao $\theta=90^o$
- Ako pretpostavimo da napon zavojnice U_L ima početni ugao $\varphi_U=0^o$ onda će struja zaostajati za naponom za ugao $\varphi_I=-90^o$
- Za impedansu $\mathbf{Z_L}$ u možemo napisati:

$$\overline{Z_L} = \frac{\overline{U_L}}{\overline{I_L}} = \frac{U_L\angle 0^o}{I_L\angle -90^0} = \frac{U_L}{I_L}\angle 90^o$$

$$\overline{Z_L} = \omega L\angle 90^o = j\omega L = jX_L$$





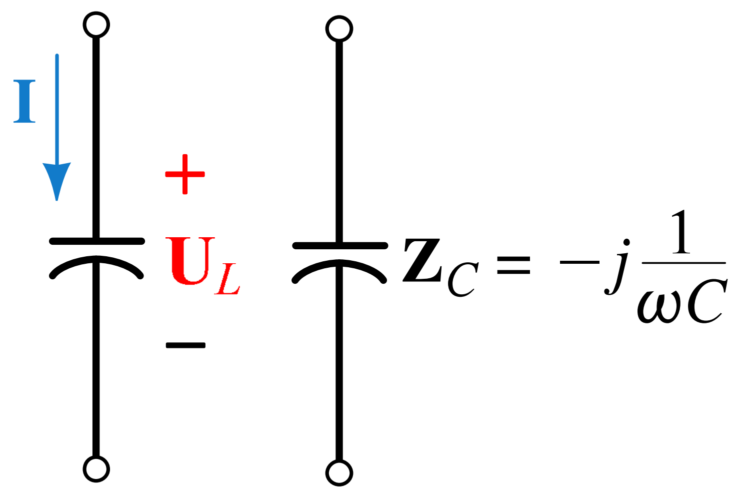


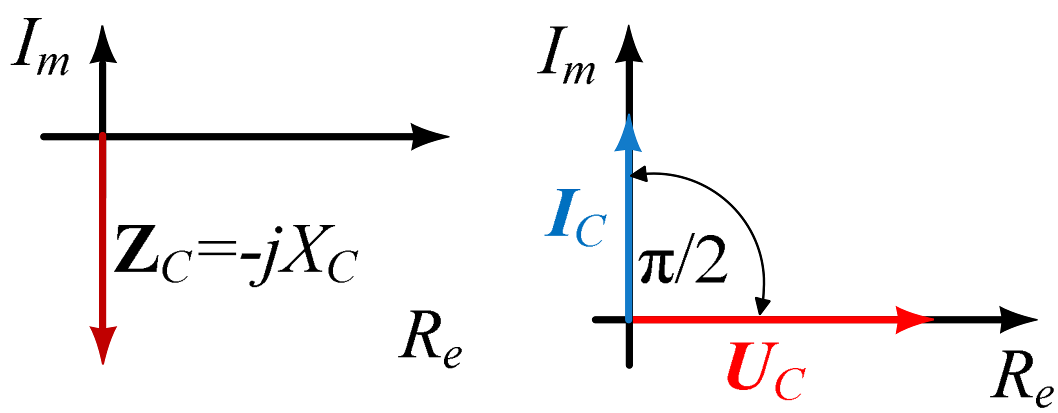
Predstavljanje kondenzatora C kao impedanse

- Kod kondenzatora C, struja I_C prednjači naponu U_C kondenzatora za ugao $\theta=90^o$
- Ako pretpostavimo da napon kondenzator U_C ima početni ugao $\varphi_U=0^o$ onda će struja I_C prednjačiti za naponom za ugao $\varphi_I=90^o$
- Za impedansu $\mathbf{Z_C}$ u možemo napisati:

$$\overline{Z_C} = \frac{\overline{U_C}}{\overline{I_C}} = \frac{U_C\angle 0^o}{I_C\angle 90^0} = \frac{U_C}{I_C}\angle -90^o$$

$$\overline{Z_L} = \frac{1}{\omega C}\angle -90^o = -j\frac{1}{\omega C} = -jX_C$$





Zavojnica L u kolu naizmjenične struje

Primjer:

EXAMPLE 16–16 Consider again Example 16–12. Given $v_L = 100 \sin(400t + 70°)$ and $L = 0.2$ H, determine i_L using the impedance concept.

Solution See Figure 16–40.

$$\mathbf{V}_L = 70.7 \text{ V}\angle 70° \quad \text{and} \quad \omega = 400 \text{ rad/s}$$

$$\mathbf{Z}_L = j\omega L = j(400)(0.2) = j80\ \Omega$$

$$\mathbf{I}_L = \frac{\mathbf{V}_L}{\mathbf{Z}_L} = \frac{70.7\angle 70°}{j80} = \frac{70.7\angle 70°}{80\angle 90°} = 0.884 \text{ A}\angle -20°$$

In the time domain, $i_L = \sqrt{2}(0.884)\sin(400t - 20°) = 1.25 \sin(400t - 20°)$ A, which agrees with our previous solution.

