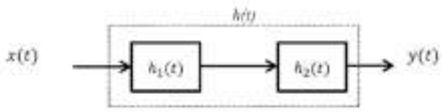
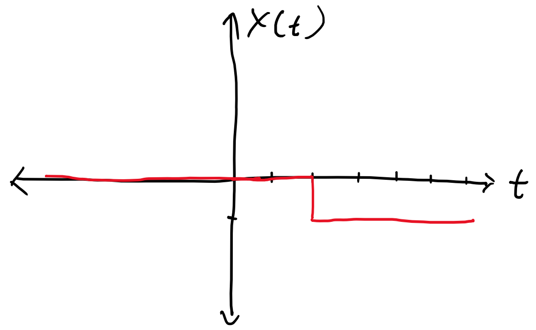
1. Sebuah sistem waktu kontinyu, menerima sinyal masukkan $x(t)$, masuk dalam respon sistem $h_1(t)$ kemudian $h_2(t)$. Bila $x(t) = u(t) - u(t-2)$, respons sistem $h_1(t) = e^{-t}u(t)$ dan $h_2(t) = \delta(t)$. keluarannya adalah sinyal $y(t)$.



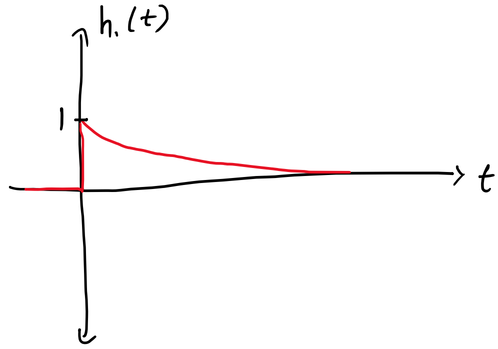
a. Gambarkan sinyal masukkan $x(t)$
b. Dapatkan respons sistem $h(t) = h_1(t) * h_2(t)$
c. Gambarkan respons sistem $h(t)$
d. Dapatkan keluaran sistem $y(t) = x(t) * h(t)$
e. Gambarkan keluaran sistem $y(t)$

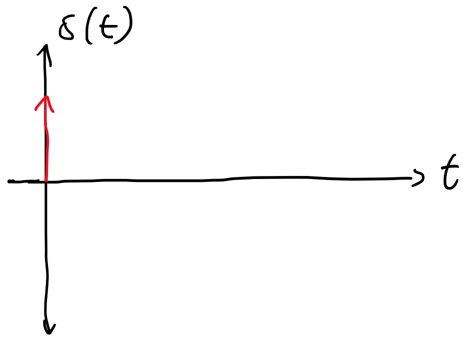
a.



b. $h(t) = h_1(t) * h_2(t)$

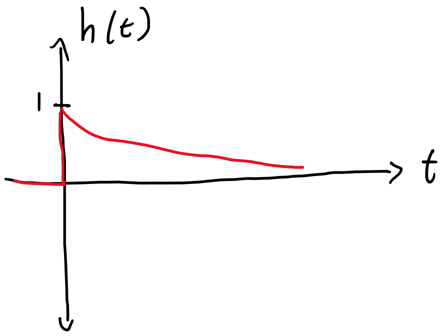
$= e^{-t}u(t) * \delta(t)$



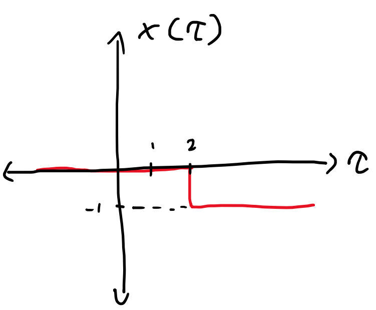


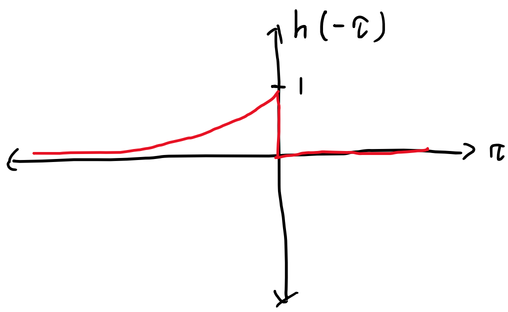
$h(t) = e^{-t}u(t)$

c.

