Feryanai Nurdiantoro / 165 13 146

PAR PR 06

(1) Setelah penutupan saklar: KCL

$$i(t) = \frac{v(t)}{R_2} + C\frac{d\,v(t)}{dt} \quad \text{... (1)}$$

Dengan KVL :

$$V_S = R_1 \cdot i(t) + L\frac{d\,i(t)}{dt} + v(t) \quad \text{... (2)}$$

Subtitusi persamaan: (1) dan (2)

$$V_S = \frac{R_1}{R_2} v(t) + R_1 \cdot C\frac{d\,v(t)}{dt} + \frac{L}{R_2}\cdot\frac{d\,v(t)}{dt} + CL\frac{d^2 v(t)}{dt} + v(t)$$

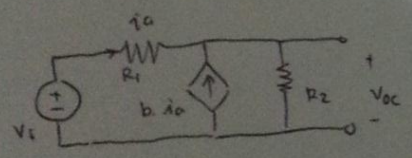
$$= CL\frac{d^2 v(t)}{dt^2} + \left(R_1 C + \frac{L}{R_2}\right)\frac{d\,v(t)}{dt} + \frac{R_1+R_2}{R_2} v(t)$$

$$\frac{V_S}{CL} = \frac{d^2 v(t)}{dt^2} + \left(\frac{R_1}{L} + \frac{1}{R_2 C}\right)\cdot\frac{d\,v(t)}{dt} + \frac{R_1+R_2}{R_2 CL} v(t)$$

disederhanakan menjadi : $\frac{d\,v(t)}{dt} = u$

$$\frac{V_S}{CL} = u^2 + \left(\frac{R_1}{L} + \frac{1}{R_2 C}\right) u + \frac{R_1+R_2}{R_2 CL}\cdot v(t)$$

(2)

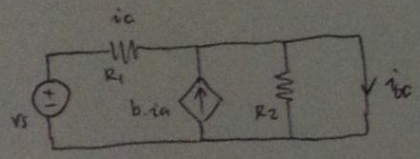


$$i_a = \frac{V_S - V_{OC}}{R_1}$$

$$i_a + b.i_a = \frac{V_{OC}}{R_2}$$

Subtitusi :

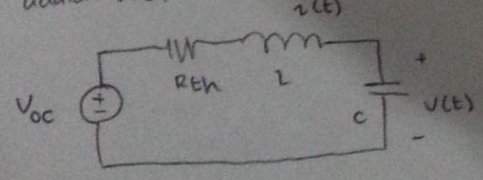
$$V_{OC} = \frac{V_S R_2 (1+b)}{R_1 + R_2(1+b)}$$



$$i_{SC} = i_a(1+b) = \frac{V_S}{R_1}(1+b)$$

$$R_{Th} = \frac{V_{OC}}{i_{SC}} = \frac{\frac{V_S R_2 (1+b)}{R_1 + R_2(1+b)}}{\frac{V_S}{R_1}(1+b)} = \frac{R_1 R_2}{R_1 + R_2(1+b)}$$

Rangkaian equivalent thevenin-nya adalah sbb:



Menggunakan loop:

$$R_{Th}\, i(t) + L\frac{d\,i(t)}{dt} + v(t) - V_{OC} = 0$$

$$i(t) = C\frac{dv(t)}{dt}$$

Cont.

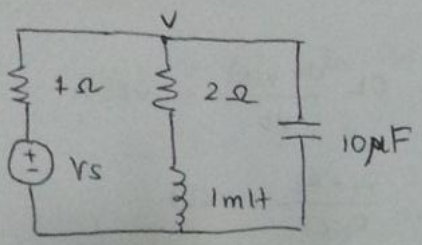
② $R_{th}\, C \cdot \frac{dv(t)}{dt} + LC \cdot \frac{d^2 v(t)}{dt} + v(t) = V_{oc}$

$\frac{R_{th}}{L} \frac{dv(t)}{dt} + \frac{d^2 v(t)}{dt} + \frac{v(t)}{LC} = \frac{V_{oc}}{LC}$.

