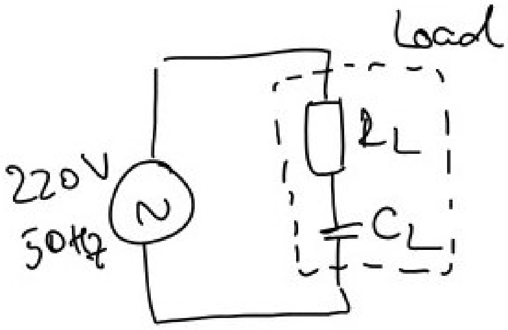
Seminar 2 electronică I :

$R_L = 50\,\Omega$; $C_L = 1000\,\mu F$



$P = ?$

$Q = ?$

$S = ?$

$Z_L = R_L + j \cdot X_L$

$R_L = 50\,\Omega$

$X_L = -\frac{1}{\omega C_L} = -\frac{1}{2\pi f C_L} =$

$= -\frac{1}{6.28 \cdot 50 \cdot 1000 \cdot 10^{-6}} =$

$= -\frac{1}{6.28 \cdot 5} \cdot 10^2 = 3.18\,\Omega$

$S = P + j \cdot Q$

$P = I^2 \cdot R_L$

$Q = I^2 \cdot X_L$

$|S| = \sqrt{P^2 + Q^2}$

$U = Z \cdot I \rightarrow U = |Z| \cdot I \Rightarrow I = \frac{U}{|Z|}$

$|Z| = \sqrt{R_L^2 + X_L^2} = \sqrt{50^2 + 3.18^2} = 50.10\,\Omega$

$I = \frac{220V}{50.1} = 4.39\,A$

$P = I^2 \cdot R_L = 4.39^2 \cdot 50 = \underline{963.605\,W}$

$Q = I^2 \cdot X_L = 4.39^2 \cdot 3.18 = \underline{61.28\,VAR}$

$S = 963.605 + j \cdot 61.28$

$|S| = \sqrt{963.605^2 + 61.28^2} = \underline{965.55\,VA}$

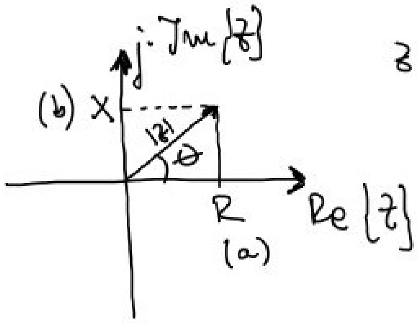
Impedanța:

- rezistență aparentă

$Z = R + j \cdot X$ $\qquad [Z] = \Omega$

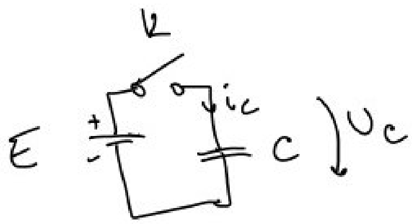
$X \to$ inductivă $X_L = \omega \cdot L = 2\pi f L$ $\qquad f$ - frecvența $[Hz]$

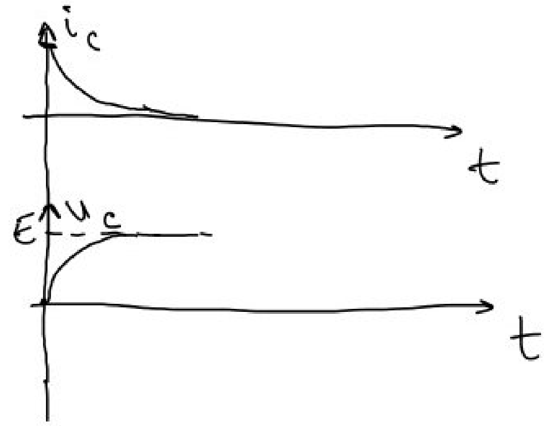
capacitivă $X_C = -\frac{1}{\omega C} = -\frac{1}{2\pi f C}$

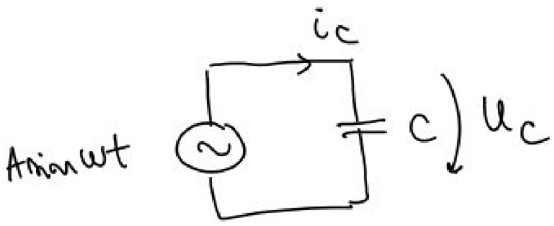


$z = a + j \cdot b$

$z = |z| \cdot e^{j \cdot \theta}$

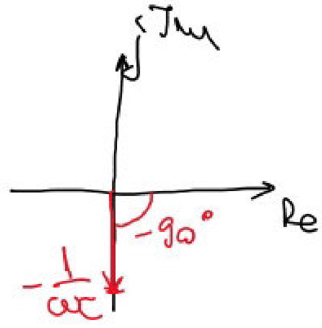






$u_C = Z_C \cdot I_C = \underbrace{|Z| \cdot e^{j \cdot \theta}}_{Z_C} I_C$

$Z_C = j \cdot X_C = -\frac{j}{\omega C}$



$U_C = \sqrt{\left(-\frac{1}{\omega C}\right)^2} \cdot e^{j \cdot -\frac{\pi}{2}} \cdot I_C$