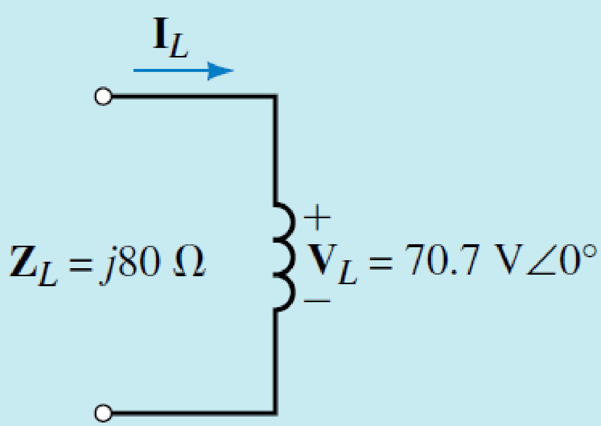


FIGURE 16–40

Kondenzator C u kolu naizmjenične struje

Primjer: EXAMPLE 16–17 Given $v_C = 100 \sin(\omega t - 40°)$, $f = 1000$ Hz, and $C = 10\ \mu$F, determine i_C in Figure 16–42.

Solution

$$\omega = 2\pi f = 2\pi(1000 \text{ Hz}) = 6283 \text{ rads/s}$$

$$\mathbf{V}_C = 70.7 \text{ V}\angle -40°$$

$$\mathbf{Z}_C = -j\frac{1}{\omega C} = -j\left(\frac{1}{6283 \times 10 \times 10^{-6}}\right) = -j15.92\ \Omega.$$

$$\mathbf{I}_C = \frac{\mathbf{V}_C}{\mathbf{Z}_C} = \frac{70.7\angle -40°}{-j15.92} = \frac{70.7\angle -40°}{15.92\angle -90°} = 4.442 \text{ A}\angle 50°$$

In the time domain, $i_C = \sqrt{2}(4.442) \sin(6283t + 50°) = 6.28 \sin(6283t + 50°)$ A, which agrees with our previous solution, in Example 16–14.

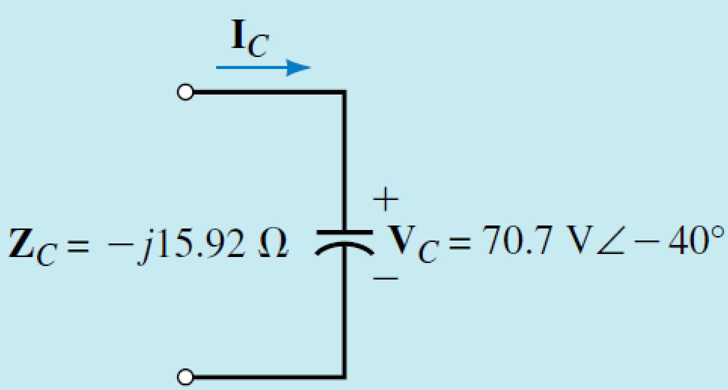


FIGURE 16–42

Zavojnica L u kolu naizmjenične struje

Primjer:

1. If $\mathbf{I}_L = 5\ \text{mA}\angle -60°$, $L = 2$ mH, and $f = 10$ kHz, what is $\mathbf{V}_L$?
2. A capacitor has a reactance of 50 Ω at 1200 Hz. If $v_C = 80 \sin 800t$ V, what is i_C?

Answers:

1. $628\ \text{mV}\angle 30°$
2. $0.170 \sin(800t + 90°)$ A

Serijsko RL kolo

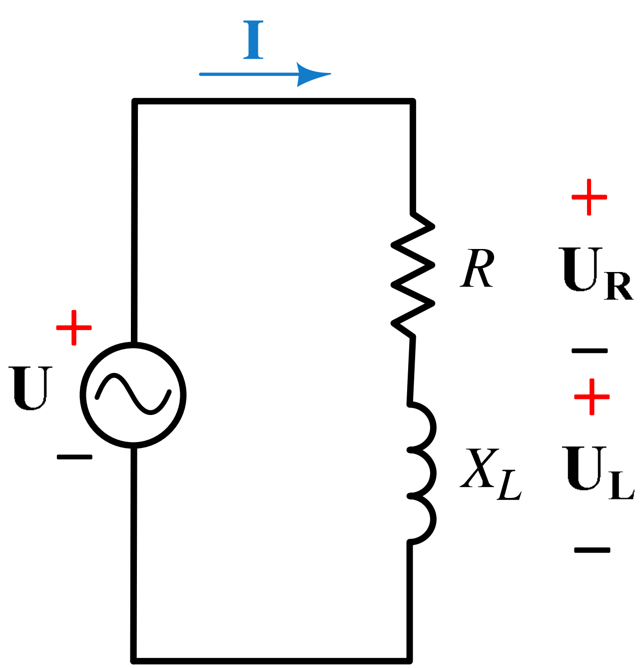
- U serijskom kolu struja je zajednička za oba elementa. Neka je struja data u obliku: $\overline{\boldsymbol{I}} = I\angle 0^o = I$
- Primjenom II Kirhofovog zakona u kompleksnom domenu dobijamo:

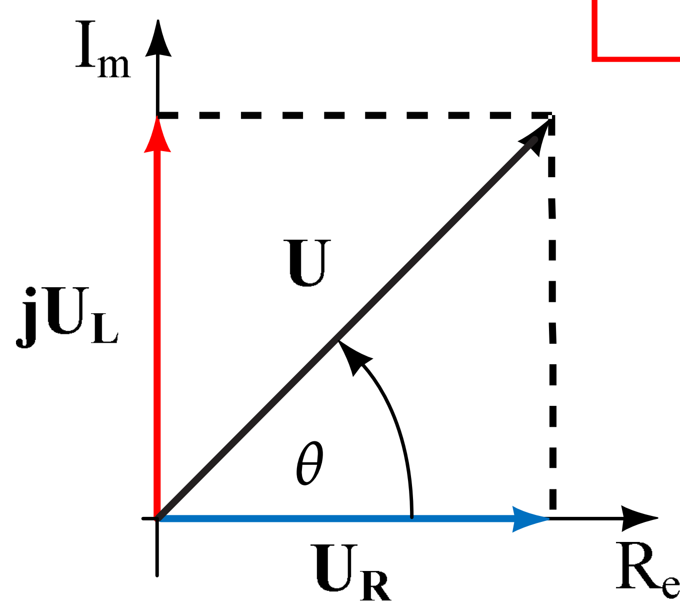
$$\overline{\boldsymbol{U}} = \overline{\boldsymbol{U}_R} + \overline{\boldsymbol{U}_L}; \quad \overline{\boldsymbol{U}} = U_R\angle 0^o + U_L\angle 90^o; \overline{\boldsymbol{U}} = U_R + jU_L$$

$$U = \sqrt{U_R^2 + U_L^2}$$

- Ugao θ i amplituda napona ***U*** može se dobiti iz izraza:

$$\theta = arctg\frac{U_L}{U_R}$$





Serijsko RL kolo

- Padovi napona na elementima R i L dati su sa: $\overline{U}_R = \overline{I} \cdot \overline{Z}_R; \quad \overline{U}_L = \overline{I} \cdot \overline{Z}_L$
- Zamjenom impedansi sa: $\overline{Z}_R = R; \quad \overline{Z}_L = jX_L$
- Jednačina za napon se može napisati u obliku:

$$\overline{U} = \overline{I} \cdot R + j\overline{I} \cdot X_L = \overline{I} \cdot (R + jX_L) \Rightarrow \overline{U} = \overline{I} \cdot \overline{Z}$$

$$\overline{Z} = R + jX_L$$

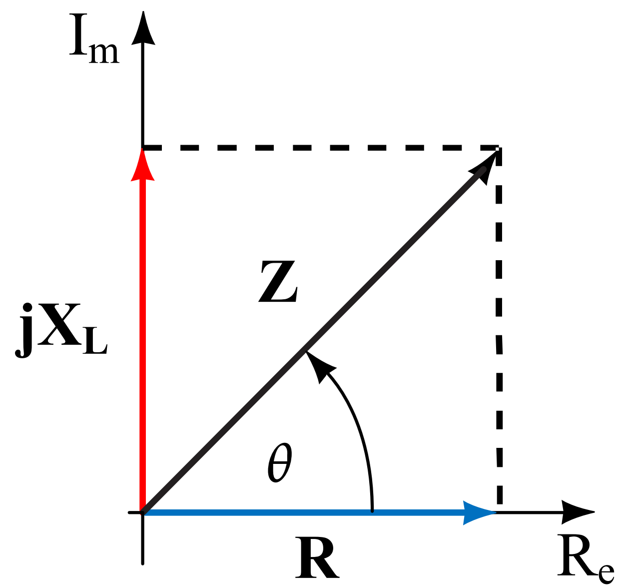
- Ugao θ i moduo impedanse Z može se dobiti iz izraza:

$$Z = \sqrt{R^2 + X_L^2}$$

$$R = Z \cdot \cos\theta$$

$$\theta = arctg\frac{X_L}{R}$$

$$X_L = Z \cdot \sin\theta$$



Serijsko RC kolo

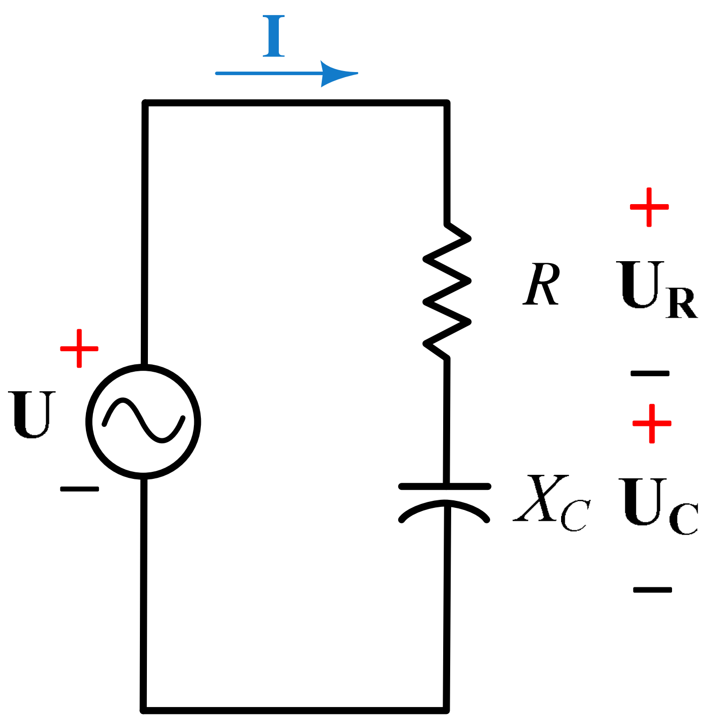
- U serijskom kolu struja je zajednička za oba elementa. Neka je struja data u obliku: $\overline{\boldsymbol{I}} = I\angle 0^o = I$
- Primjenom II Kirhofovog zakona u kompleksnom domenu dobijamo:

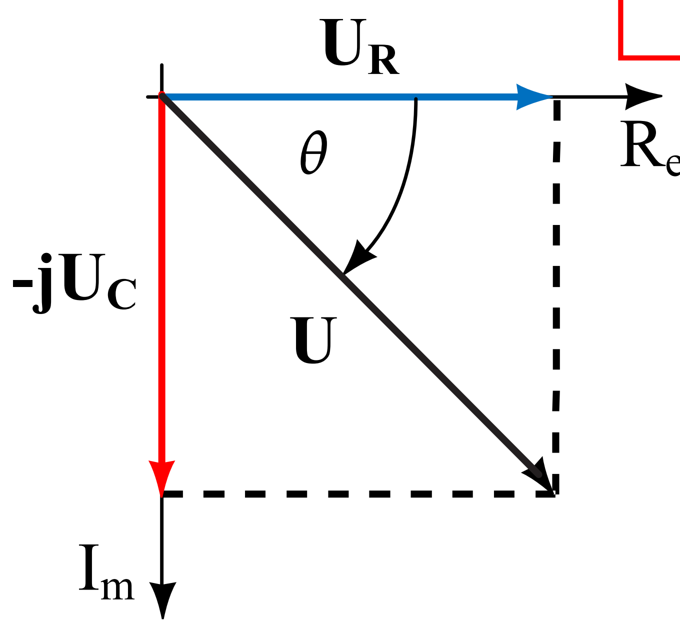
$$\overline{\boldsymbol{U}} = \overline{\boldsymbol{U}}_R + \overline{\boldsymbol{U}}_C; \quad \overline{\boldsymbol{U}} = U_R\angle 0^o + U_C\angle -90^o; \overline{\boldsymbol{U}} = U_R - jU_C$$

$$U = \sqrt{U_R^2 + U_C^2}$$

- Ugao θ i amplituda napona $\boldsymbol{U}$ može se dobiti iz izraza:

$$\theta = arctg\frac{U_C}{U_R}$$





Serijsko RC kolo

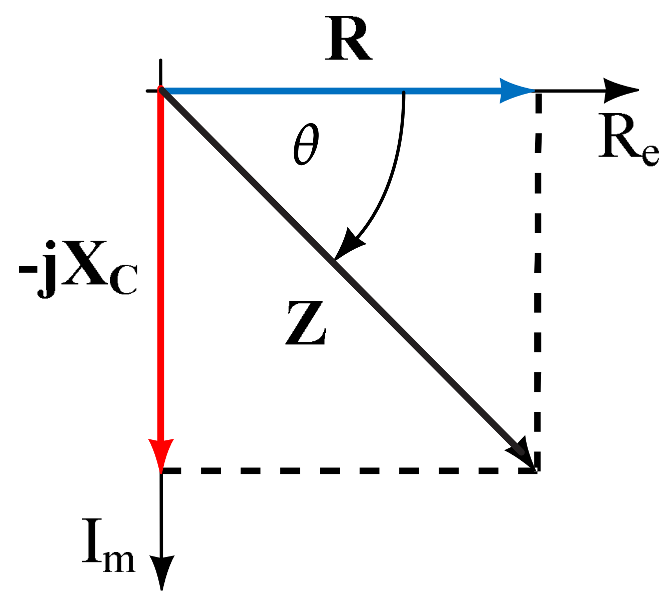
- Padovi napona na elementima R i C dati su sa: $\overline{U}_R = \overline{I} \cdot \overline{Z}_R; \quad \overline{U}_C = \overline{I} \cdot \overline{Z}_C$
- Zamjenom impedansi sa: $\overline{Z}_R = R; \quad \overline{Z}_C = -jX_C$
- Jednačina za napon se može napisati u obliku:

$$\overline{U} = \overline{I} \cdot R - j\overline{I} \cdot X_C = \overline{I} \cdot (R - jX_C) \Rightarrow \overline{U} = \overline{I} \cdot \overline{Z} \qquad \overline{Z} = R - jX_C$$

- Ugao θ i moduo impedanse Z može se dobiti iz izraza:

$$Z = \sqrt{R^2 + X_C^2} \qquad R = Z \cdot \cos\theta$$

$$\theta = arctg\frac{X_C}{R} \qquad X_C = Z \cdot \sin\theta$$



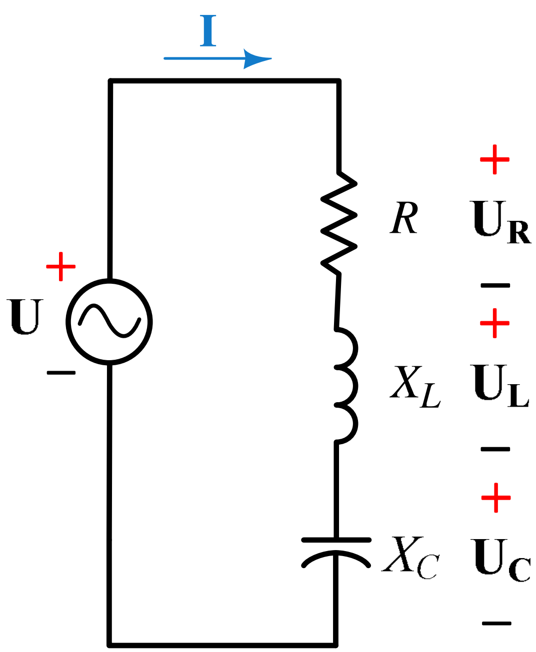
Serijsko RLC kolo

- U serijskom kolu struja je zajednička za oba elementa. Neka je struja data u obliku: $\overline{\boldsymbol{I}} = I\angle 0^o = I$
- Primjenom II Kirhofovog zakona u kompleksnom domenu dobijamo:

$$\overline{\boldsymbol{U}} = \overline{\boldsymbol{U}_R} + \overline{\boldsymbol{U}_L} + \overline{\boldsymbol{U}_C};\quad \overline{\boldsymbol{U}} = U_R\angle 0^o + U_L\angle 90^o + U_C\angle -90^o;$$

$$\overline{\boldsymbol{U}} = U_R + jU_L - jU_C \Rightarrow \overline{\boldsymbol{U}} = U_R + j\left(U_L - U_C\right)$$

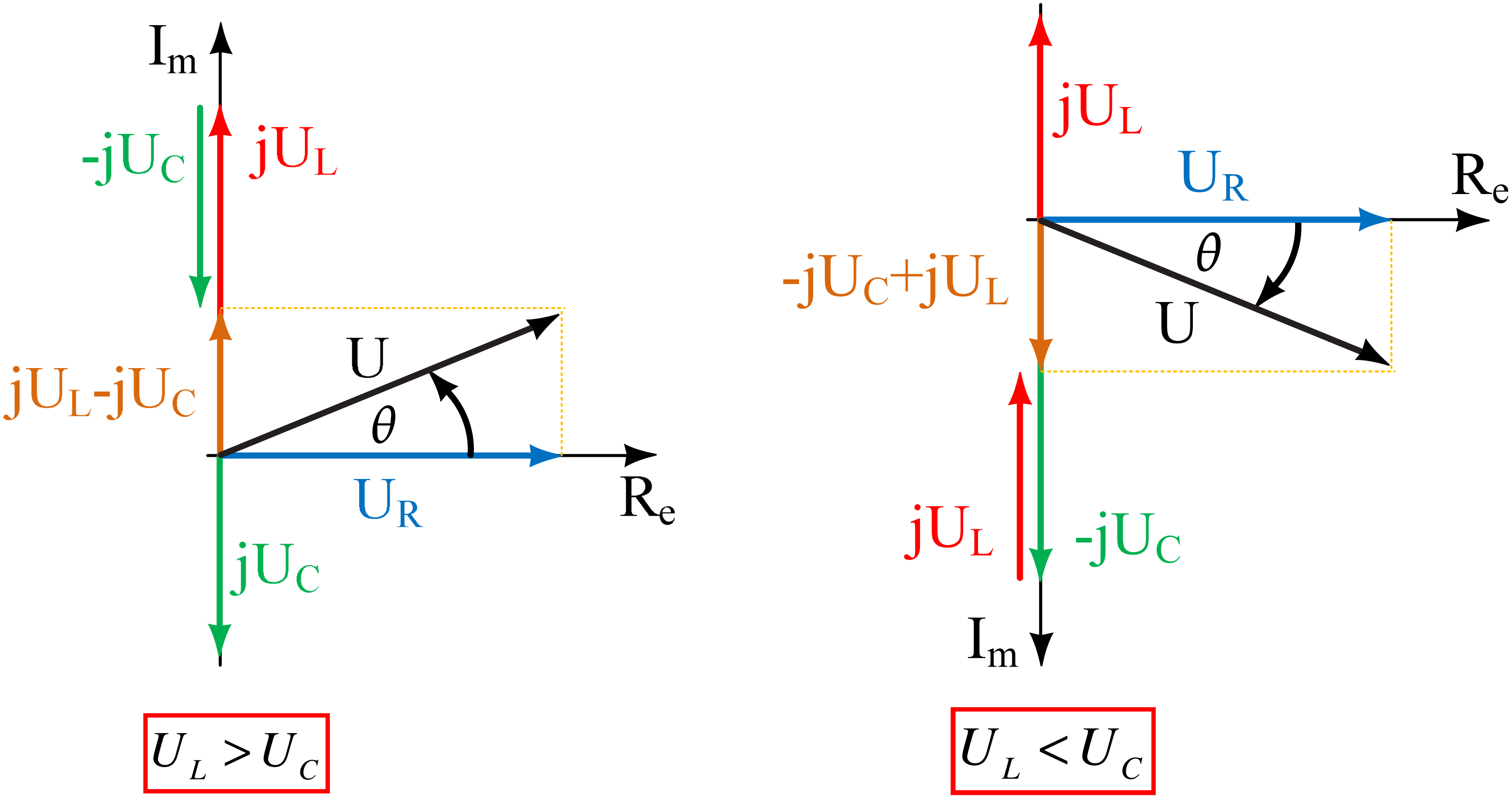
- Ugao θ i amplituda napona ***U*** može se dobiti iz izraza:



$$U = \sqrt{U_R^2 + \left(U_L - U_C\right)^2}$$

$$\theta = arctg\,\frac{U_L - U_C}{U_R}$$

Serijsko RLC kolo



Serijsko RLC kolo

- Padovi napona na elementima R i C dati su sa:

$$\overline{\boldsymbol{U}_R} = \overline{\boldsymbol{I}} \cdot \overline{\boldsymbol{Z}_R}; \quad \overline{\boldsymbol{U}_L} = \overline{\boldsymbol{I}} \cdot \overline{\boldsymbol{Z}_L}; \quad \overline{\boldsymbol{U}_C} = \overline{\boldsymbol{I}} \cdot \overline{\boldsymbol{Z}_C};$$