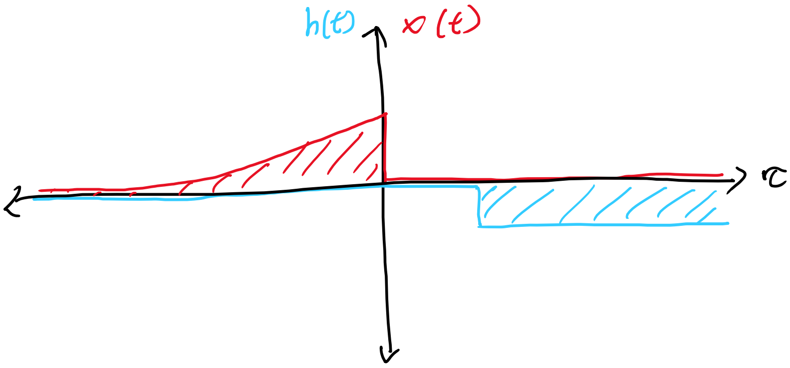


d. $y(t) = x(t) * h(t) = [u(t) - u(t-2)] * [e^{-t}u(t)]$





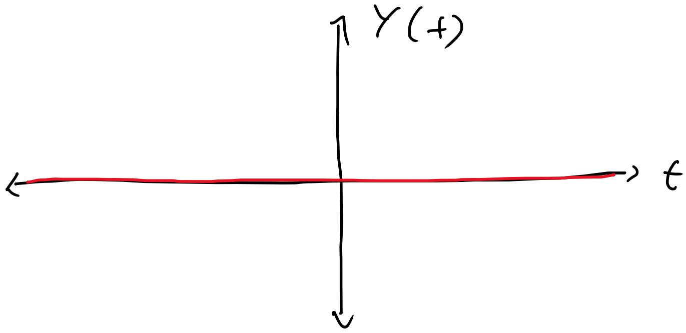
$-\infty < t < \infty$



$$Y(t) = \int_{-\infty}^{\infty} 0 . 0 \, d\tau = 0$$

$Y(t) = 0$

e.



2. Sebuah sistem dengan persamaan differensial:

$$\frac{d^2}{dt^2}\,y(t) + 4\,\frac{d}{dt}\,y(t) + 3\,y(t) = x(t)$$

a. Gambar realisasi sistem dengan menggunakan integrator

b. Tentukan solusi homogen sistem $y^{(h)}(t)$

c. Tentukan solusi partikular (khusus) sistem $y^{(p)}(t)$, bila sistem mendapatkan masukkan $x(t) = \sin(t)$

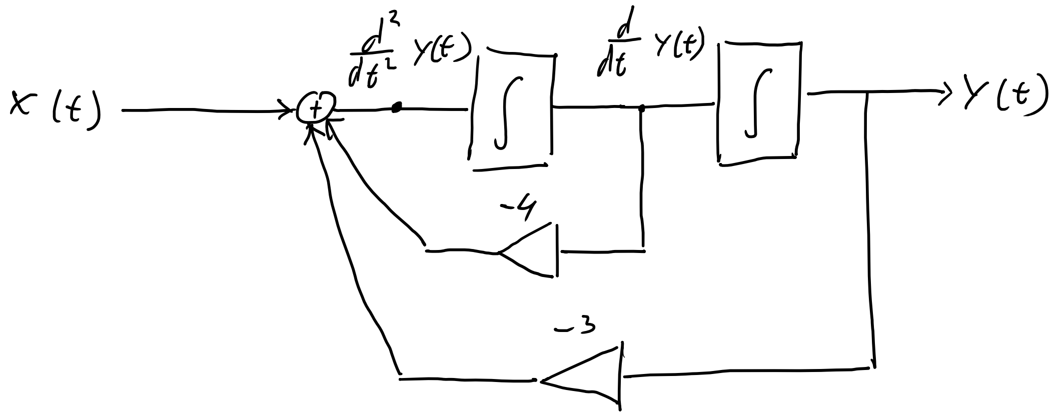
d. Tentukan solusi komplit sistem jika diketahui $y(0) = 0$, $\left.\frac{d}{dt}y(t)\right|_{t=0} = 0$ dan masukkan sistem adalah $x(t) = \sin(t)u(t)$

e. Dapatkan respon frekuensi $H(j\Omega)$!

