Kap 31: Vekselstrømskretser

31.1 Visere og kompleks notasjon

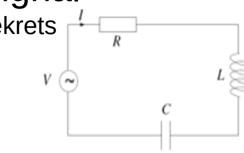
31.2 (Kompleks) reaktans

31.3 RLC-krets

31.5 Resonans (i RLC-krets)

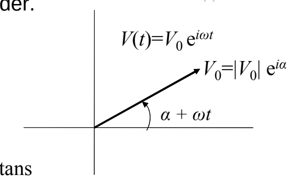
Kretslover for AC-signal

med eksempel i RLC-seriekrets



Regler:

1. $V(t) = V_0 \cdot e^{i\omega t}$ (1)
   $I(t) = I_0 \cdot e^{i\omega t}$ (2) osv. $V_R(t)$, $V_L(t)$, $V_C(t)$
   med lik frekvens ω og komplekse amplituder.



2. Resistans: $V_R = Z_R I = R \cdot I$ (6)
   $Z_R = R$ = resistans = resistiv impedans

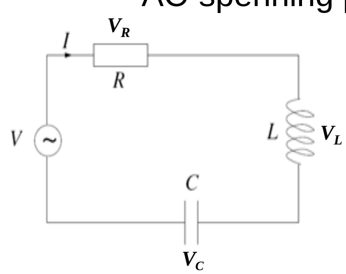
3. Induktans: $V_L = Z_L I = i\omega L \cdot I$ (7)
   $Z_L = i\omega L$ = induktiv impedans, L = induktans

4. Kapasitans: $V_C = Z_C I = 1/i\omega C \cdot I$ (8)
   $Z_C = 1/i\omega C$ = kapasitiv impedans, C = kapasitans

5. Kirchhoffs lover som vanlig.

OBS:
$d/dt\,(e^{i\omega t}) = i\omega\, e^{i\omega t}$

AC-spenning på RLC-krets



Kirchhoff:
$V(t) = V_R + V_L + V_C = Z\, I(t)$ (9)

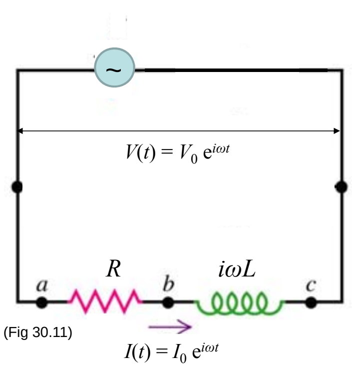
$V_R = Z_R I = R \cdot I$ (6)
$V_L = Z_L I = i\omega L \cdot I$ (7)
$V_C = Z_C I = 1/i\omega C \cdot I$ (8)

gir seriekretsens komplekse impedans:

$$Z = R + i\omega L + 1/i\omega C$$
$$= R + i(\omega L - 1/\omega C) \quad (10)$$

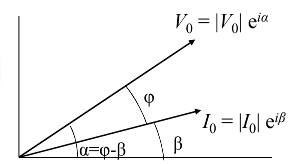
eller
$Z = R + Z_L + Z_C$
(vanlig seriekopling av impedanser)

Detaljer for RL-krets

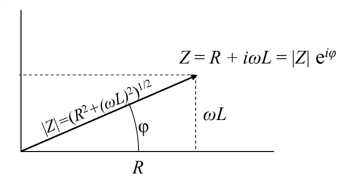


(Fig 30.11)

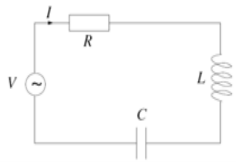
Ohm: $V(t) = Z\ I(t)$
impedans $Z = R + i\omega L = |Z|\ e^{i\varphi}$
(Kompleks) amplityde:
$V_0(t) = Z\ I_0(t)$



