

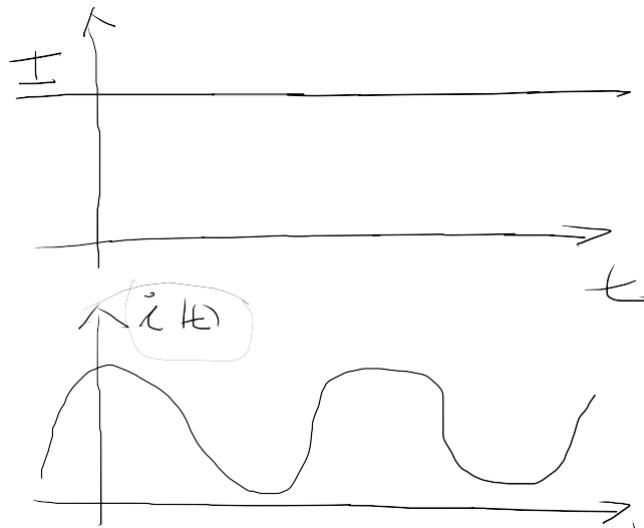
# Анализа кола у простопериодичном режиму.

Основи електротехнике 2  
Предавање: 7. блок

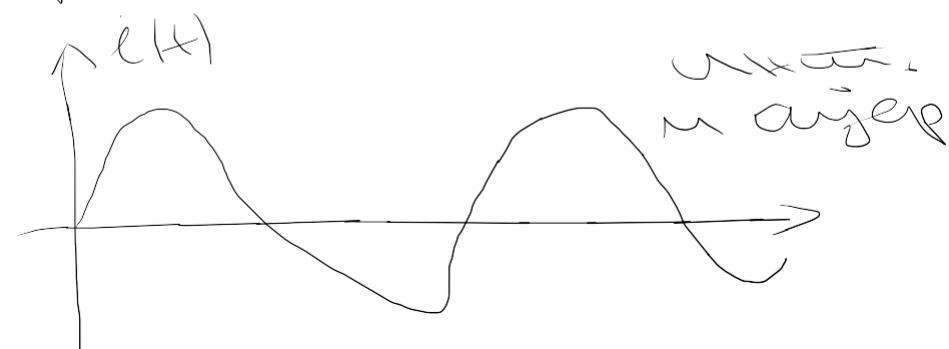
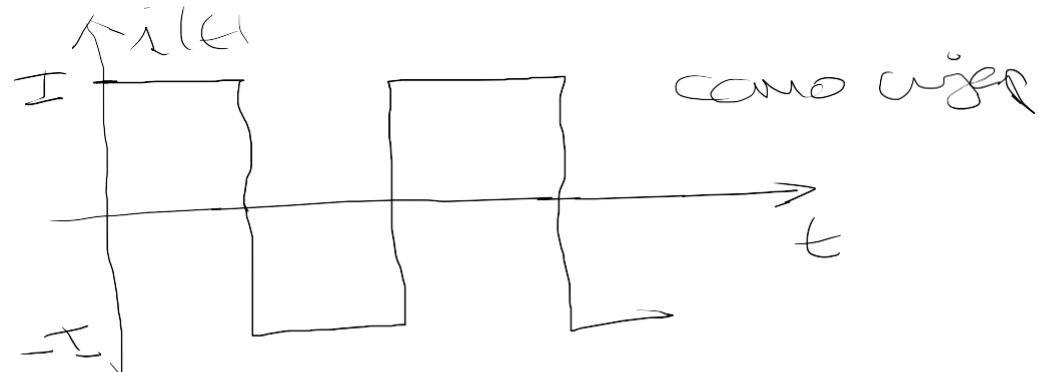
# ЕЛЕКТРИЧЕСКИЕ МЕТОДЫ САБРЕМ ВРОМЕХ ВУЗУМ СПРЯМАНИЯ

- Основные фигуры и соединения

Фигура и волна се регенеративни процеси

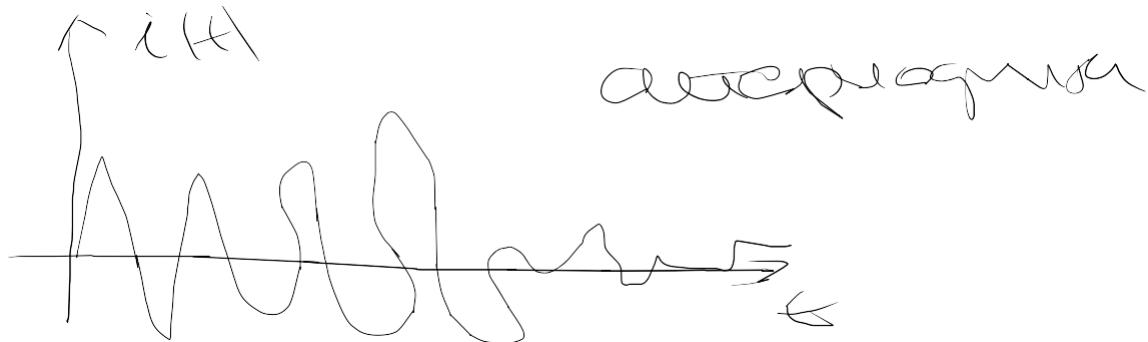


јакина  
домаје се  
у регенерацији



The reversible elements are called **xa**

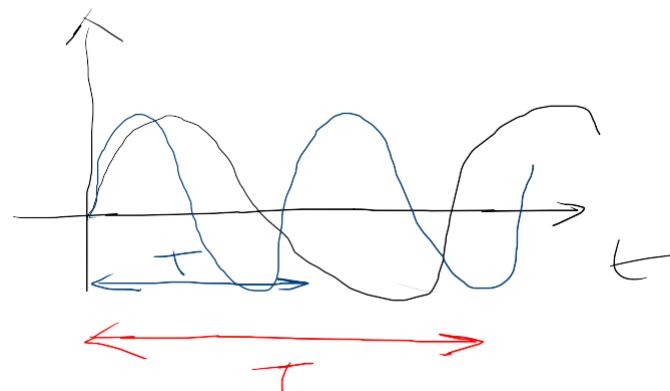
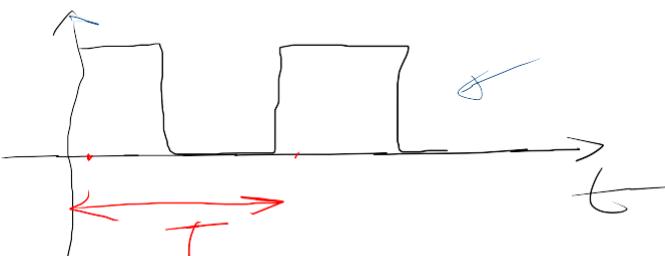
- autocorrelation
- cross-correlation