f. Dapatkan persamaan & gambarkan respon magnitude $|H(j\Omega)|$

g. Dapatkan persamaan & gambarkan respon phase $\text{Arg } H(j\Omega)$

a.



b. $$\frac{d^2}{dt^2} Y(t) + 4\frac{d}{dt} Y(t) + 3\,Y(t) = x(t)$$

$$r^2 + 4r + 3 = 0$$

$$(r+3)(r+1) = 0$$

$$r_1 = -3 \lor r_2 = -1$$

$$Y_h(t) = c_1 e^{r_1 t} + c_2 e^{r_2 t}$$

$$= c_1 e^{-3t} + c_2 e^{-1t}$$

c. $x(t) = \sin(t)$

$$Y_p(t) = A \sin t + B \cos t$$

$$Y_p'(t) = A \cos t - B \sin t$$

$$Y_p''(t) = -A \sin t - B \cos t$$

$$Y_p''(t) + 4Y_p'(t) + 3Y_p(t) = x(t)$$

$$(-A\sin t - B\cos t) + 4(A\cos t - B\sin t) + 3(A\sin t + B\cos t) = \sin t$$

$$(-A - 4B + 3A)\sin t + (-B + 4A + 3B)\cos t = \sin t$$

$$(2A - 4B)\sin t + (4A + 2B)\cos t = \sin t$$

$$\begin{array}{l|l|l} 2A - 4B = 1 & \times 1 & 2A - 4B = 1 \\ 4A + 2B = 0 & \times 2 & 8A + 2B = 0 \end{array} \; +$$

$$10A = 1$$

$$A = 0{,}1 \rightarrow B = -0{,}2$$

$$Y_p(t) = A\sin t + B\cos t$$

$$Y_p(t) = 0{,}1\sin t - 0{,}2\cos t$$

d. $Y(t) = Y_h(t) + Y_p(t)$

$$Y(t) = C_1 e^{-3t} + C_2 e^{-t} + 0{,}1\sin t - 0{,}2\cos t$$

$$Y(0) = 0$$

$$C_1 e^{-3 \cdot 0} + C_2 e^{-0} + 0{,}1\sin 0 - 0{,}2\cos 0 = 0$$

$$C_1 + C_2 + 0 - 0{,}2 = 0$$

$$C_1 + C_2 = 0{,}2$$

$$\frac{d}{dt} Y(t)\Big|_{t=0} = 0$$

$$-3C_1 e^{-3t} - C_2 e^{-t} + 0{,}1\cos t + 0{,}2\sin t\Big|_{t=0} = 0$$

$$-3C_1 - C_2 + 0{,}1 + 0 = 0$$

$$\begin{array}{l} 3C_1 + C_2 = 0{,}1 \\ C_1 + C_2 = 0{,}2 \\ \hline 2C_1 = -0{,}1 \end{array} \; -$$

$$C_1 = -0{,}05 \rightarrow C_2 = 0{,}25$$

$$Y(t) = C_1 e^{-3t} + C_2 e^{-t} + 0{,}1 \sin t - 0{,}2 \cos t$$

$$Y(t) = -0{,}05\, e^{-3t} + 0{,}25\, e^{-t} + 0{,}1 \sin t - 0{,}2 \cos t$$

e.

