SIG 4002 Eksamen 7/5 - 2001

Oppgave 1

a) $Z = \sqrt{R^2 + (\omega L - \frac{1}{\omega C})^2} = \sqrt{R^2 + (X_L - X_c)^2}$

(På kompleks form: $Z = R + j(\omega L - \frac{1}{\omega C})$)

$X_L = 2\pi \cdot 6 \cdot 10^3 \cdot 4 \cdot 10^{-3}\,\Omega = 150{,}8\,\Omega$

$X_c = (2\pi \cdot 6 \cdot 10^3 \cdot 0{,}4 \cdot 10^{-6})^{-1}\,\Omega = 66{,}3\,\Omega$

$R = 160\,\Omega$

$Z = \underline{181\,\Omega}$

$$\tan\varphi = \frac{X_L - X_c}{R} = \frac{150{,}8 - 66{,}3}{160} = 0{,}53$$

$\varphi = \underline{28^\circ}$

$$I_0 = \frac{V_0}{Z} = \frac{10}{181}\,A = \underline{0{,}055\,A}$$

b)

$$V_s = \sqrt{V_R^2 + (V_L - V_c)^2} = I\sqrt{R^2 + (\omega L - \frac{1}{\omega C})^2}$$

$$V_{ut} = \sqrt{V_R^2 + V_L^2} = I\sqrt{R^2 + (\omega L)^2}$$

$$\frac{V_{ut}}{V_s} = \sqrt{\frac{R^2 + (\omega L)^2}{R^2 + (\omega L - \frac{1}{\omega C})^2}} \approx \sqrt{\frac{R^2}{(\frac{1}{\omega C})^2}} = \underline{\omega R C} \text{ for små } \omega$$

dvs $\frac{V_{ut}}{V_s}$ tilnærmet proporsjonalt med ω for små ω

For store ω er $\frac{1}{\omega C} \ll \omega L$ og $\omega L \gg R$:

$$\Rightarrow \frac{V_{ut}}{V_s} \approx \sqrt{\frac{(\omega L)^2}{(\omega L)^2}} = \underline{1}$$

Oppgave 1 forts

c)
$$V_s = I\sqrt{R^2 + (\omega L - \frac{1}{\omega C})^2}$$

$$V_{ut} = V_c = I \cdot \frac{1}{\omega C}$$

$$\frac{V_{ut}}{V_s} = \frac{\frac{1}{\omega C}}{\sqrt{R^2 + (\omega L - \frac{1}{\omega C})^2}}$$

For stor ω er $\frac{1}{\omega C} << \omega L$ og $\omega L >> R$:

$$\Rightarrow \frac{V_{ut}}{V_s} \approx \frac{\frac{1}{\omega C}}{\sqrt{(\omega L)^2}} = \frac{1}{\omega^2 LC} \propto \frac{1}{\omega^2}$$

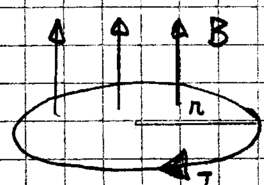
For liten ω er $\frac{1}{\omega C} >> \omega L$ og $\frac{1}{\omega C} >> R$:

$$\Rightarrow \frac{V_{ut}}{V_s} \approx \frac{\frac{1}{\omega C}}{\sqrt{(\frac{1}{\omega C})^2}} = \underline{1}$$

d) $r = r_0(1 + \alpha t) \Rightarrow \frac{dr}{dt} = r_0 \alpha$

Fluks gjennom ringen: $\Phi_B = \vec{B} \cdot \vec{A} = B \pi r^2$

Indusert emf: $\mathcal{E} = -\frac{d\Phi_B}{dt} = -2B\pi r \cdot \frac{dr}{dt}$



$\mathcal{E} = -2\pi B r_0(1 + \alpha t) \cdot r_0 \alpha = -2\pi B r_0^2 \alpha (1 + \alpha t)$

Resistans $R' = R \cdot 2\pi r = R_0(1 + \beta t) 2\pi r_0 (1 + \alpha t)$

Indusert strøm $I = \mathcal{E}/R' = \frac{-2\pi B r_0^2 \alpha (1 + \alpha t)}{R_0(1 + \beta t) 2\pi r_0 (1 + \alpha t)}$

$\underline{I = \frac{-B r_0 \alpha}{R_0(1 + \beta t)}}$ I figuren er strømretningen med klokken.