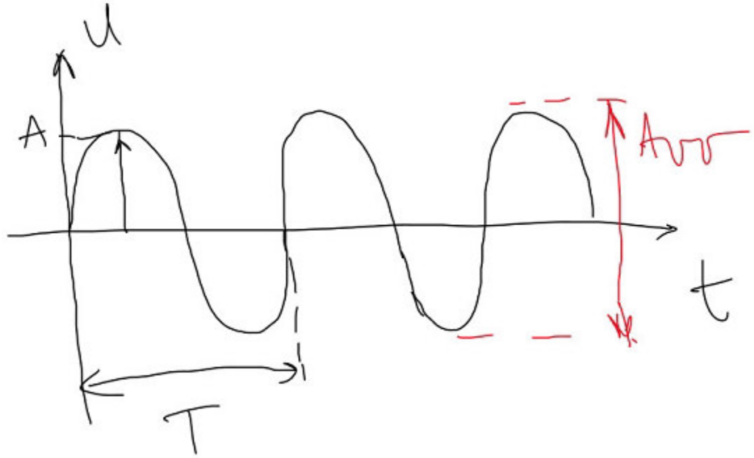
$U_C = \frac{1}{\omega C} \cdot e^{j \cdot -\frac{\pi}{2}} \cdot I_C$

$I_C = \omega C \cdot e^{j \cdot \frac{\pi}{2}}$

Semnale în electronică:

semnal → U(t), I(t)

semnal sinusoidal:



caracteristici:

amplitudine A (peak value)

perioada T ⇒ frecvența f

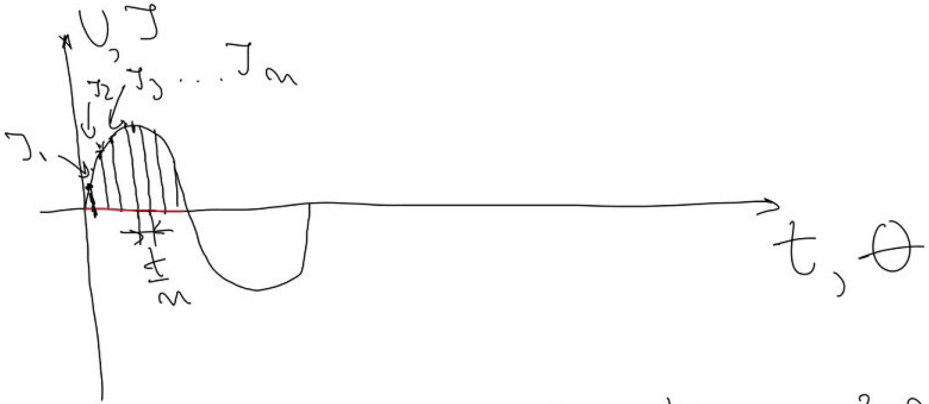
A_{vv} - amplit. vârf-la-vârf.

A_{pk-pk} - peak-to-peak amplitude

faza (phase)

RMS - root mean square (valoare efectivă)

RMS pentru un semnal sinusoidal:



$$U(\theta) = A \sin\theta$$

$P = ?$ $\quad P = I^2 \cdot R$

$$P_{eff} = I_{eff}^2 \cdot R$$

$$I_{eff}^2 \cdot R \cdot t = I_1^2 \cdot R \cdot \frac{t}{n} + I_2^2 \cdot R \cdot \frac{t}{n} + \ldots + I_n^2 \cdot R \cdot \frac{t}{n}$$

$$= \frac{R \cdot t}{n} \cdot \left(I_1^2 + I_2^2 + I_3^2 + \ldots + I_n^2\right)$$

$$I_{eff}^2 = \frac{1}{n}\left(I_1^2 + I_2^2 + I_3^2 + \ldots + I_n^2\right)$$

$$I_{eff} = \sqrt{\frac{I_1^2 + I_2^2 + \ldots + I_n^2}{n}} \qquad V_{eff} = \sqrt{\frac{V_1^2 + V_2^2 + \ldots + V_n^2}{n}}$$

$$V_{eff} = \sqrt{\frac{1}{\frac{\pi}{2}} \int_0^{\pi/2} (A \sin\theta)^2 \, d\theta} =$$