$f(t)$

$T \rightarrow$  memory response time

$$f(t+\tau) = f(t)$$



antisymmetrische Differenz

$$f(t + \frac{\pi}{2}) = -f(t)$$

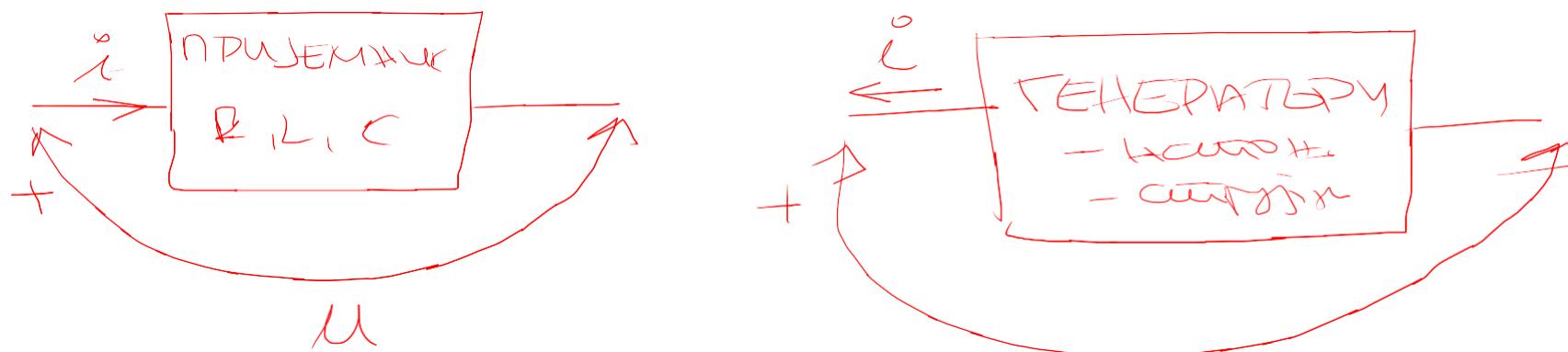
+ - antisym

- antisymmetrische Differenz  $\rightarrow$  Menge der  $y$ -t  
so dass  $f(x) = -f(x + t)$

Одно из видов организаций с ограниченной  
ответственностью

- Телекомпания (дистанционное вещание)
- Медицинская организация (ФСБ)
- Консультационная консалтинговая (Консалтинговая)
- Клиники и медицинские центры (Медицина)
- Капиталы для инвесторов (Инвесторы)
- Финансовые учреждения (Банки)
- Торговые фирмы (Торговля)

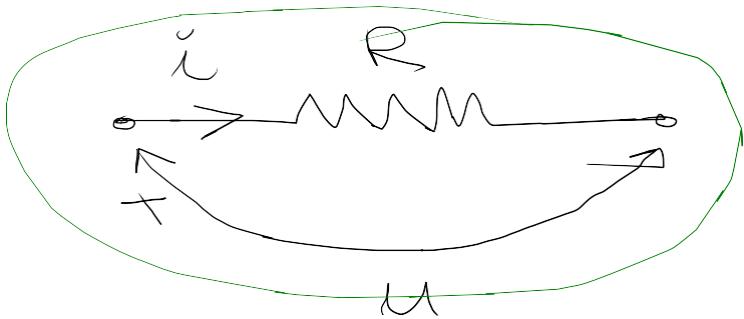
ПРИЕМНИКИ



Целью - извлечь прибыль и минимизировать  
риски

- Ohm's Law

$$U(t) = R i(t) \Rightarrow i(t) = \frac{U(t)}{R}$$

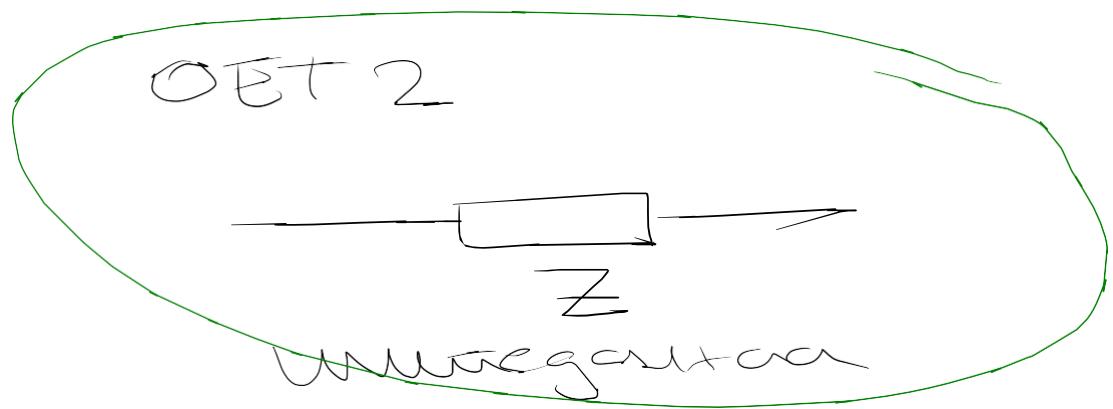
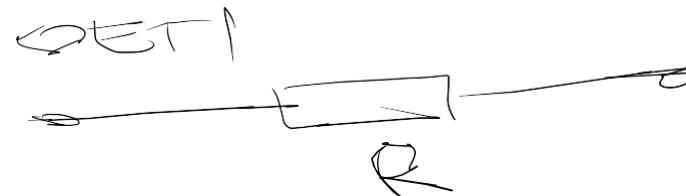


