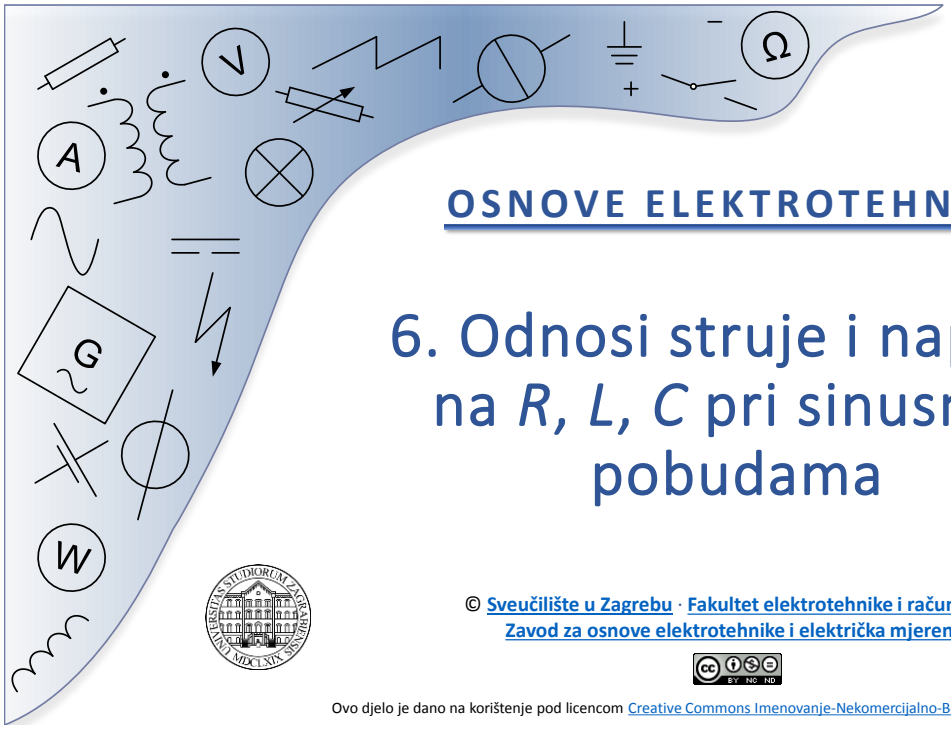


OSNOVE ELEKTROTEHNIKE

6. Odnosi struje i napona na *R*, *L*, *C* pri sinusnim pobudama

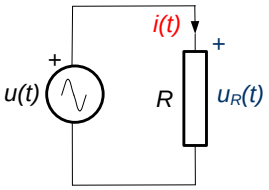
Otpor na sinusnom naponu u vremenskoj domeni

- Vremenska domena
  - Drugi Kirchhoffov zakon:

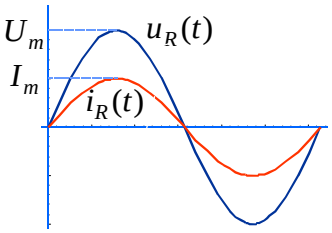
$$u(t) = U_m \sin(\omega t) = u_R(t)$$

  - Ohmov zakon:

$$i(t) = \frac{u(t)}{R} = \frac{U_m}{R}\sin(\omega t) = I_m \sin(\omega t) \quad ; \quad I_m = \frac{U_m}{R}$$

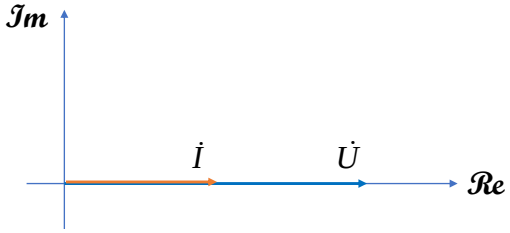


  - Fazni pomak između napona i struje je nula
    - Struja je **u fazi** s naponom



Otpor na sinusnom naponu u fazorskoj domeni

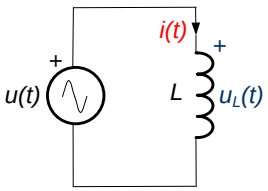
- Fazor napona: $\dot{U} = \frac{U_m}{\sqrt{2}} \angle 0° = U \angle 0°$
- Fazor struje (Ohmov zakon): $\dot{I} = \frac{\dot{U}}{R} = \frac{U}{R} \angle 0°$
- Prikaz u kompleksnoj ravnini



Induktivitet na sinusnom naponu u vremenskoj domeni

- Vremenska domena
  - Drugi Kirchhoffov zakon:

$$u(t) = U_m \sin(\omega t) = u_L(t) = L \frac{di}{dt}$$



  - Struja u krugu je:

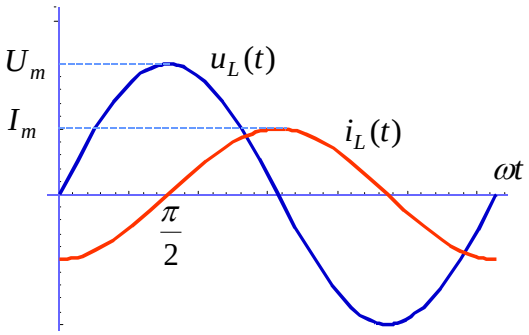
$$i(t) = \frac{1}{L}\int u(t)dt = \frac{1}{L}\int U_m \sin(\omega t)dt = -\frac{U_m}{\omega L}\cos(\omega t) = \frac{U_m}{\omega L}\sin\left(\omega t - \frac{\pi}{2}\right)$$

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

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

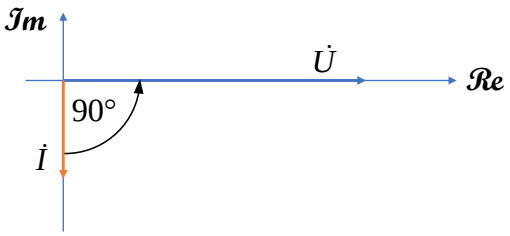
Induktivitet na sinusnom naponu u vremenskoj domeni

- Fazni pomak između napona i struje je $\varphi = \alpha_u - \alpha_i = 0 - \left(-\frac{\pi}{2}\right) = \frac{\pi}{2}$
- Na induktivitetu napon prethodi struji za 90°
- Struja zaostaje za naponom za 90°



Induktivitet na sinusnom naponu u fazorskoj domeni

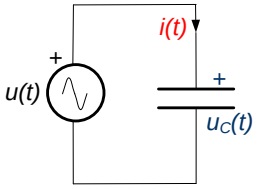
- Fazor napona: $\dot{U} = \frac{U_m}{\sqrt{2}}\angle 0° = U\angle 0°$
- Fazor struje: $\dot{I} = \frac{1}{L}\int \dot{U}dt = \frac{1}{j\omega L}\dot{U} = \frac{\dot{U}}{jX_L} = -j\frac{\dot{U}}{X_L} = \frac{\dot{U}}{X_L}e^{-j\frac{\pi}{2}} = \frac{\dot{U}}{X_L}\angle -90°$
- $X_L = \omega L$ je **induktivna reaktancija**, ima dimenziju otpora (Ω)
- Prikaz u kompleksnoj ravnini



Kapacitet na sinusnom naponu u vremenskoj domeni

- Vremenska domena
  - Drugi Kirchhoffov zakon:

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



  - Struja u krugu je:

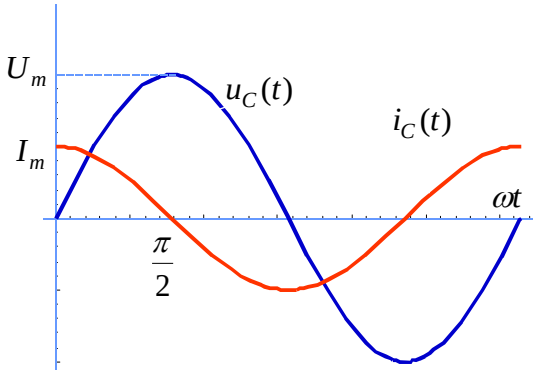
$$i(t) = C\frac{du_C}{dt} = C\frac{d}{dt}\left[U_m \sin(\omega t)\right] = \omega C U_m \cos(\omega t) = \omega C U_m \sin\left(\omega t + \frac{\pi}{2}\right)$$

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

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

Kapacitet na sinusnom naponu u vremenskoj domeni

- Fazni pomak između napona i struje je $\varphi = \alpha_u - \alpha_i = 0 - \left(\frac{\pi}{2}\right) = -\frac{\pi}{2}$
- Na kapacitetu napon zaostaje za strujom za 90°
- Struja prethodi naponu za 90°



Kapacitet na sinusnom naponu u fazorskoj domeni

- Fazor napona: $\dot{U} = \frac{U_m}{\sqrt{2}} \angle 0° = U \angle 0°$
- Fazor struje: $\dot{I} = C \frac{d}{dt} \dot{U} = j\omega C \dot{U} = \frac{\dot{U}}{\frac{1}{j\omega C}} = \frac{\dot{U}}{-jX_C} = j\frac{\dot{U}}{X_C} = \frac{\dot{U}}{X_C} e^{j\frac{\pi}{2}} = \frac{\dot{U}}{X_C} \angle 90°$
- $X_C = 1/\omega C$ je **kapacitivna reaktancija**, dimenzija otpora (Ω)
- Prikaz u kompleksnoj ravnini