$$\frac{d^2}{dt^2} Y(t) + 4 \frac{d}{dt} Y(t) + 3\,Y(t) = x(t)$$

$$(j\Omega)^2\, Y(j\Omega) + 4(j\Omega)\, Y(j\Omega) + 3\,Y(j\Omega) = X(j\Omega)$$

$$(-\Omega^2 + 4(j\Omega) + 3)\, Y(j\Omega) = X(j\Omega)$$

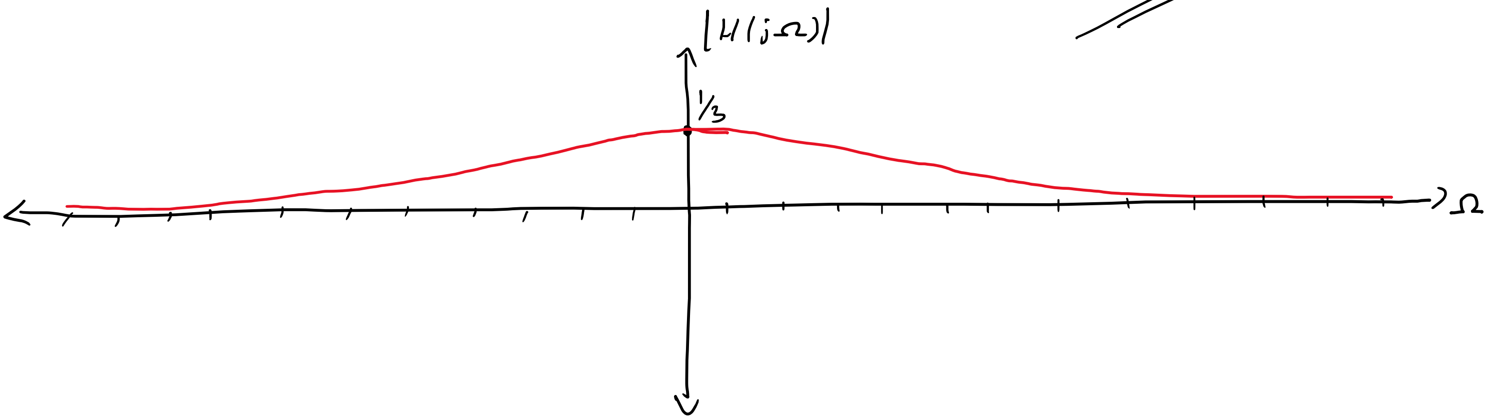
$$\frac{X(j\Omega)}{Y(j\Omega} = 3 - \Omega^2 + 4j\Omega$$

$$H(j\Omega) = \frac{Y(j\Omega)}{X(j\Omega)} = \frac{1}{3 - \Omega^2 + 4j\Omega}$$

f

$$|H(j\Omega)| = \frac{\sqrt{1^2 + 0^2}}{\sqrt{(3-\Omega^2)^2 + (4\Omega)^2}}$$

$$= \frac{1}{\sqrt{9 - 6\Omega^2 + \Omega^4 + 16\Omega^2}} = \frac{1}{\sqrt{\Omega^4 + 10\Omega^2 + 9}}$$



f.

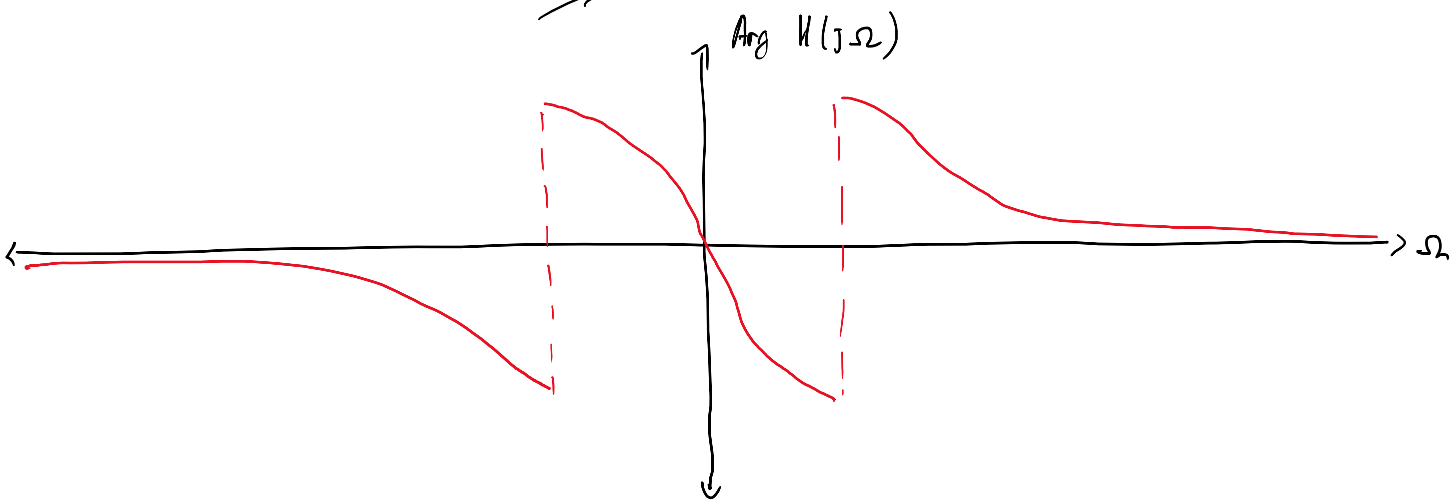
$$H(j\Omega) = \frac{1}{3-\Omega^2+4j\Omega} \times \frac{3-\Omega^2-4j\Omega}{3-\Omega^2-4j\Omega}$$