$$\ddot{i}(t) = G U(t)$$

$$RG = 1$$

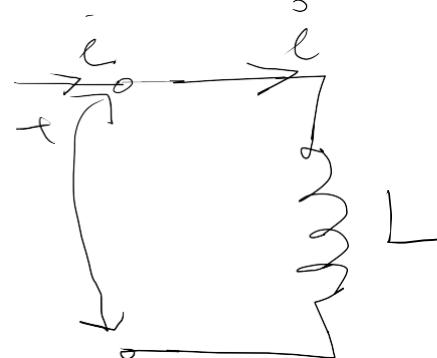
$$R \neq f(t)$$

$$R[\Omega]$$



- magnetische Kavenn (Längskoerper)
  - Kavenn ist um  $\rightarrow$  lösbar

$$U(t) = L \frac{di(t)}{dt} \Rightarrow i(t) = \frac{1}{L} \int u(t) dt + I_0$$



$$L(H)$$

$$L \neq f(t)$$

- Kondensator P

$$Q = C \cdot U$$

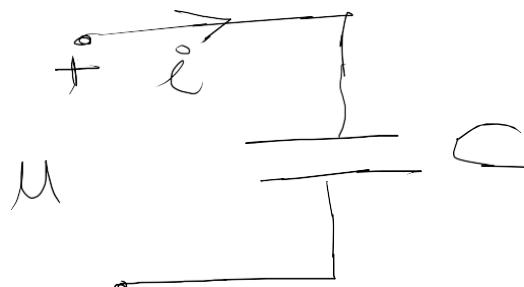
$$Z = \int i dt$$

$$Q(t) = C \cdot u(t)$$

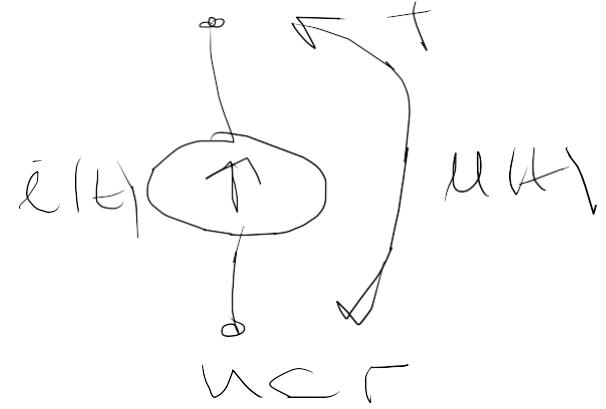
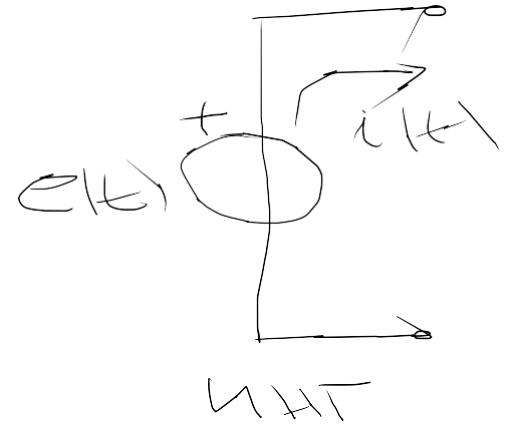
$$r(t) = \frac{dQ(t)}{dt}$$

$$i(t) = \frac{d}{dt}(C u(t)) = C \frac{du}{dt}$$

(TEK)



$$\Rightarrow u(t) = \frac{1}{C} \int i(t) dt + U_0$$



# KURXOFOB ZAKONU ZA KONA SA SPREM- NPOMJESENIM BUKA CTPSIJAMA

$$\sum_{k=1}^n l_k(t) = \emptyset$$

ПРВИ КУРХОФОВ ЗАКОН  
(у дакаш употреба)

$\int_1 + " \text{ ка љеви}$

$\int_1 - " \text{ од љупа}$

а наје м одјојес

$$M_{AB}(t) = \sum_{\text{од } A \text{ до } B} M(t)$$

$\int_1 + " \text{ око се око наје на } \int_1 + "$  наје се  
 $\int_1 - "$

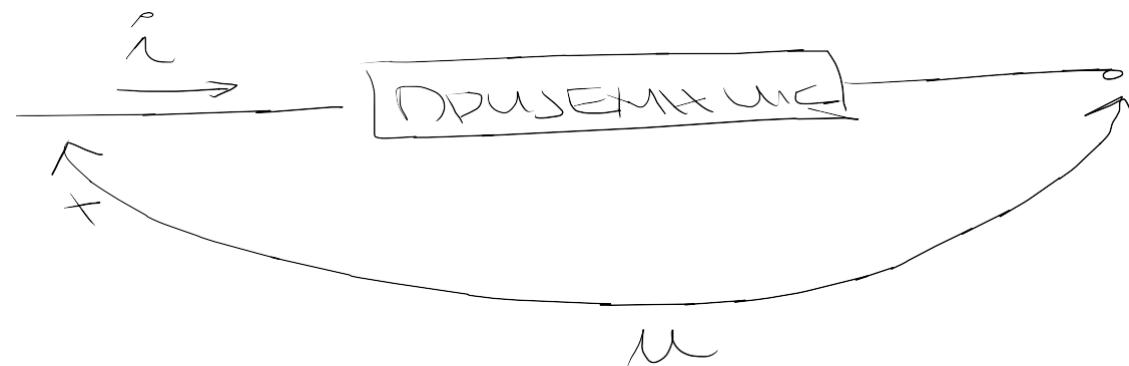
$$\sum_{k=1}^n l_k(t) = \emptyset$$

ДРУГИ  
КУРХОФОВ  
ЗАКОН  
(у дакаш употреба  
справа)

