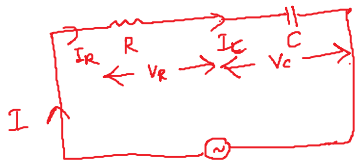
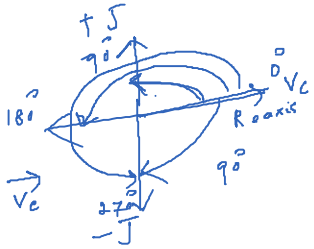
$\theta = \tan^{-1}\left(\frac{X_L}{R}\right)$ $= 90^\circ$

L: $v = V_m \sin\omega t$, $i = I_m \sin(\omega t - 90^\circ)$

C: $v = V_m \sin\omega t$, $i = I_m \sin(\omega t + 90^\circ)$

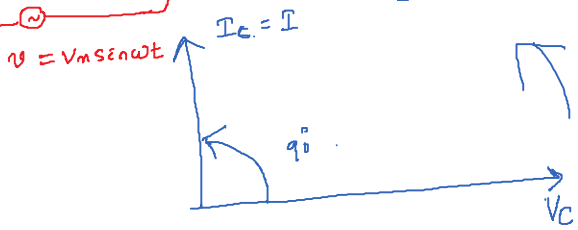
Series RC Circuit



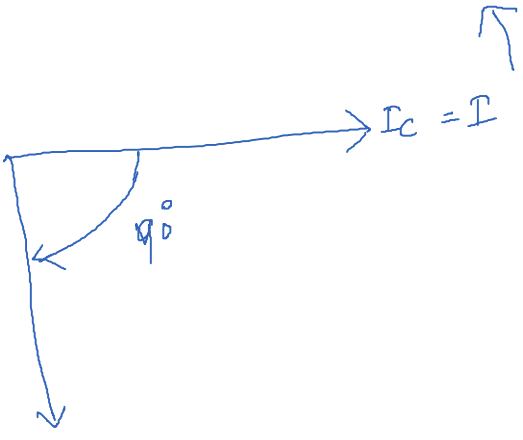


$\vec{V} = \vec{V_R} + \vec{V_C}$

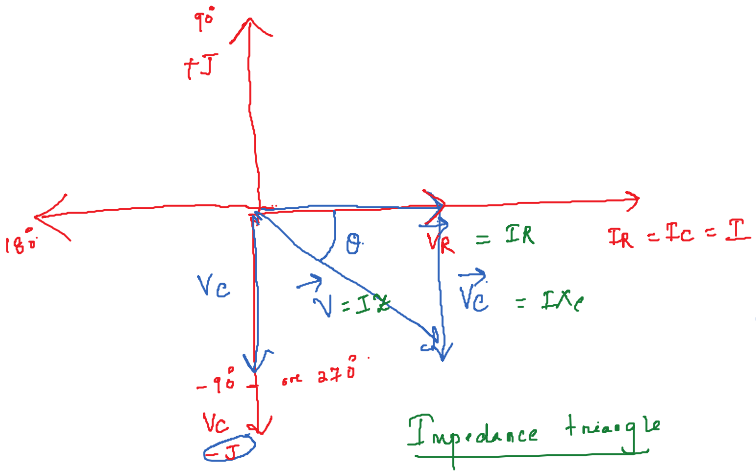
C



R



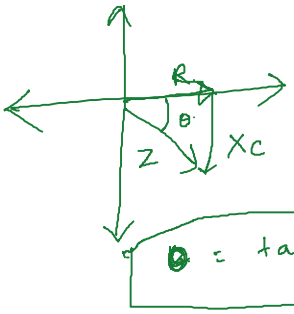
R - C



$\vec{V} = \vec{V_R} + \vec{V_C}$

$= (IR + J0) + (0 - JIX_C)$

Impedance triangle



$\theta = \tan^{-1}\left(\frac{X_C}{R}\right)$

$I\vec{Z} = IR - JIX_C$

$\vec{Z} = R - JX_C$ — (1)

Complex Impedance

$\vec{Z} = |Z| \angle -\theta$

$= \sqrt{R^2 + X_C^2} \angle -\tan^{-1}\left(\frac{X_C}{R}\right)$ — (2)

$v = V_m \sin\omega t$

$i = \frac{V_m}{\quad} \sin(\omega t + \tan^{-1}\left(\frac{X_C}{R}\right))$ — (3)

$v = V_m \sin \omega t$

$i = \frac{V_m}{\sqrt{R^2 + X_c^2}} \sin\left(\omega t + \tan^{-1}\left(\frac{X_c}{R}\right)\right)$ — (3)

$V = |V| \angle 0^\circ$

$I = \frac{|V| \angle 0^\circ}{|Z| \angle -\theta} = \frac{|V|}{|Z|} \angle +\theta$ — (4)

Q. A current of 0.9A flows through a series combination of $R = 120\Omega$ and $X_C = 250\Omega$. Find Z, pf, V, V_R, V_C, P_{app}, P_{active}, $P_{reactive}$?

Solution a) $Z = 120 - j250 = 277.308 \angle -64.4^\circ$

(b) $pf = \cos\theta = \cos(-64.4^\circ)$

$= 0.432$ Leading

(c) $V = IZ = 0.9\angle 0^\circ \times 277.308 \angle -64.4^\circ$

$= 249.56 \angle -64.4^\circ$ V

$(V_C) = IX_C$

$= -jIX_C$

$= -j \times 0.9 \times 250$

$= -j225$

$a - jb$

$0 - j225$

$= 225 \angle -90^\circ$

(d) $V_R = 0.9 \times 120 = 108$ V

(e) $V_C = -jIX_C = 0.9\angle 0^\circ \times 250 \angle -90^\circ$

$= 225 \angle -90^\circ$ V

(f) $P_{app} = VI$

$= 249.56 \angle -64.4^\circ \times 0.9 \angle 0^\circ$

$= 224.604 \angle -64.4^\circ$ VA

(g) $P_{active} = VI\cos\theta$

$= 249.56 \times 0.9 \cos 64.4^\circ$

$= 97.02$ W

(h) $P_{reactive} = VI\sin\theta$

= 249.56 × 0.9 ≈ 64.4

= 202.59 VAR