$$= \frac{3-\Omega^2-4j\Omega}{9-6\Omega^2+\Omega^4+16\Omega^2}$$

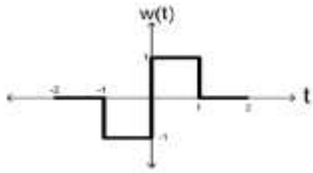
$$= \frac{3-\Omega^2}{\Omega^4+10\Omega^2+9} + j\,\frac{-4\Omega}{\Omega^4+10\Omega^2+9}$$

$$\operatorname{Arg} H(j\Omega) = \tan^{-1}\left(\frac{\operatorname{Im}(H(j\Omega))}{\operatorname{Re}(H(j\Omega))}\right)$$

$$= \tan^{-1}\left(\frac{-4\Omega}{3-\Omega^2}\right)$$



3. Diketahui sinyal $w(t)$ seperti gambar dibawah ini:



a. Tuliskan Persamaan sinyal $w(t)$

b. Jika $x(t) = \sum_{k=-\infty}^{\infty} w(t-4k)$, gambarkan sinyal $x(t)$

c. Dapatkan koefesien deret fourier eksponensial untuk sinyal $x(t)$

d. Koefesien deret fourier trigonometri B[0] untuk sinyal $x(t)$

e. Koefesien deret fourier trigonometri B[k] untuk sinyal $x(t)$

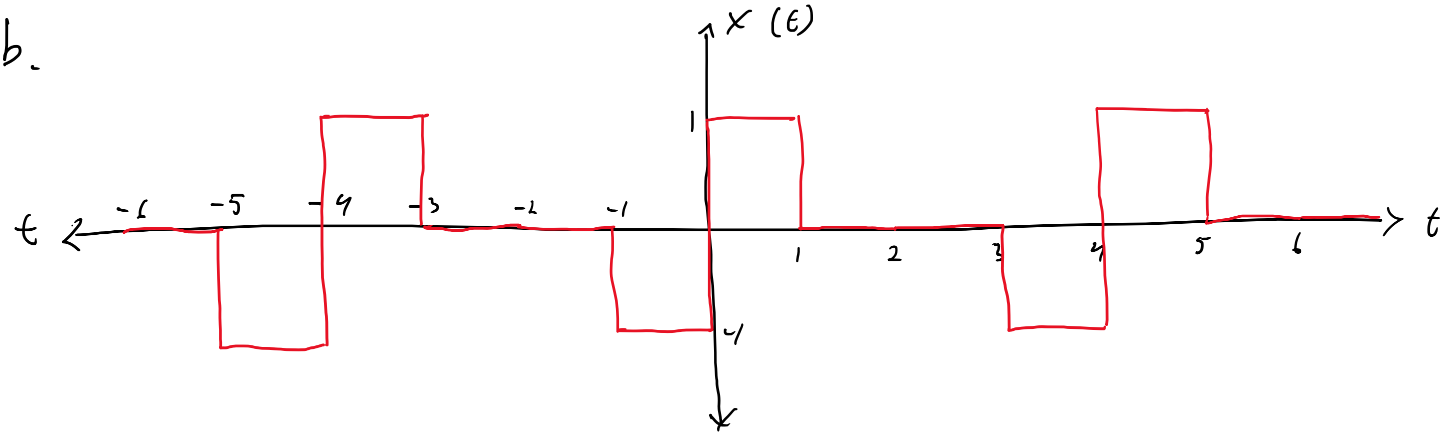
f. Koefesien deret fourier trigonometri A[k] untuk sinyal $x(t)$

g. Persamaan representasi deret fourier trigonometri untuk sinyal $x(t)$

a.

