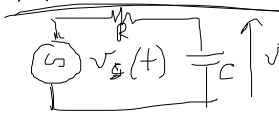
* Analisis Steady State



Diketahui:
$v_s(t) = 12 \sin \omega t$
Tentukan $v_c(t)$, utk $t >>> 0$

$$V_s(s) \longrightarrow \boxed{G(s)} \longrightarrow V_c(s)$$

$$G(s) = \frac{V_c(s)}{V_s(s)} = \frac{1}{RCs+1}$$

$s = j\omega \rightarrow j = \sqrt{-1}$

$\omega = 2\pi f$, $f = \frac{1}{T}$ [Hertz]

T = periode [second]

$$V_s(j\omega) \longrightarrow \boxed{G(j\omega)} \longrightarrow V_c(j\omega)$$

$v_s(t) = A_1 \sin \omega t$

$v_c(t) = A_2 \sin(\omega t + \phi)$

$$\frac{A_2}{A_1} = |G(j\omega)| \qquad \phi = \angle G(j\omega)$$

$$G(j\omega) = \frac{1}{j\omega RC + 1} \rightarrow \frac{A_2}{A_1} = |G(j\omega)|$$

Spektrum GAIN $= \left| \frac{1}{j\omega RC + 1} \right|$

$$= \frac{1}{\sqrt{\omega^2 R^2 C^2 + 1}}$$

$$\angle G(j\omega) = \angle \frac{1}{j\omega RC + 1}$$ PHASE

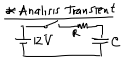
$$\phi = -\tan^{-1} \omega RC$$

$\omega \rightarrow 0 \longrightarrow A_2 \approx 12, \phi \approx 0$

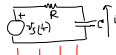
$\omega \rightarrow \infty \longrightarrow A_2 \approx 0, \phi = -90^\circ$

(lagging)

* Analisis Transient



saklar ditutup pada $t = 0$
$v_c(0) = 0$
Tentukan $v_c(t)$, $t \geq 0$!



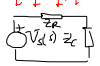
$v_c(t)$ $\quad v_s(t) \rightarrow \boxed{g(t)} \rightarrow v_c(t)$

$$v_s(t) \begin{cases} = 0, & t < 0 \\ = 12, & t \geq 0 \end{cases}$$

Transf. Laplace

$$V_s(s) = \mathcal{L}\, v_s(t) = 12\, \mathcal{L}\, u(t) = \frac{12}{s}$$

(bab 2, Table 4.1, hal. 60)



$$V_c(s) = \frac{Z_C}{Z_R + Z_C} V_s(s) = \frac{1/Cs}{R + 1/Cs} V_s(s)$$

$$= \frac{1}{RCs + 1} V_s(s)$$

$$G(s) = \frac{V_c(s)}{V_s(s)} = \frac{1}{RCs+1}$$

$$V_s(s) \longrightarrow \boxed{G(s)} \longrightarrow V_c(s)$$

$$V_c(s) = G(s) \cdot V_s(s) = \frac{1}{RCs+1} \cdot \frac{12}{s} = \frac{12}{s(RCs+1)} = \frac{12}{RCs\left(s + \frac{1}{RC}\right)}$$

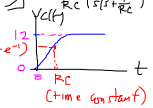
$t \geq 0$.

$$v_c(t) = \frac{12}{RC} \mathcal{L}^{-1} \frac{1}{s\left(s + \frac{1}{RC}\right)} = \frac{12}{RC} \left[RC\left(1 - e^{-t/RC}\right) \right] = \frac{12}{RC} \left(\frac{1}{s\left(s + \frac{1}{RC}\right)} \right)$$

$$= 12\left(1 - e^{-t/RC}\right)$$

bab 7 Tabel Appendix hal. 361

$\frac{1}{s(s+a)}$, $a = \frac{1}{RC}$



(time constant)

$$v_c(t) = A_2 \sin(\omega t + \phi)$$

$$A_2 = \frac{1}{\sqrt{\omega^2 R^2 C^2 + 1}} A_1$$

$$= \frac{12}{\sqrt{\omega^2 R^2 C^2 + 1}}$$

$$\phi = -\tan^{-1} \omega RC$$

(LOW PASS FILTER)