- Zamjenom impedansi sa:

$$\overline{\boldsymbol{Z}_R} = R; \quad \overline{\boldsymbol{Z}_L} = jX_L; \quad \overline{\boldsymbol{Z}_C} = -jX_C$$

- Jednačina za napon se može napisati u obliku:

$$\overline{\boldsymbol{U}} = \overline{\boldsymbol{I}} \cdot R + j\overline{\boldsymbol{I}} \cdot X_L - j\overline{\boldsymbol{I}} \cdot X_C = \overline{\boldsymbol{I}} \cdot (R + jX_L - jX_C)$$

$$\overline{\boldsymbol{U}} = \overline{\boldsymbol{I}} \cdot \left[R + j(X_L - X_C)\right] = \overline{\boldsymbol{I}} \cdot (R \pm jX);$$

$$\overline{\boldsymbol{Z}} = R \pm jX; \quad \overline{\boldsymbol{U}} = \overline{\boldsymbol{I}} \cdot \overline{\boldsymbol{Z}}$$

- Ugao θ i moduo impedanse Z može se dobiti iz izraza:

$$Z = \sqrt{R^2 + (X_L - X_C)^2}$$

$$\theta = arctg\frac{X_L - X_C}{R}$$

$$R = Z \cdot \cos\theta$$

$$X = Z \cdot \sin\theta$$

Serijsko RLC kolo

Primjer:

EXAMPLE 18–5 Consider the network of Figure 18–20.

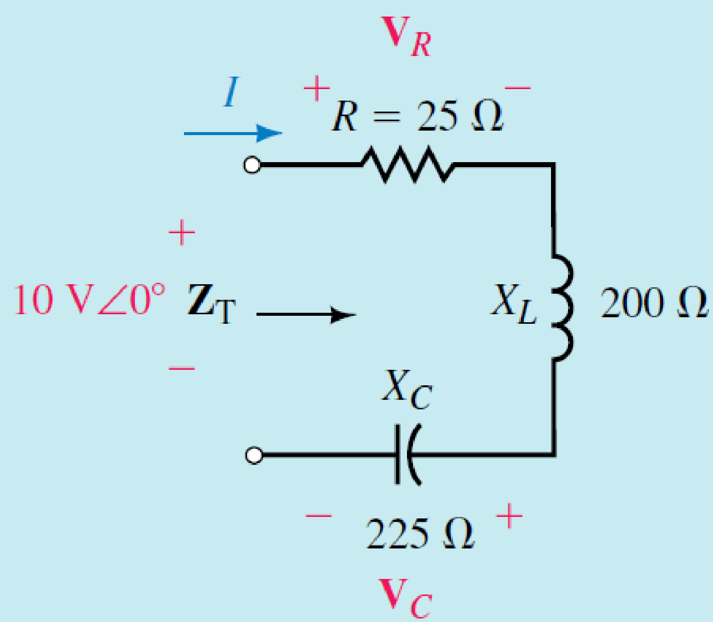


FIGURE 18–20

a. Find $\mathbf{Z}_T$.

b. Sketch the impedance diagram for the network and indicate whether the total impedance of the circuit is inductive, capacitive, or resistive.

c. Use Ohm's law to determine $\mathbf{I}$, $\mathbf{V}_R$, and $\mathbf{V}_C$.

Serijsko RLC kolo

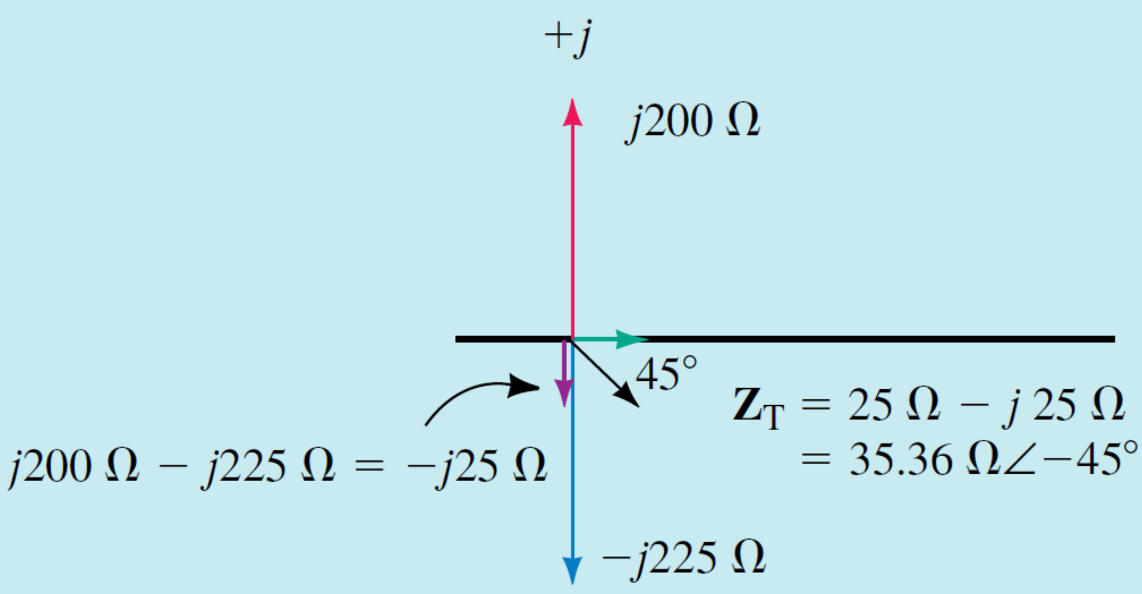
Primjer:

Solution

a. The total impedance is the vector sum

$$\mathbf{Z}_T = 25\ \Omega + j200\ \Omega + (-j225\ \Omega)$$
$$= 25\ \Omega - j25\ \Omega$$
$$= 35.36\ \Omega\angle -45°$$

b. The corresponding impedance diagram is shown in Figure 18–21.



Serijsko RLC kolo

Primjer:

Because the total impedance has a negative reactance term ($-j25\ \Omega$), $\mathbf{Z}_T$ is capacitive.

c. $$\mathbf{I} = \frac{10\ \text{V}\angle 0^\circ}{35.36\ \Omega\angle -45^\circ} = 0.283\ \text{A}\angle 45^\circ$$

$$\mathbf{V}_R = (282.8\ \text{mA}\angle 45^\circ)(25\ \Omega\angle 0^\circ) = 7.07\ \text{V}\angle 45^\circ$$

$$\mathbf{V}_C = (282.8\ \text{mA}\angle 45^\circ)(225\ \Omega\angle -90^\circ) = 63.6\ \text{V}\angle -45^\circ$$

Serijsko RLC kolo

Primjer:

EXAMPLE 18–6 Determine the impedance **Z** which must be within the indicated block of Figure 18–22 if the total impedance of the network is 13 Ω∠22.62°.

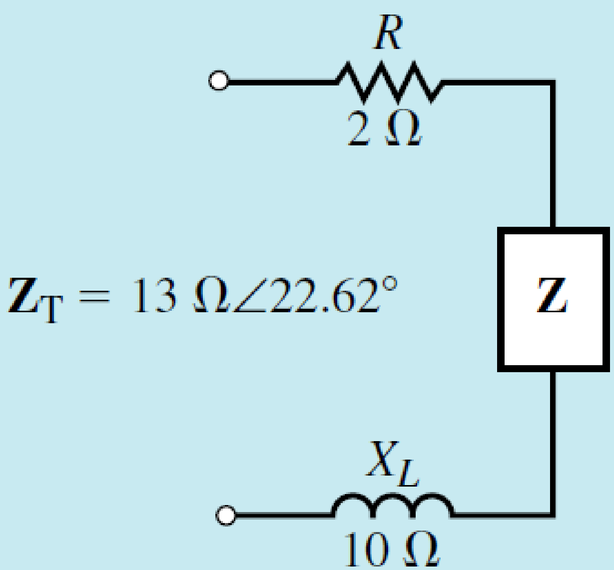


FIGURE 18–22

Serijsko RLC kolo

Primjer:

Solution Converting the total impedance from polar to rectangular form, we get

$$\mathbf{Z}_T = 13\ \Omega\angle 22.62° \Leftrightarrow 12\ \Omega + j5\ \Omega$$

Now, we know that the total impedance is determined from the summation of the individual impedance vectors, namely

$$\mathbf{Z}_T = 2\ \Omega + j10\ \Omega + \mathbf{Z} = 12\ \Omega + j5\ \Omega$$

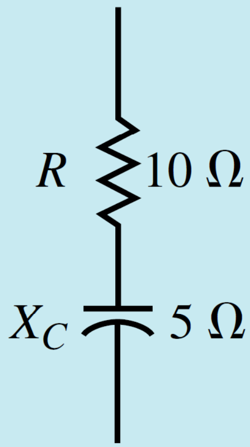
Therefore, the impedance **Z** is found as

$$\begin{aligned}\mathbf{Z} &= 12\ \Omega + j5\ \Omega - (2\ \Omega + j10\ \Omega)\\ &= 10\ \Omega - j5\ \Omega\\ &= 11.18\ \Omega\angle -26.57°\end{aligned}$$

Serijsko RLC kolo

Primjer:

In its most simple form, the impedance **Z** will consist of a series combination of a 10-Ω resistor and a capacitor having a reactance of 5 Ω. Figure 18–23 shows the elements which may be contained within **Z** to satisfy the given conditions.



$$\mathbf{Z} = 10\ \Omega - j\,5\Omega$$
$$= 11.18\ \Omega\ \angle -26.57^\circ$$

FIGURE 18–23

Serijsko RLC kolo

Primjer:

EXAMPLE 18–7 Find the total impedance for the network of Figure 18–24. Sketch the impedance diagram showing $\mathbf{Z}_1$, $\mathbf{Z}_2$, and $\mathbf{Z}_T$.