$$w(t) = \begin{cases} 0, & -\infty < t \le -1 \\ -1, & -1 \le t \le 0 \\ 1, & 0 \le t \le 1 \\ 0, & 1 \le t < \infty \end{cases}$$

b.



$$x(t) = \sum_{k=-\infty}^{\infty} w(t-4k)$$

$$\omega = \frac{2\pi}{T} = \frac{2\pi}{4} = \frac{\pi}{2}$$

c.

$$X[k] = \frac{1}{T}\int_0^T x(t).e^{-jk\omega t}\,dt$$

$$= \frac{1}{4}\left[\int_{-1}^{0} -1.e^{-jk\omega t}\,dt + \int_0^1 1.e^{-jk\omega t}\,dt\right]$$

$$= \frac{1}{4}\left[\frac{-1}{-jk\omega}e^{-jk\omega t}\Big|_{-1}^{0} + \frac{1}{-jk\omega}e^{-jk\omega t}\Big|_0^1\right]$$

$$= \frac{1}{4}\left[\left(\frac{1}{jk\omega} - \frac{1}{jk\omega}e^{jk\omega}\right) + \left(\frac{1}{-jk\omega}e^{-jk\omega} - \frac{1}{-jk\omega}\right)\right]$$

$$X[k] = \frac{1}{4jk\omega}\left(2 - e^{jk\omega} - e^{-jk\omega}\right)$$

$$X[k] = \frac{1}{4jk\omega}\left(2-\left(e^{jk\omega}+e^{-jk\omega}\right)\right)$$

$$= -\frac{1}{4jk\omega}\left(2-2\cos(k\omega)\right)$$

$$X[k] = \frac{1-\cos\left(k\frac{\pi}{2}\right)}{2jk\frac{\pi}{2}}$$

d. $B[0] = X[0]$

$$B[0] = \lim_{k\to 0} \frac{1-\cos\left(k\frac{\pi}{2}\right)}{2jk\frac{\pi}{2}}$$

$$B[0] = \lim_{k\to 0} \frac{1}{2j} \cdot \frac{1-\cos\left(k\frac{\pi}{2}\right)}{k\cdot\frac{\pi}{2}}$$

$$B[0] = 0$$

e. $$X[-k] = \frac{1-\cos\left(-k\frac{\pi}{2}\right)}{2j-k\frac{\pi}{2}} = \frac{1-\cos\left(k\frac{\pi}{2}\right)}{-2jk\frac{\pi}{2}} = -X[k]$$

$$B[k] = X[k] + X[-k]$$

$$B[k] = X[k] - X[k]$$

$$B[k] = 0$$

f $$A[k] = j\left(X[k]-X[-k]\right)$$

$$= 2j\left(X[k]\right)$$

$$= \cancel{2}j \cdot \frac{1-\cos\left(k\frac{\pi}{2}\right)}{\cancel{2j}k\frac{\pi}{2}}$$

$$A[k] = \frac{1-\cos\left(k\frac{\pi}{2}\right)}{k\frac{\pi}{2}}$$

9.

$$x(t) = B[0] + \sum_{k=-\infty}^{\infty} \left\{ B[k]\cos(k\omega t) + A[k]\sin(k\omega t) \right\}$$

$$x(t) = 0 + \sum_{k=-\infty}^{\infty} \left\{ 0 + \frac{1-\cos(k\frac{\pi}{2})}{k\frac{\pi}{2}} \cdot \sin(k\frac{\pi}{2}t) \right\}$$

$$x(t) = \sum_{k=-\infty}^{\infty} \left[\frac{1-\cos(k\frac{\pi}{2})}{k\frac{\pi}{2}} \cdot \sin(k\frac{\pi}{2}t) \right]$$