Актуална и актуална са баченски правителстви  
Саша Ђорђевић

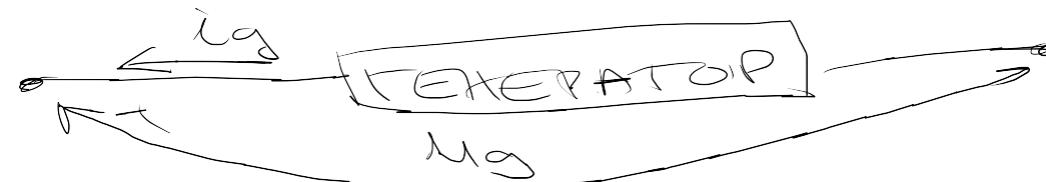
Математички пројекциони став оцењивања је

$$P(x) = u(x) \cdot i(x)$$



Математички пројекциони став транспортниј

$$P_g(x) = u_g(x) \cdot i_g(x)$$



# ПРОСТОРНОДУИНЕ ВЕЛИЧИНЕ

$$y = \sin t$$

$$y = \cos t$$

$$\sin x = \cos(x - \frac{\pi}{2}) = \cos(\frac{\pi}{2} - x)$$

$-\infty < t < \infty$

$$i(t) = I_m \cos(wt + \varphi)$$

↑

превращение  
сдвиг фазы

некомплексная const.  
амплитуда  $\Delta A$

превращение фазы  
 $wt + \varphi$

$w > 0$  [рад/с]

круговая устойчивость

$\varphi$  за  $t = 0$

номерная фаза  $A$

$(-\pi, \pi]$ ,  $\varphi \geq 2\pi$

$$u(t) = U_m \cos(wt + \Theta)$$

превращение фазы  
фаза за  $t = 0$

Каноничният облик

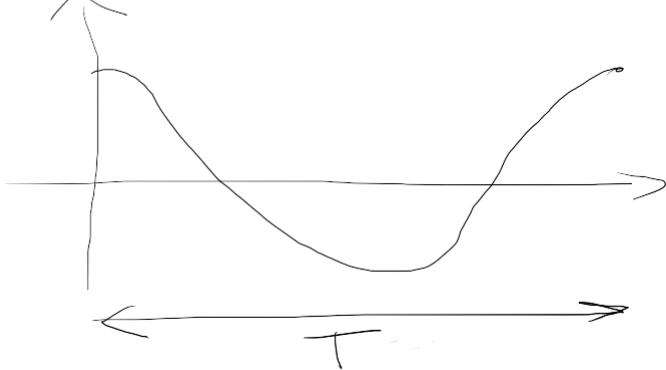
$$i(t) = \begin{cases} I_m \cos(\omega t + \varphi - \frac{\pi}{2}) \\ I_m \sin(\omega t + \varphi) \end{cases}$$

WCO JE

f [Hz]

Xperi

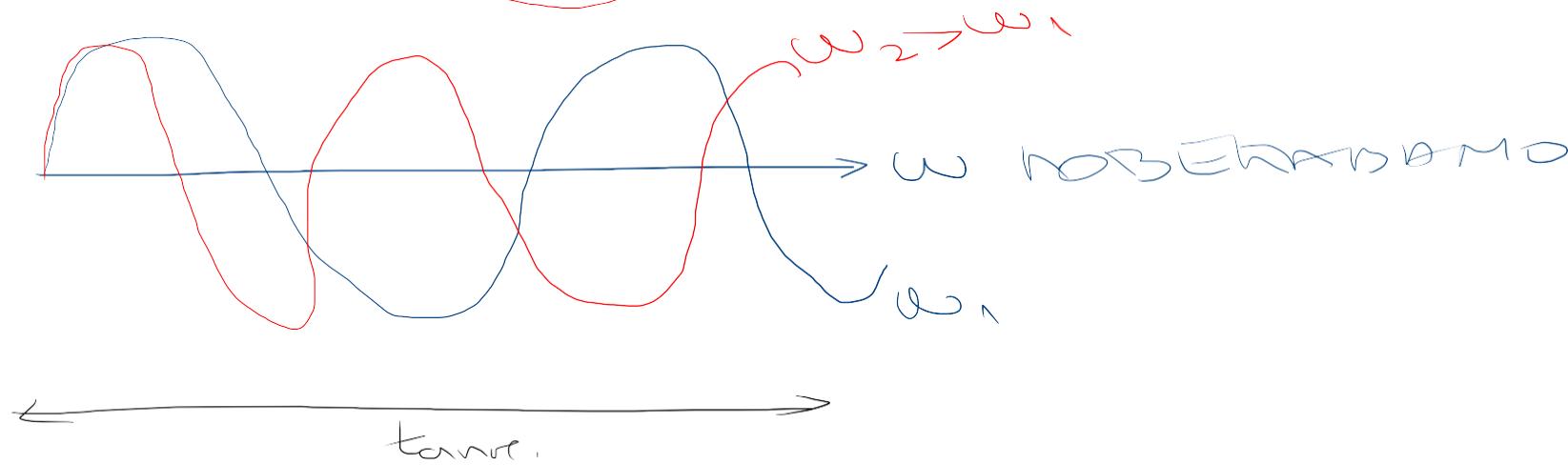
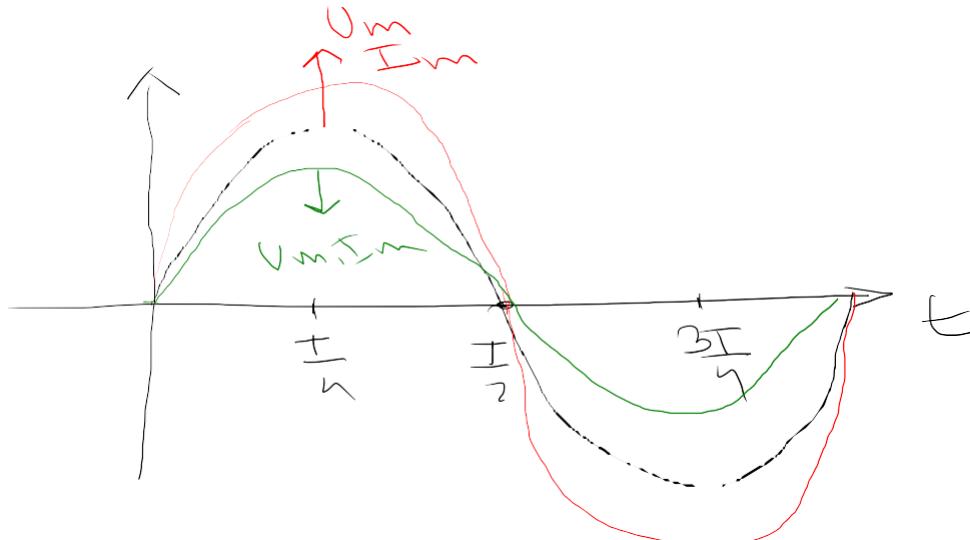
Timpang