Her:
velger
$\beta = 0$



Eks.: RLC-krets

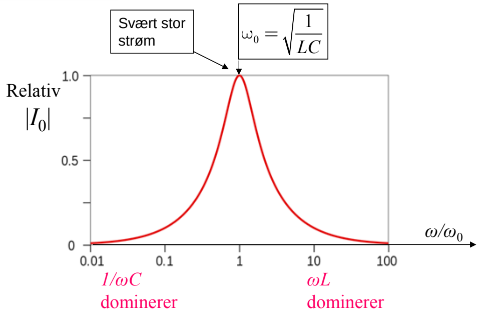


Kirchhoffs spenningslov:

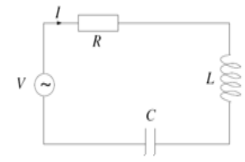
$V(t) = V_R + V_L + V_C = Z \cdot I(t)$

gir $Z = R + i\omega L + 1/i\omega C$
=> $|Z| = (R^2 + (\omega L - 1/\omega C)^2)^{1/2}$

$I_0 = |V_0|/|Z| \exp(-i\varphi)$



Eks.: RLC-krets



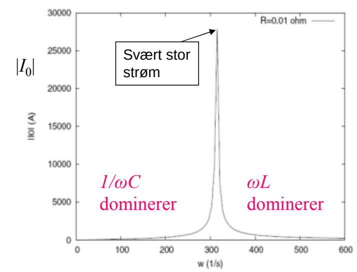
Kirchhoffs spenningslov:

$V(t) = V_R + V_L + V_C = Z \cdot I(t)$

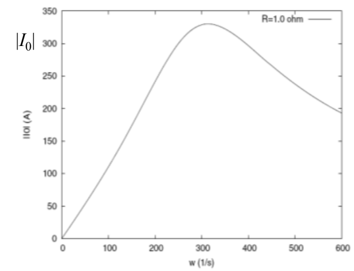
gir $Z = R + i\omega L + 1/i\omega C$
=> $|Z| = (R^2 + (\omega L - 1/\omega C)^2)^{1/2}$

$I_0 = |V_0|/|Z| \exp(-i\varphi)$

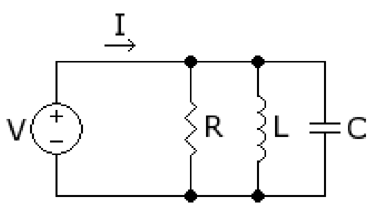
Med $R = 1/100\ \Omega$:



Med $R = 1\ \Omega$:



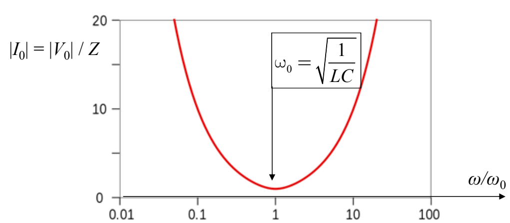
Eks: RLC-parallellkrets



Parallellkopling:

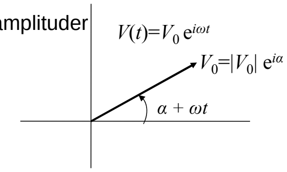
$1/Z = 1/R + 1/i\omega L + i\omega C$

$$Z = \frac{R}{1 + i\left(\omega RC - \frac{R}{\omega L}\right)}$$



Kompleks impedans med AC-signal

1. $V(t) = V_0 \cdot e^{i\omega t}$ og $I(t) = I_0 \cdot e^{i\omega t}$
   med lik frekvens ω og komplekse amplituder V_0 og I_0 gir en utvidet Ohms lov:
2. Resistans: $V_R = Z_R\, I = R \cdot I$
3. Induktans: $V_L = Z_L\, I = i\omega L \cdot I$
4. Kapasitans: $V_C = Z_C\, I = 1/i\omega C \cdot I$



- Seriekopling: $Z = Z_1 + Z_2$
- Parallellkopling: $1/Z = 1/Z_1 + 1/Z_2$

- Alle kretslover gjelder for AC når Z brukes:
  Kirchoff 1 (strømlov)
  Kirchoff 2 (spenningslov)
  Ohms lov

- OBS:
  Z gjelder kun AC-signal, ikke andre periodiske signal eller ikke-periodiske signal.