R-AC - piiri

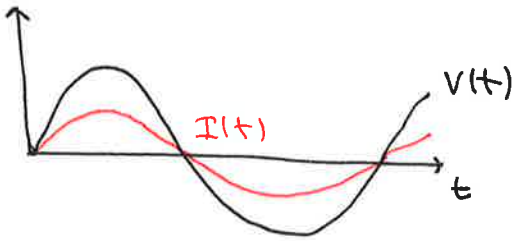
↑ vaihtojännitelähde $\quad V(t) = V_0 \cos(\omega t)$.

↑ amplitudi $\quad$ ↑ taajuus

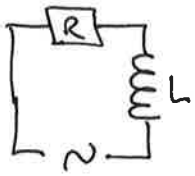
Jännite piirin ympäri:

$$V(t) - RI(t) = 0.$$

$$\Rightarrow I(t) = \frac{V(t)}{R} = \frac{V_0}{R}\cos(\omega t)$$



RL-AC - piiri



$$V(t) - RI(t) - L\frac{dI(t)}{dt} = 0.$$

$$\Rightarrow LI'(t) + RI(t) = V(t). \qquad \text{1.tl dy.}$$

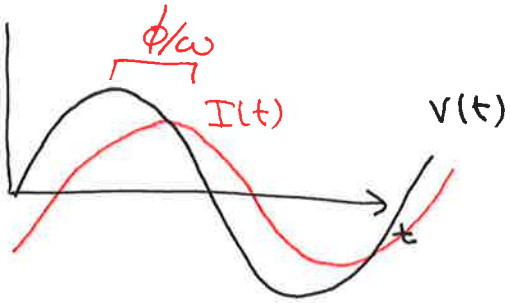
$\Rightarrow$ ... Wolfram alpha ...

$$\Rightarrow I(t) = \frac{V_0}{\sqrt{R^2 + (\omega L)^2}}\cos(\omega t - \phi)$$

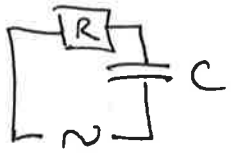
↑ vaihesiirto eli mitä on jännitteen ja virran vaihe-ero.

$$\phi = \operatorname{atan}\left(\frac{\omega L}{R}\right)$$

dynaaminen vastus, nimeltään induktiivinen reaktanssi $X_L = \omega L$.



RC-AC-piiri



$$V(t) - R\underbrace{I(t)}_{\frac{dQ(t)}{dt}} - \frac{Q(t)}{C} = 0 .$$

$\Rightarrow$

$$RQ'(t) + \frac{1}{C}Q(t) = V(t) . \qquad \text{1.kl dy}$$

$\Rightarrow$ .... Wolfram alpha...

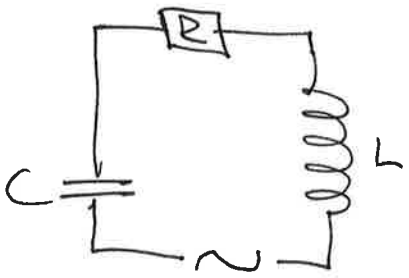
$\Rightarrow$

$$I(t) = \frac{dQ(t)}{dt} = \frac{V_0}{\sqrt{R^2 + \left(\frac{1}{\omega C}\right)^2}} \cos(\omega t + \phi)$$

$$\phi = \operatorname{atan}\left(\frac{1}{\omega C R}\right)$$

Kapasitiivinen reaktanssi $X_c = \frac{1}{\omega C}$.

RLC-AC-piiri



$$V(t) - R\underbrace{I(t)}_{\frac{dQ(t)}{dt}} - \frac{Q(t)}{C} - L\underbrace{\frac{dI(t)}{dt}}_{\frac{d^2Q(t)}{dt^2}} = 0 .$$

$\Rightarrow$

$$LQ''(t) + RQ'(t) + \frac{1}{C}Q(t) = V(t)$$

2.kl dy

$\Rightarrow$ Wolfram alpha $\Rightarrow$

$$I(t) = \underbrace{\frac{V_0}{\sqrt{R^2 + (X_L - X_C)^2}}}_{\text{oskilloidi amplitudi maksimi kun } X_L = X_C \Rightarrow \omega L = \frac{1}{\omega C}} \cos(\omega t - \phi)$$

$$\phi = \operatorname{atan}\left(\frac{X_L - X_C}{R}\right)$$

$\Rightarrow \omega = 1/\sqrt{LC}$, eli vastaavan LC-piirin resonanssitaajuus.