$$\omega = 2\pi f$$

$$T = \frac{2\pi}{\omega}$$

$$f = \frac{1}{T} \quad \text{periode}$$



$$i(t) = I_m \cos(\omega t + \varphi)$$

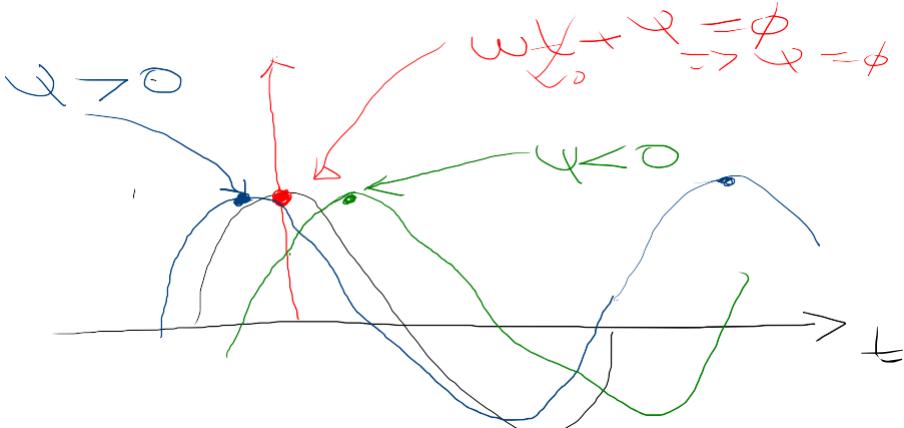
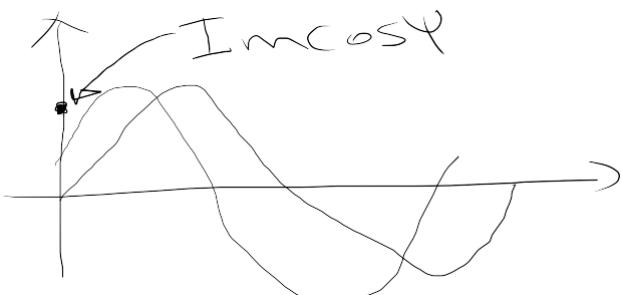
$$i(t) \rightarrow_{\max} \text{ao je } \cos(\omega t + \varphi) = 1$$

$I_m$

$$\omega t + \varphi = \phi$$

$$\omega t = -\varphi$$

$$\text{Díko je } \varphi > 0 \Rightarrow$$



$$\varphi < 0 \quad \omega t = -\varphi$$

$$\cos(\omega t + \varphi) = 1$$

$$u_1(t) = U_{m1} \cos(\omega t + \theta_1)$$

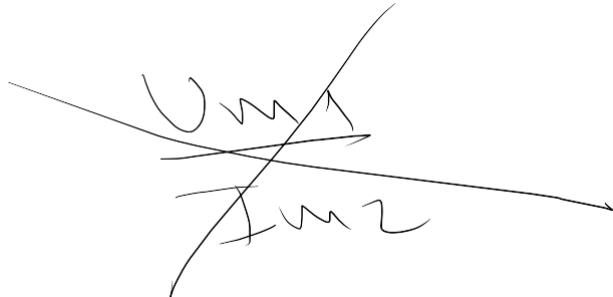
$$u_2(t) = U_{m2} \cos(\omega t + \theta_2)$$

$$\frac{U_{m1}}{U_{m2}}$$

$$\frac{I_{m1}}{I_{m2}}$$

$$x_1(t) = I_{m1} \cos(\omega t + \varphi_1)$$

$$i_2(t) = I_{m2} \cos(\omega t + \varphi_2)$$



$$(\omega t + \theta_1) - (\omega t + \theta_2) = \theta_1 - \theta_2$$

$$\theta_1 = \theta_2$$

у фазы

$$\theta_1 > \theta_2$$

$\Rightarrow$  у<sub>1</sub> фаза ~~задержка~~ у<sub>2</sub>

$$\theta_1 < \theta_2$$

$\Rightarrow$  у<sub>1</sub> фаза ~~задержка~~ за у<sub>2</sub>

$$\theta_1 - \theta_2 = \pi$$

у<sub>1</sub> ~~последовательно~~ фазы

$$\theta_1 - \theta_2 = \pi \frac{\pi}{2}$$

у<sub>1</sub> ~~последовательно~~ фазы

$$(\omega t + \phi_1) - (\omega t + \phi_2) = \phi_1 - \phi_2$$

Motoren mit phasen gegeneinander  
drehen.

