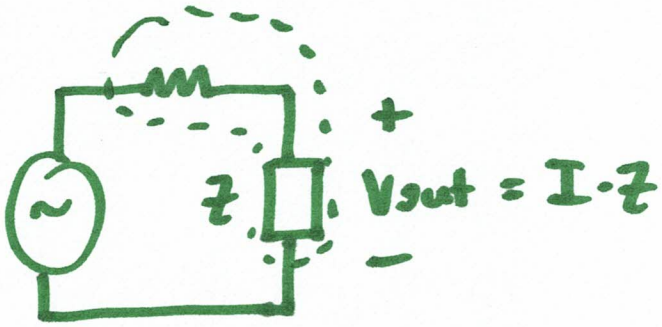
EE 220: Circuits I



$R + j\omega L$

$\phi = \tan^{-1}\left(\frac{\omega L}{R}\right)$

$\phi = \tan^{-1}\left(\frac{y}{x}\right)$

$z = x + jy$

$\phi = \tan^{-1}\left(\frac{0}{R}\right)$

$z_R = R = R + j0 \rightarrow$ ~~$\tan$~~

$z_C = \frac{1}{j\omega C} = -j \cdot \frac{1}{\omega C} \rightarrow \phi = \tan^{-1}\left(\frac{-y}{0}\right)$

$= -90°$

$z_L = j\omega L \Rightarrow \phi = \tan^{-1}\left(\frac{+y}{0}\right) = 90°$

RLC Circuit Example

$|V_{out}| = 622\,mV$

$\angle V_{out} = -51.5°$

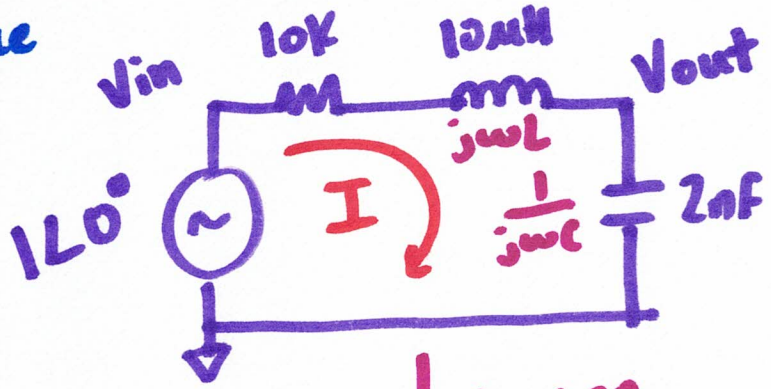
impedance

$R + jZ$

↑ resistance

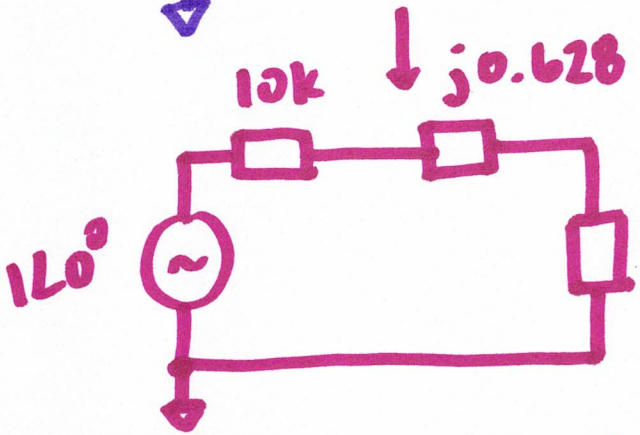
↑ reactance

$f = 10kHz$



$\mu \rightarrow$ micro $\rightarrow 10^{-6}$

$m \rightarrow$ milli $\rightarrow 10^{-3}$



$Z_T = 10k + j0.628 - j7.957k$

$Z_T = 10K - j7.957K$

$|Z_T| = \sqrt{(10k)^2 + (7.957k)^2}$

$|Z_T| = 12.779K$

$\phi = \tan^{-1}\left(\frac{-7.957K}{10k}\right)$

$\phi = -38.5°$

$\therefore Z_T = 12.779K\angle -38.5°\ \Omega$

$I = \frac{V_{in}}{Z_T} = \frac{1\angle 0°}{12.78K\angle -38.5°}$

$I = 78.24\angle 38.5°\ A$

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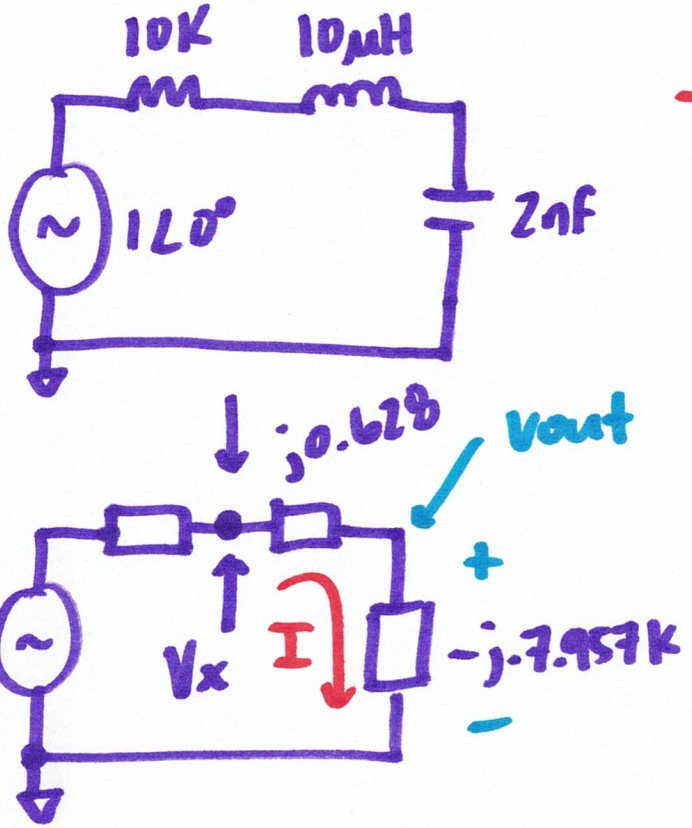
RLC continued

$$I = 78.2 \angle 38.5^\circ \text{ mA}$$



$$V_{out} = I \cdot Z_c$$

$78.2 \angle 38.5^\circ \text{ mA}$ $\quad -j7.957\text{K}$

$$\Phi \rightarrow \tan^{-1}\left(\frac{-7.957\text{K}}{0}\right) = -90^\circ$$

$$|Z_c| = \sqrt{0^2 + (7.957\text{K})^2}$$

$$|Z_c| = 7.957\text{K}$$

$$\therefore Z_c = 7.957\text{K} \angle -90^\circ \ \Omega$$

$$V_{out} = I \cdot Z_c = (78.2\text{m} \angle 38.5^\circ \text{A}) \cdot (7.957\text{K} \angle -90^\circ)$$

$\times$

$$V_{out} = 0.622 \angle -51.5^\circ \text{ V}$$

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