dengan $\frac{dv(t)}{dt} = x$

$x^2 + \frac{R_{th}}{L} x + \frac{v(t)}{LC} = \frac{\frac{V_S R_2 (1+b)}{R_1 + R_2 (1+b)}}{LC}$ ← V_S berhubungan dengan $v(t)$

③



KCL → $\frac{v - v_s}{1\Omega} + i_L + 10\mu \cdot \frac{dv}{dt} = 0$

KVL → $(v) = 2 i_L + 1m \cdot \frac{di_L}{dt}$

$0 = 2 i_L + 1m \cdot \frac{di_L}{dt} - v$ ⇐ $\frac{v - v_s}{1\Omega} + i_L + 10\mu \cdot \frac{dv}{dt} = 0$.

$0 = 2 i_L + 1m \cdot \frac{di_L}{dt} - v_s + i_L + 10\mu \cdot \frac{dv}{dt}$.

$0 = 2 i_L + 1m \cdot \frac{di_L}{dt} - v_s + i_L + 10\mu \cdot 2 \frac{di_L}{dt} + 10\mu \cdot 1m \cdot \frac{d^2 i_L}{dt^2}$.

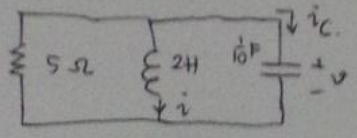
$V_s = 3 i_L + 0{,}00102 \frac{di_L}{dt} + 10^{-8} \cdot \frac{d^2 i_L}{dt^2}$

$V_s \times 10^8 = 3 \times 10^8 i_L + 102000 \frac{di_L}{dt} + \frac{d^2 i_L}{dt^2}$.

$s^2 + 102000 s + 3 \times 10^8 = 0$

$s_1 = 3031$; $s_2 = -98969$

④



$v(0) = 2V$

$i(0) = \frac{1}{10}$ A

Dan rumus didapat :

$$s^2 + \frac{1}{RC}s + \frac{1}{LC} = 0 \quad \text{atau} \quad s^2 + 2s + 5 = 0$$

akar-akarnya :

$$s_{1,2} = -1 \pm j2$$

Sesuai karakteristik s-nya digunakan :

$$v(t) = e^{-t}\left[B_1 \cos 2t + B_2 \sin 2t\right]$$

$$v(0^+) = 2 = B_1$$

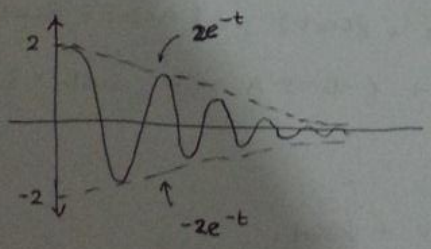
$$\frac{d(v(0^+))}{dt} = \frac{1}{C} i_c(0^+)$$

Dengan KCL :

$$i_c(0^+) = -\frac{v(0^+)}{5} - i(0^+) = -\frac{1}{2} \cdot \frac{V}{5}$$

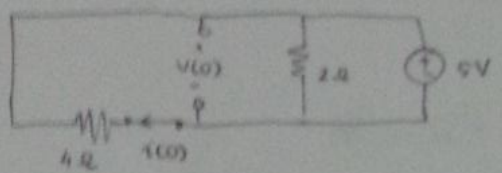
$$\frac{d(v(0^+))}{dt} = 10\left(-\frac{1}{2}\right) = -B_1 + 2B_2 \rightarrow B_2 = -3/2$$

Sehingga, $v(t) = 2e^{-t}\cos 2t - \frac{3}{2}e^{-t}\sin 2t$ V dengan $t > 0$.