CURRENTA BEWEGUNG  $f(t)$  der beiden Maschinen  
phasen (a,b)

$$I_{S2} = \frac{1}{b-a} \int_a^b f(t) dt$$

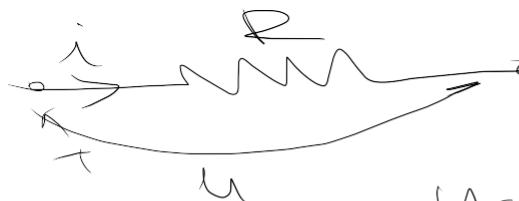
$i(t) = I_m \cos \omega t$  die jegrundeperiode ist je

$$I_{S2} = \frac{1}{T} \int_0^T i(t) dt = \frac{1}{T} \int_0^T I_m \cos \omega t dt = \frac{I_m}{T} \left[ \frac{1}{\omega} \sin \omega t \right]_0^T$$

$$= \frac{I_m}{\omega T} \left( \sin \frac{2\pi}{\omega} T - 0 \right) = \phi$$

# ЕФЕКТУРНАЯ ВДУХЕДНОСТЬ

$$I \quad e(t) \quad R$$



Что  
чтобы?

$$P(t) = u(t) \cdot i(t) = R \cdot i^2(t)$$

$$P_{SR} = \frac{1}{T} \int_0^T P(t) dt = \frac{1}{T} \int_0^T R i^2(t) dt = R I^2$$

$$I^2 = \frac{1}{T} \int_0^T i^2(t) dt \Rightarrow I = \sqrt{\frac{1}{T} \int_0^T i^2(t) dt}$$

$$i(t) = I_m \cos \omega t \Rightarrow I^2 = \frac{1}{T} \int_0^T I_m^2 \cos^2 \omega t dt$$

$$I^2 = \frac{1}{T} \int_0^T I_m^2 \frac{1 + \cos 2\omega t}{2} dt = \frac{1}{T} \frac{I_m^2}{2} T \Rightarrow I = \frac{I_m}{\sqrt{2}}$$

$$i(t) = I_m \cos(\omega t + \varphi)$$

$$= \sqrt{2} I \cos(\omega t + \varphi)$$

уровень  
тока

$\sqrt{2}I = I_m$

одинакова  
амплитуда

$\varphi$  —  
фаза

одинаковая  
фаза

$$u(t) = \sqrt{2} U \cos(\omega t + \theta)$$

$$\sqrt{2}U = U_m$$

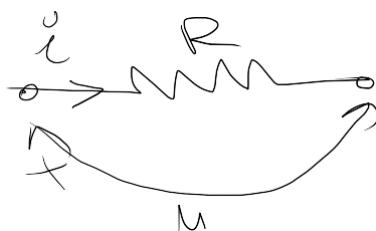
# ELEMENTU KONAKS INDUCTIVE PRODUCTION

## PENAMBY

- VCT



- inductor



$$u = R \cdot i$$

$$i = G u$$

$$\begin{aligned} P(t) &= u(t) \cdot i(t) \\ &= R i^2(t) = \frac{u^2(t)}{R} \end{aligned}$$

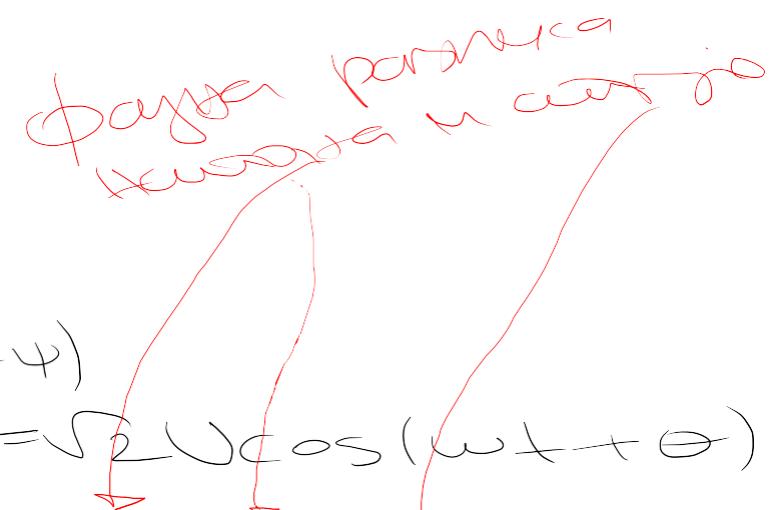
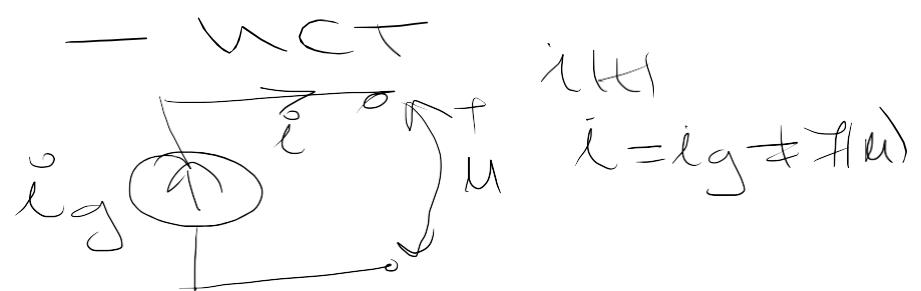
$$i(t) = I_m \cos(\omega t + \varphi) = \sqrt{2} I \cos(\omega t + \varphi)$$

$$u(t) = R i(t) = \sqrt{2} R I \cos(\omega t + \varphi) = \sqrt{2} U \cos(\omega t + \theta)$$

