Curs Fizică 3

Compunere oscilații paralele

Două oscilații $x_1, x_2 \sim x_{1,2} = A_{1,2} \cos\left(\omega_{1,2}\, t + \alpha_{1,2}\right)$
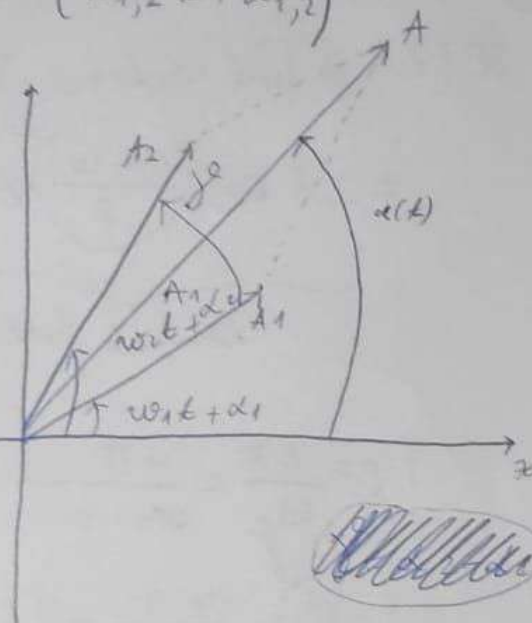
$$x(t) = x_1(t) + x_2(t)$$

$$\downarrow \qquad\qquad \downarrow$$

$$A_1, \omega_1 \parallel A_2, \omega_2$$

$A = |\vec{A}| \quad \circledast$

$A_{1,2} = |\vec{A}_{1,2}|$

$\vec{A} = \vec{A}_1 + \vec{A}_2 \quad \big|^2$

$\vec{A}^2 = (\vec{A}_1 + \vec{A}_2)^2 \iff \vec{A} \cdot \vec{A} = (\vec{A}_1 + \vec{A}_2)(\vec{A}_1 + \vec{A}_2)$

$$\begin{cases} A^2 = A_1^2 + A_2^2 + 2 A_1 A_2 \cos\!\big((\omega_2 - \omega_1)t + \alpha_2 - \alpha_1\big) \\ \\ A = A(t) \end{cases}$$

γ

$\cos\gamma = -1$

$\sqrt{(A_1 - A_2)^2} \Rightarrow |A_1 - A_2|$

$$|A_1 - A_2| \le A(t) \le A_1 + A_2.$$

$A(t) = A(t + T_b) \implies T_b = \dfrac{2\pi}{|\omega_2 - \omega_1|} \ (>0)$

$\cos\big((\omega_2 - \omega_1)t + \alpha_2 - \alpha_1\big) = \cos\big((\omega_2 - \omega_1)(t + T_b) + \alpha_2 - \alpha_1\big)$

$\boxed{T_b(\omega_2 - \omega_1) = 2\pi}$

$$x(t) = A(t) \cos[\alpha(t)]$$

$$\cos[\alpha(t)] = \frac{A_1 \cos(\omega_1 t + \alpha_1) + A_2 \cos(\omega_2 t + \alpha_2)}{A(t)}$$

bătăi

ⓐ $A_1 = A_2$; $A_1 = A_2 = A$, $\omega_1 \neq \omega_2$ $(\omega_1 \simeq \omega_2)$ și $\alpha_1 = \alpha_2 = 0$

$$x(t) = A[\cos(\omega_1 t + \alpha_1) + \cos(\omega_2 t + \alpha_2)] = \quad \omega_p > 0$$

$$= 2A \cos\left(\boxed{\frac{\omega_1 + \omega_2}{2}} t + \frac{\alpha_1 + \alpha_2}{2}\right) \cdot \cos\left(\boxed{\frac{\omega_1 - \omega_2}{2}} t + \frac{\alpha_1 + \alpha_2}{2}\right)$$

