TUGAS

ISYARAT DAN SISTEM

(TEE 201)

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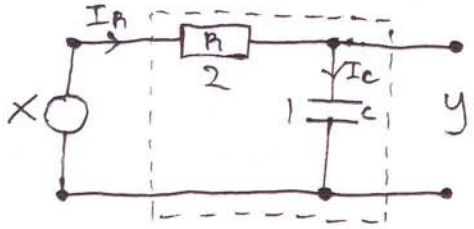
SOAL:



1.) Tentukan pers. differensial sistem, cari $y(t)$ jika diketahui $X(t) = 5\,u(t)$.

2.) Tentukan impulse response sistem, cari $y(t)$ dengan konvolusi jika $X(t) = 5\,u(t)$. Bandingkan hasilnya dengan soal nomor 1.

3.) Cari $y(t)$ dengan transformasi Laplace

JAWAB:

1.) $I_R = I_C = C\frac{dV(t)}{dt}$ (karena R dan C diseri)

$V(t) = y(t)$, $V_{input} = x(t)$

Pers. sistem:

$V_{input} = V_R + V_C$

$x(t) = I_R \cdot R + V(t)$

$x(t) = R \cdot C \cdot \frac{dV(t)}{dt} + y(t)$

$x(t) = RC\frac{dy(t)}{dt} + y(t)$

$\frac{1}{RC}x(t) = \frac{dy(t)}{dt} + \frac{1}{RC}\cdot y(t)$

$\frac{dy(t)}{dt} + \frac{1}{RC}y(t) - \frac{1}{RC}x(t) = 0$

Jadi persamaan differensialnya : $\boxed{\frac{dy(t)}{dt} + \frac{1}{RC}y(t) - \frac{1}{RC}x(t) = 0}$

Homogen (saat masukan $x(t) = 0$):

misal: $y(t) = Ae^{st}$

$\frac{dy(t)}{dt} = Ase^{st}$

Persamaannya menjadi:

$\Rightarrow \quad Ase^{st} + \frac{1}{RC}Ae^{st} - 0 = 0$

$\Rightarrow \underbrace{Ae^{st}}_{\text{tidak mungkin nol}}\underbrace{\left(s + \frac{1}{RC}\right)}_{\text{mungkin nol}} = 0$

$\Rightarrow s + \frac{1}{RC} = 0$

$\Rightarrow s = -\frac{1}{RC}$

Maka : $y_{(H)} = Ae^{st}$

$y_{(H)} = Ae^{-(1/RC)t}$

Partikular (saat sudah dalam keadaan tunak):

$x(t) = 5\,u(t)$

misal:

$y(t)$ = nilai maksimum $y = B$

$\frac{dy(t)}{dt} = 0$

Persamaannya menjadi :

$\Rightarrow 0 + \frac{1}{RC} \cdot B - \frac{1}{RC} \cdot 5u(t) = 0$

$\Rightarrow B = 5 \cdot u(t) = y(P)$

Jadi :

$y(t) = y(H) + y(P)$

$= Ae^{-\frac{1}{RC}t} + 5u(t)$

Tegangan awal kapasitor $= y(0) = 0$

$y(0) = A \cdot e^{-\frac{1}{RC} \cdot 0} + 5u(t)$

$0 = A + 5u(t)$

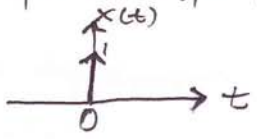
$A = -5u(t)$

Maka :

$y(t) = -5e^{-\frac{1}{RC}t} + 5u(t)$

$y(t) = (5 - 5e^{-\frac{1}{RC}t})\, u(t)$ =

2.) a) Impulse response sistem $H(t) = y(t)$ saat $x(t) = \delta(t)$ = impulse



$x(0) = 1$

Pers. differensial :

$$\frac{dy(t)}{dt} + \frac{1}{RC}\, y(t) - \frac{1}{RC} \cdot x(t) = 0$$

$$t=0 \rightarrow \quad \frac{dy(0)}{dt} + \frac{1}{RC} \cdot y(0) - \frac{1}{RC} \cdot x(0) = 0$$

$$\frac{1}{RC} = A \cdot 1$$

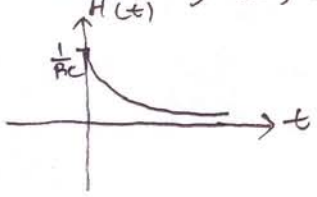
$$A = \frac{1}{RC}$$

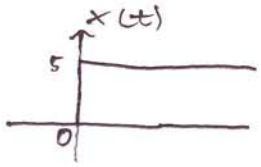
$$H(t) = y(t) = A e^{st} = \frac{1}{RC} e^{-(1/RC)\cdot t}$$

Jadi reponse sistem $= H(t) = \frac{1}{RC} e^{\left(-\frac{1}{RC} \cdot t\right)}$

b) $H(t) = \frac{y(t)}{x(t)}$

maka $y(t) = H(t) * x(t)$





$$y(t) = H(t) * x(t)$$

$$= \int_0^\infty H(\tau) \cdot x(t-\tau)\, d\tau \cdot u(t)$$

$$= \int_0^t \frac{1}{RC} \cdot e^{-\frac{1}{RC}\tau} \cdot 5\, d\tau \cdot u(t)$$

$$= \frac{5}{RC} \cdot (-RC)\, e^{-\frac{1}{RC}\tau} \Big]_0^t \cdot u(t)$$

$$= -5 \cdot e^{-\frac{1}{RC}\cdot\tau} \Big]_0^t \cdot u(t)$$

$$= \left[-5\left(e^{-\frac{1}{RC}\cdot t} - 1\right)\right] u(t)$$

$$= \left(5 - 5\, e^{-\frac{1}{RC}\cdot t}\right) u(t) \;//$$

Ternyata bila dibandingkan dengan soal nomor 1, hasilnya SAMA, yaitu $\left(5 - 5e^{-\frac{1}{RC}t}\right) u(t)$.

3.) Dengan transformasi Laplace

Pers. differensial :

$$\frac{dy(t)}{dt} + \frac{1}{RC} y(t) - \frac{1}{RC} x(t) = 0$$

$$\Rightarrow \quad [s \cdot Y(s) - y(0^-)] + \frac{1}{RC} Y(s) - \frac{1}{RC} X(s) = 0$$

$$\Rightarrow \quad sY(s) - 0 + \frac{1}{RC} Y(s) - \frac{1}{RC} X(s) = 0$$

$$\Rightarrow \quad \left(s + \frac{1}{RC}\right) Y(s) = \frac{1}{RC} X(s)$$

$$\Rightarrow \quad \frac{Y(s)}{X(s)} = \frac{1/RC}{s + 1/RC} = H(s)$$

$$\Rightarrow \quad h(t) = \frac{1}{RC} \cdot e^{-\frac{1}{RC} \cdot t} u(t) =$$

∴ Tanggapan impulse sistem $= \frac{1}{RC} \cdot e^{-\frac{1}{RC} \cdot t} u(t)$

$$x(t) = 5\,u(t) \rightarrow X(s) = \frac{5}{s}$$

$$Y(s) = \frac{1/RC}{s + 1/RC} \cdot \frac{5}{s}$$

$$Y(s) = \frac{-5}{s + \frac{1}{RC}} + \frac{5}{s}$$

$$y(t) = \left\{ -5 \cdot e^{-\frac{1}{RC} \cdot t} + 5 \right\} u(t)$$

$$y(t) = \left(5 - 5\, e^{-\frac{1}{RC} \cdot t} \right) u(t) =$$

Ternyata hasilnya SAMA.