$$\Rightarrow U = RI$$

$$\theta = \varphi$$

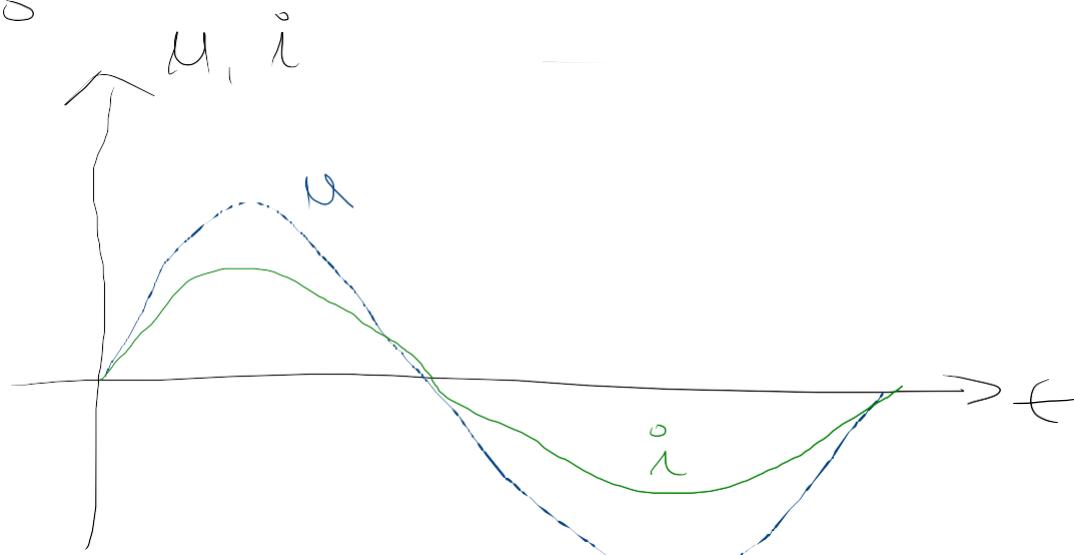
$$\Rightarrow \phi = \theta - \varphi = \phi$$



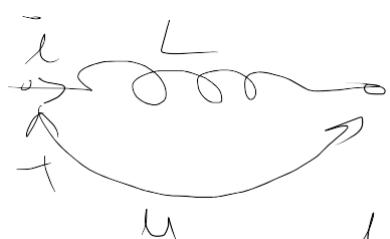
$$P(t) = U(1H \cdot 1H) = 2RI^2 \cos^2(\omega t + \varphi)$$

$$= RI^2 (\lambda + \cos(2\omega t + 2\varphi))$$

$$P = \frac{1}{T} \int_0^T P(t) dt = \dots = RI^2$$



-kanan



$$U = L \frac{di}{dt}$$

$$i(t) = \sqrt{2} I \cos(\omega t + \varphi)$$

$$U(t) = L \frac{di}{dt} = -\omega L \sqrt{2} I \sin(\omega t + \varphi)$$

$$= \sqrt{2} \omega L I \cos\left(\omega t + \varphi + \frac{\pi}{2}\right) = \sqrt{2} U \cos(\omega t + \theta)$$

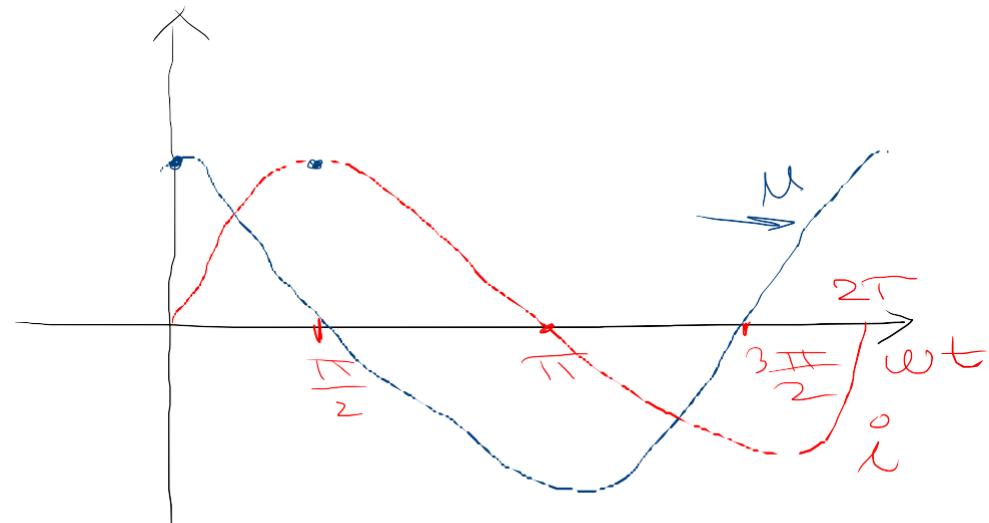
$$\Rightarrow U = \omega L I$$

$$\theta = \varphi + \frac{\pi}{2}$$

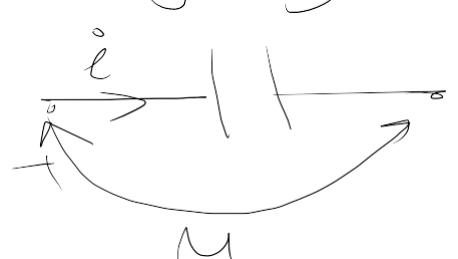
$$\phi = \theta - \varphi = \frac{\pi}{2}$$

$$B_S = \phi$$

$$P(t) = U(t) i(t) = \dots = \omega L I^2 \sin(2\omega t + 2\theta)$$



-Koherenzphasor



$$i = C \frac{du}{dt}$$

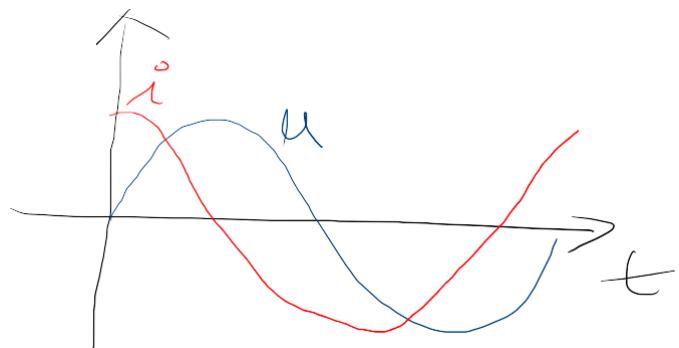
$$u(t) = \sqrt{2} U \cos(\omega t + \phi)$$