$\underbrace{\qquad}$ semnal purtător

ω_p

$\omega_b' > 0$

semnal modulator

$\cos(\alpha + \beta) = \cos\alpha \cos\beta - \sin\alpha \sin\beta$

$\cos(\alpha - \beta) = \cos\alpha \cos\beta + \sin\alpha \sin\beta$

$\cos u + \cos v = 2 \cos\alpha \cos\beta$
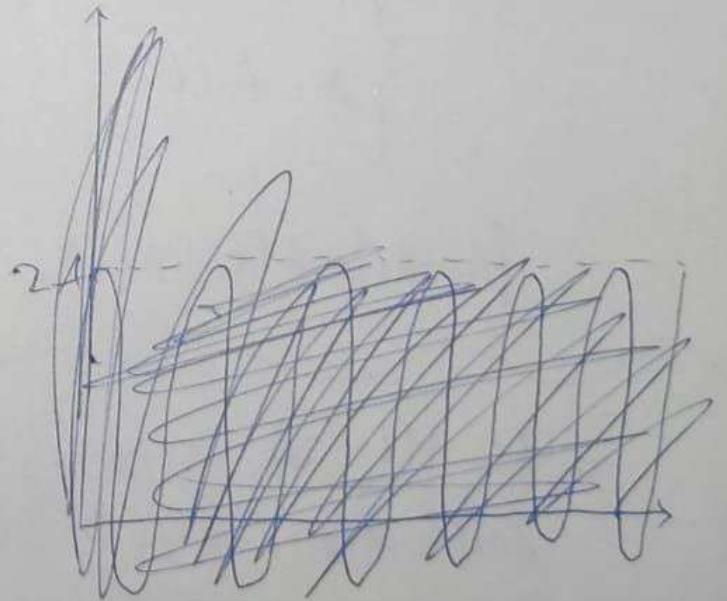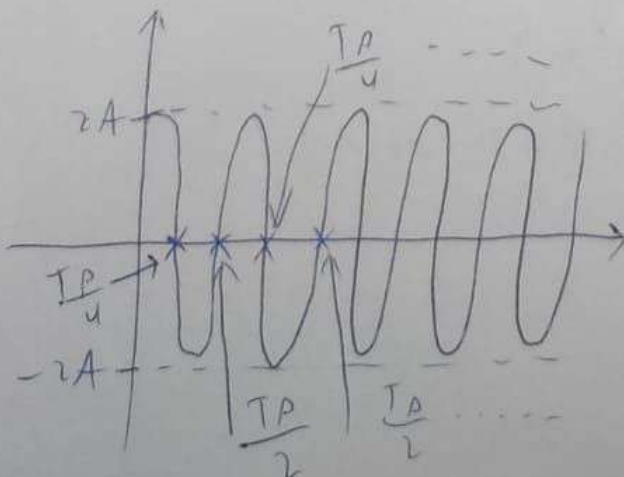
$\cos u + \cos v = 2 \cos\frac{u+v}{2} \cos\frac{u-v}{2}$

$$T_p = \frac{2\pi}{\omega_p} = \frac{4\pi}{\omega_1 + \omega_2}$$

$$t_b' = \boxed{\frac{1}{2}} \cdot \frac{4\pi}{\omega_1 - \omega_2} = T_b$$

$$T_b = \frac{1}{2} \cdot \frac{2\pi}{\boxed{\dfrac{\omega_1 - \omega_2}{2}}} \rightarrow \omega_b'$$

$$\boxed{T_b = \frac{1}{2} \frac{2\pi}{\omega_b}}$$

$$x_{1,2}(t) = A_1 \cos(\omega_1 t + \alpha_1) + A_2 \cos(\omega_2 t + \alpha_2)$$

A - amplitudinea

ω - pulsatia

$$x(t) = x_1(t) + x_2(t)$$

a) $\omega_1 = \omega_2$, $A_1 \neq A_2$

b) $\omega_1 \neq \omega_2$, $A_1 = A_2 = A$

$\hookrightarrow$ bătăi