$$= \sqrt{\frac{2A^2}{\pi} \int_0^{\pi/2} \sin^2\theta \, d\theta} = \sqrt{\frac{2A^2}{\pi} \int_0^{\pi/2} \left(\frac{1}{2} - \frac{1}{2}\cos 2\theta\right) d\theta} =$$

$$\cos 2x = \cos^2 x - \sin^2 x = 1 - \sin^2 x - \sin^2 x$$

$$\cos 2x = 1 - 2\sin^2 x$$

$$-2\sin^2 x = \cos 2x - 1$$

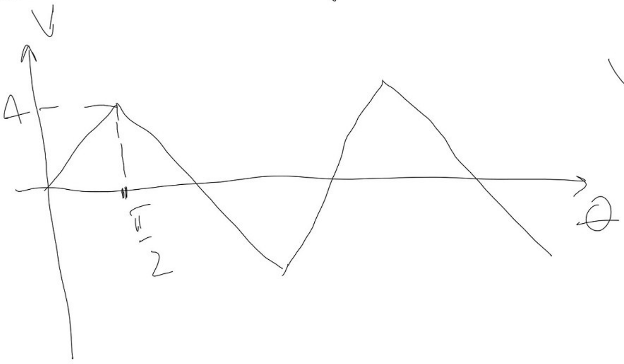
$$\sin^2 x = \frac{1}{2} - \frac{1}{2}\cos 2x$$

$$= \sqrt{\frac{2A^2}{\pi}\left[\int_0^{\pi/2} \frac{1}{2} d\theta - \frac{1}{2}\int_0^{\pi/2} \cos 2\theta \, d\theta\right]} = \sqrt{\frac{2A^2}{\pi}\left[\frac{\pi}{4} - \frac{1}{4}\left(\sin\frac{2\pi}{2} - \sin 0\right)\right]} =$$

$$= \sqrt{\frac{2A^2\pi}{4\pi}} = \sqrt{\frac{A^2}{2}} = \frac{A}{\sqrt{2}} = 0.707 \cdot A = 70,7\% \, A.$$

ex: 220V RMS $\quad A = ?$ $\quad A = \frac{1}{0.707} \cdot V_{eff} = \frac{220}{0.707} = \underline{311V}$

Semnal triunghiular:



$$V_{eff} = V_{rms} = \sqrt{\frac{1}{\frac{\pi}{2}} \int_0^{\pi/2} \left(\frac{2}{\pi}\cdot A\cdot\theta\right)^2} =$$

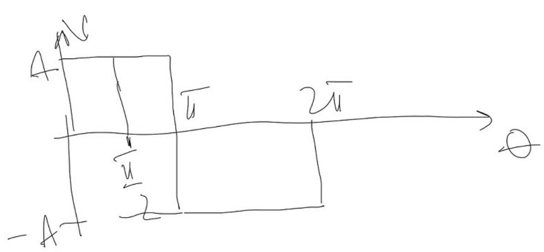
$$= \sqrt{\frac{2}{\pi}\cdot\frac{4A^2}{\pi^2}\int_0^{\pi/2}\theta^2 \, d\theta} =$$

$$u = A\cdot\theta\cdot\frac{1}{\frac{\pi}{2}}$$

$$= \sqrt{\frac{8A^2}{\pi^3}\cdot\frac{1}{3}\cdot\theta^3\Big|_0^{\pi/2}} = \sqrt{\frac{8A^2}{\pi^3}\cdot\frac{1}{3}\cdot\frac{\pi^3}{8}} =$$

$$= \frac{A}{\sqrt{3}} = 0.577A$$

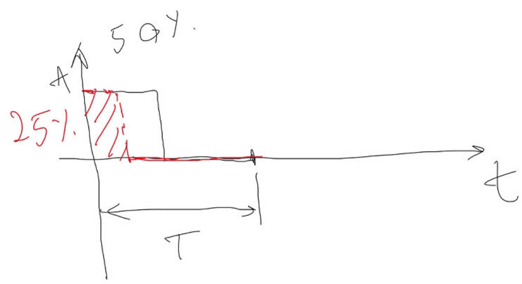
Semnal dreptunghiular:



$V = A, \ \theta = 0 \div \pi$

$V = -A, \ \theta = \pi \div 2\pi$

$$V_{rms} = \sqrt{\frac{1}{\frac{\pi}{2}}\int_0^{\pi/2} A^2 \, d\theta} = \sqrt{\frac{2}{\pi}\cdot A^2\cdot\frac{\pi}{2}} = A$$



duty cycle 50% → $\frac{T}{2}$ on ; $\frac{T}{2}$ off

25% → $\frac{T}{4}$ on ; $\frac{3T}{4}$ off

DC offset:

$U = U_{DC} + A\sin\theta$

$U_{eff} = U_{DC} + U_{eff}^{AC}$