⑤ Saat $t < 0$

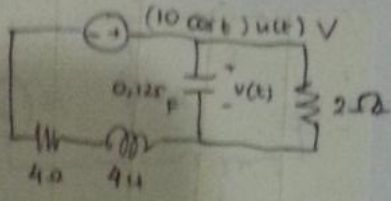
rangkaian ekuivalen:



$i(0) = -\frac{5}{4} = -1{,}25$ mA

$v(0) = 9$ V

Saat $t = 0$



KCL node 1

$$\frac{v}{2} + 0{,}125\frac{dv}{dt} = i \quad \dots (1)$$

KVL loop kanan:

$$-10\cos t + v + 4\frac{di}{dt} + 4i = 0$$

$$\frac{d^2v}{dt^2} + 5\frac{dv}{dt} + 6v = 20\cos t.$$

$$s^2 + 5s + 6 = 0$$

$$s_{1,2} = -2, -3$$

$$v_f = A\cos t + B\sin t$$

$$\frac{d^2}{dt^2}(A\cos t + B\sin t) + 5\frac{d}{dt}(A\cos t + B\sin t) + 6(A\cos t + B\sin t) = 20\cos t.$$

$$(-A\cos t - B\sin t) + 5(-A\sin t + B\cos t) + 6(A\cos t + B\sin t) = 20\cos t$$

$$(-A + 5B + 6A)\cos t + (-B - 5A + 6B)\sin t = 20\cos t.$$

$A = 2$ dan $B = 2$

$$v_f = 2\cos t + 2\sin t.$$

$$v(t) = 2\cos t + 2\sin t + A_1 e^{-2t} + A_2 e^{-3t}$$

dari pers. 1

$$\frac{v(t)}{2} + 0{,}125\frac{dv}{dt} = i$$

$$\frac{dv}{dt} = 8i - 4v \quad \rightarrow \quad \frac{dv(0)}{dt} = 8i(0) - 4v(0) = 8\left(-\frac{5}{4}\right) - 4(5) =$$

$$= -30\ \left(\frac{V}{s}\right)$$

⑤ cont

⑤ Saat $t = 0$

$$5 = v(0) = 2\cos 0 + 2\sin 0 + A_1 e^{-0} + A_2 e^{-0} = 2 + A_1 + A_2$$

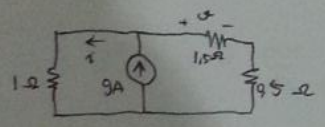
$$\frac{dv(t)}{dt} = -2\sin t + 2\cos t - 2A_1 e^{-2t} - 3A_2 e^{-3t}$$

$$-30 = \frac{dv(0)}{dt} = -2\sin 0 + 2\cos 0 - 2A_1 e^{-0} - 3A_2 e^{-0} = 2 - 2A_1 - 3A_2$$

$A_1 = -23$ dan $A_2 = 26$

$$v(t) = 2\cos t + 2\sin t - 23e^{-2t} + 26e^{-3t}$$

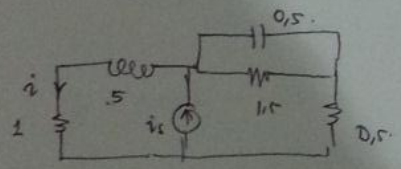
⑥ Saat $t < 0$



$$i(0^-) = \frac{2}{2+1} \times 9 = 6A = i(0^+)$$

$$v(0^-) = \frac{1}{2+1} \times 9 \times 1,5 = 4,5\ V = v(0^+)$$

Saat $t > 0$



KCL pada node tengah:

$$i + 0,5\frac{dv}{dt} + \frac{v}{1,5} = i_s \quad \cdots (1)$$

KVL :

$$v + \left(0,5\frac{dv}{dt} + \frac{v}{1,5}\right)0,5 = \frac{5di}{dt} + i \quad \cdots (2)$$

Subtitusi (1) ke (2)

$$\frac{d^2v}{dt^2} + \frac{49}{30}\frac{dv}{dt} + \frac{4}{5}v = \frac{2}{5}i_s + 2\frac{di_s}{dt}$$ dimana : $i_s = 9 + 3e^{-2t}A$.

$$s^2 + \frac{49}{30}s + \frac{4}{5} = 0 \rightarrow \text{akar: } s_{1,2} = -0,817 \pm j\,0,365$$

$$v_n(t) = e^{-0,817t}\left[A_1 \cos(0,365t) + A_2 \sin(0,365t)\right]$$

$$v(0) = 4,5 = A_1 + 4,5 - 7,04 \rightarrow A_1 = 7,04$$

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