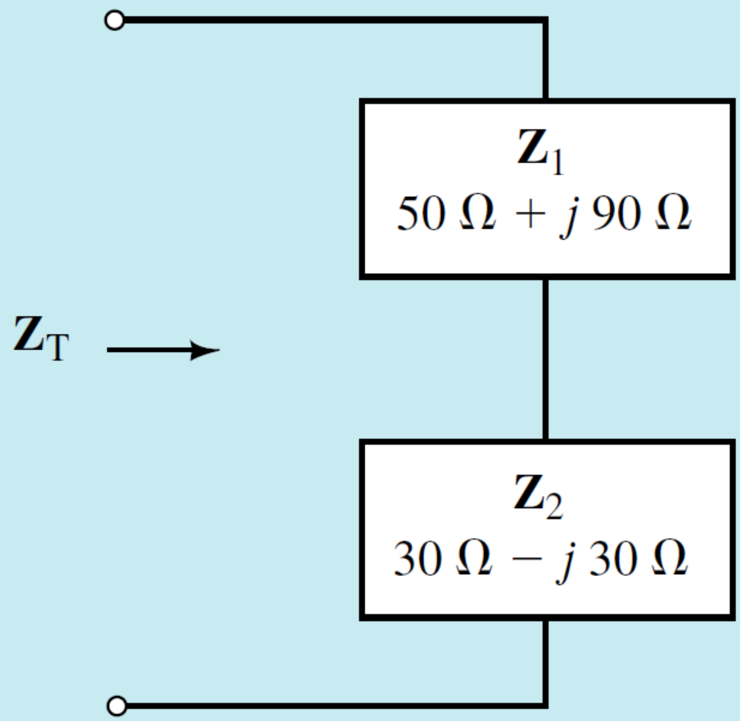


FIGURE 18–24

Serijsko RLC kolo

Primjer:

Solution:

$$\mathbf{Z}_T = \mathbf{Z}_1 + \mathbf{Z}_2$$
$$= (50\ \Omega + j90\ \Omega) + (30\ \Omega - j30\ \Omega)$$
$$= (80\ \Omega + j60\ \Omega) = 100\ \Omega\angle 36.87^\circ$$

The polar forms of the vectors $\mathbf{Z}_1$ and $\mathbf{Z}_2$ are as follows:

$$\mathbf{Z}_1 = 50\ \Omega + j90\ \Omega = 102.96\ \Omega\angle 60.95^\circ$$
$$\mathbf{Z}_2 = 30\ \Omega - j30\ \Omega = 42.43\ \Omega\angle -45^\circ$$

The resulting impedance diagram is shown in Figure 18–25.

Serijsko RLC kolo

Primjer:

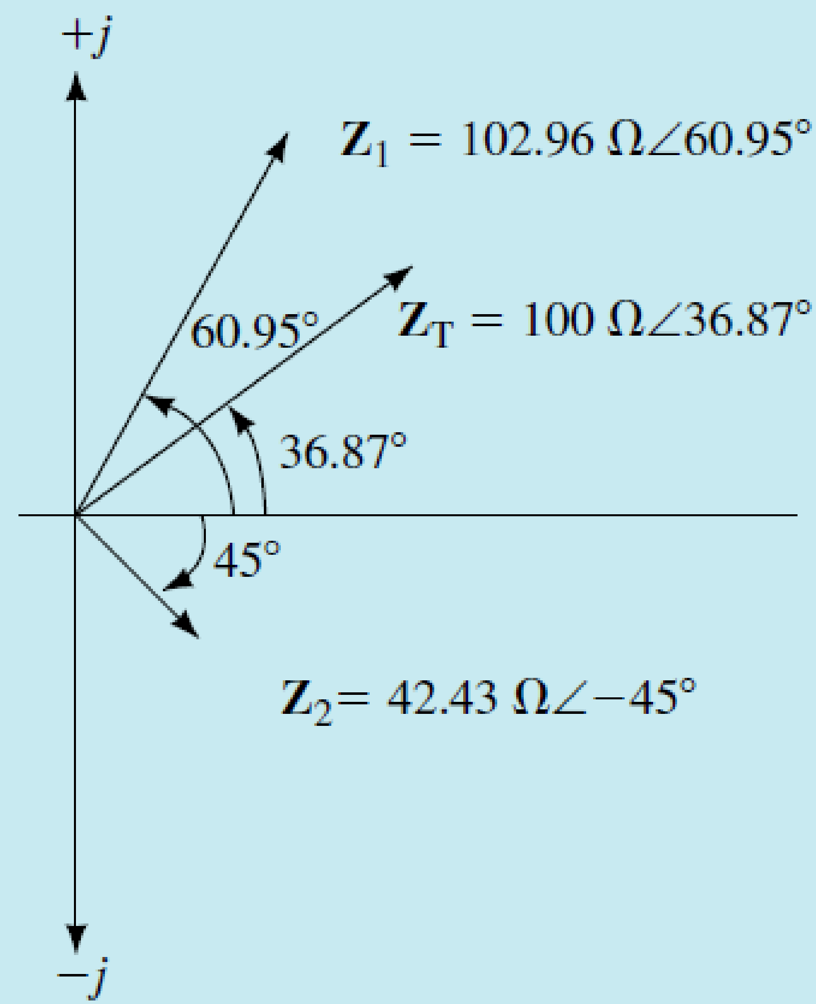


FIGURE 18–25