$$\begin{aligned} i(t) &= \sqrt{2} \omega C U \cos(\omega t + \phi + \frac{\pi}{2}) \\ &= \sqrt{2} I \cos(\omega t + \psi) \end{aligned}$$

$$\Rightarrow I = \omega C U$$

$$\psi = \phi + \frac{\pi}{2}$$

$$\phi = \phi - \psi = -\frac{\pi}{2}$$



$$P(t) = u(t) \cdot i(t)$$

$$= \dots = -\omega C U^2 \sin(2\omega t + 2\phi)$$

$$P_{\text{so}} = 0$$

$$U = RI$$

oxygen

$$U = \omega L I$$

copper

$$U = \frac{I}{\omega C}$$

$$U = \frac{Z}{P} \cdot I$$

eddy current loss

$$Z[S]$$

am

$$Z \geq 0$$

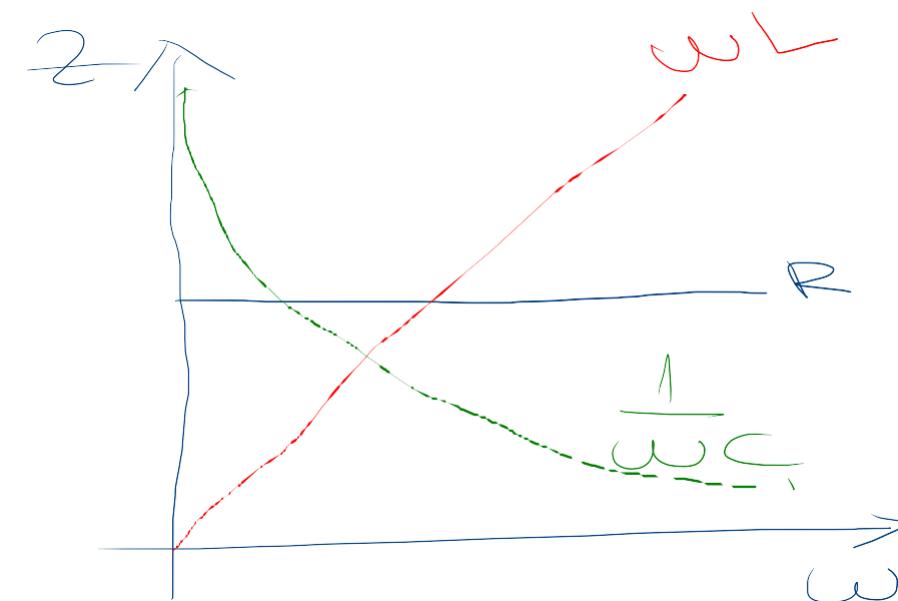
$$Y = \frac{1}{Z}$$

symmetric

$$Y[S]$$

current

$$Y \geq 0$$



AHATUBA KONA Y INDUCTOREN MODULUHOM PADAUNY

$$\sum_{\text{c}} i(t) = \phi$$

$$\sum_{\text{c}} u(t) = \phi$$

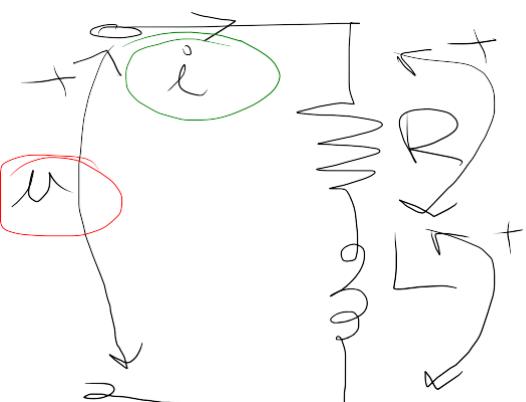
+ kompleksusasare (im) pengeyre

$$u = R i$$

$$u = L \frac{di}{dt}$$

$$i = C \frac{du}{dt}$$

NRU WEP



$$i(t) = \sqrt{2} I \cos(\omega t) \quad \text{no3man}$$

$$\begin{aligned} u &= u_R + u_L \\ u_R &= R i \\ u_L &= L \frac{di}{dt} \end{aligned} \quad \left. \begin{aligned} u_R &= \sqrt{2} R I \cos(\omega t) \\ u_L &= \sqrt{2} L I \frac{d}{dt} \cos(\omega t) \\ &= \sqrt{2} L I \omega \sin(\omega t) \end{aligned} \right\} \begin{aligned} u &= \sqrt{2} R I \cos(\omega t) + \sqrt{2} L I \omega \sin(\omega t) \\ &= \sqrt{2} U \cos(\omega t + \phi) \end{aligned}$$

$$\begin{aligned}
 U(t) &= \sqrt{2}U \cos(\omega t + \theta) \\
 &= \sqrt{2}U (\cos \omega t \cos \theta - \sin \omega t \sin \theta) \\
 &= \sqrt{2}RI \cos \omega t - \sqrt{2}WL I \sin \omega t
 \end{aligned}$$

$$U \cdot \cos \theta = RI$$

$$U \cdot \sin \theta = WL I$$

$$\left. \begin{array}{l} \Rightarrow \theta = ? \\ \Rightarrow U = ? \end{array} \right\}$$

$$\tan \theta = \frac{\omega L}{R} \Rightarrow \theta = \arctan \frac{\omega L}{R}$$

$$U^2 (\cos^2 \theta + \sin^2 \theta) = I^2 (R^2 + (\omega L)^2)$$

$$U = I \sqrt{R^2 + (\omega L)^2}$$

$$U(t) = \sqrt{2}I \sqrt{R^2 + (\omega L)^2} \cos \left( \omega t + \arctan \frac{\omega L}{R} \right)$$