

Blicevi sa 1. Labosa iz SiS-a

1. Nađite temeljni period signala $f(t) = \sin(2t) + \cos(3t + \frac{\pi}{2})$ i matlab kod za skiciranje ovog signala u intervalu $[0, 30]$.

$$\left. \begin{array}{l} \sin(2t) \rightarrow T_1 = \frac{2\pi}{2} = \pi \\ \cos(3t + \frac{\pi}{2}) \rightarrow T_2 = \frac{2\pi}{3} k \rightarrow T_2 = 2\pi \end{array} \right\} T = 2\pi$$

matlab kod: `syms t`
`f = sin(2*t) + cos(3*t + pi/2);`
`ezplot(f, [0,30])`

2. Izračunaj snagu za $f(n) = \sin(\frac{\pi}{3}n + \frac{\pi}{4}) + \cos(\frac{\pi}{5}n - \frac{\pi}{4})$.

Napiši matlab kod za izračun ovo gore.

Handwritten solution for problem 2:

② $f(n) = \sin(\frac{\pi}{3}n + \frac{\pi}{4}) + \cos(\frac{\pi}{5}n - \frac{\pi}{4})$, $P = ?$

$N_1 = \frac{2\pi}{\frac{\pi}{3}} = 6$
 $N_2 = \frac{2\pi}{\frac{\pi}{5}} = 10$ } $N = 30$

$$f(n) = \frac{1}{2j} \left(e^{j\frac{\pi}{3}n} \cdot e^{j\frac{\pi}{4}} - e^{-j\frac{\pi}{3}n} \cdot e^{-j\frac{\pi}{4}} \right) + \frac{1}{2} \left(e^{j\frac{\pi}{5}n} \cdot e^{-j\frac{\pi}{4}} + e^{-j\frac{\pi}{5}n} \cdot e^{j\frac{\pi}{4}} \right)$$

$$= \frac{1}{2} e^{j\frac{\pi}{3}n} \cdot e^{j(\frac{\pi}{4} - \frac{\pi}{2})} + \frac{1}{2} e^{-j\frac{\pi}{3}n} \cdot e^{j(\frac{\pi}{2} - \frac{\pi}{4})} + \frac{1}{2} e^{j\frac{\pi}{5}n} \cdot e^{-j\frac{\pi}{4}} + \frac{1}{2} e^{-j\frac{\pi}{5}n} \cdot e^{j\frac{\pi}{4}}$$

$$P = 4 \left(\left(\frac{1}{2} \right)^2 \right) = \underline{\underline{1}}$$

Matlab kod: `syms n`
`f = sin(pi*n/3 + pi/4) + cos(pi*n/5 - pi/4);`
`P = 1/30*symsum((abs(f))^2, n, 0, 29);`

3. Izračunaj energiju jedne periode za $f(n) = \sin(\frac{\pi}{3}n + \frac{\pi}{4}) + \cos(\frac{\pi}{5}n - \frac{\pi}{4})$.

Napiši matlab kod za izračun ovo gore.

3.

$$\sin\left(\frac{\pi}{3}n + \frac{\pi}{4}\right) \rightarrow N_1 = \frac{2\pi}{\frac{\pi}{3}} = 6 \cdot k_1 \quad \left. \begin{array}{l} k_1 = 5 \\ N = 30 \end{array} \right\}$$

$$\cos\left(\frac{\pi}{5}n - \frac{\pi}{4}\right) \rightarrow N_2 = \frac{2\pi}{\frac{\pi}{5}} = 10 \cdot k_2 \quad \left. \begin{array}{l} k_2 = 3 \end{array} \right\}$$

$$f(n) = \sin\left(\frac{\pi}{3}n + \frac{\pi}{4}\right) + \cos\left(\frac{\pi}{5}n - \frac{\pi}{4}\right) = \frac{1}{2j} \left(e^{j\frac{\pi}{3}n} \cdot e^{j\frac{\pi}{4}} - e^{-j\frac{\pi}{3}n} \cdot e^{-j\frac{\pi}{4}} \right) + \frac{1}{2} \left(e^{j\frac{\pi}{5}n} \cdot e^{-j\frac{\pi}{4}} + e^{-j\frac{\pi}{5}n} \cdot e^{j\frac{\pi}{4}} \right)$$

$$= \left(\frac{1}{2} \cdot e^{j\frac{\pi}{3}n} \cdot e^{j(-\frac{\pi}{2} + \frac{\pi}{4})} + \frac{1}{2} e^{-j\frac{\pi}{3}n} \cdot e^{j\frac{\pi}{4}} \right) + \left(\frac{1}{2} e^{j\frac{\pi}{5}n} \cdot e^{-j\frac{\pi}{4}} + \frac{1}{2} e^{-j\frac{\pi}{5}n} \cdot e^{j\frac{\pi}{4}} \right)$$

$$E = 30 \cdot \left(\left(\frac{1}{2}\right)^2 + \left(\frac{1}{2}\right)^2 + \left(\frac{1}{2}\right)^2 + \left(\frac{1}{2}\right)^2 \right) = \underline{\underline{30}}$$

Matlab kod: `syms n`

`f = sin(pi*n/3 + pi/4) + cos(pi*n/5 - pi/4);`

`E = symsum((abs(f))^2, n, 0, 29);`

4. Izračunaj energiju za $f(t) = \sin(2t) + \cos(3t + \frac{\pi}{3})$.

Napiši matlab kod za izračun ovo gore.

4.

$$\sin(2t) \rightarrow T_1 = \frac{2\pi}{2} = \pi$$

$$\cos\left(3t + \frac{\pi}{3}\right) \rightarrow T_2 = \frac{2\pi}{3} \cdot k = 2\pi \quad \left. \begin{array}{l} T = 2\pi \end{array} \right\}$$

$$f(t) = \frac{1}{2j} \left(e^{j2t} - e^{-j2t} \right) + \frac{1}{2} \left(e^{j3t} \cdot e^{j\frac{\pi}{3}} + e^{-j3t} \cdot e^{-j\frac{\pi}{3}} \right)$$

$$= \left(\frac{1}{2} e^{j2t} \cdot e^{-j\frac{\pi}{2}} + \frac{1}{2} e^{-j2t} \cdot e^{j\frac{\pi}{2}} \right) + \left(\frac{1}{2} e^{j3t} \cdot e^{j\frac{\pi}{3}} + \frac{1}{2} e^{-j3t} \cdot e^{-j\frac{\pi}{3}} \right)$$

$$E = 2\pi \cdot \left(\left(\frac{1}{2}\right)^2 \cdot 4 \right) = \underline{\underline{2\pi}}$$

Matlab kod: `syms t`
`f = sin(2*t) + cos(3*t + pi/3);`
`E = int((abs(f))^2, t, 0, 2*pi)`

5. Pretvori u CTFT signal $f(t) = 2\mu(t) - 2\mu(t-1)$. I matlab kod za to.

⑤

$$F(j\omega) = \int_{-\infty}^{\infty} f(t) \cdot e^{-j\omega t} dt = \int_{-\infty}^{\infty} (2\mu(t) - 2\mu(t-1)) \cdot e^{-j\omega t} dt = 2 \int_0^1 e^{-j\omega t} dt =$$

$$= 2 \cdot \frac{1}{-j\omega} \cdot e^{-j\omega t} \Big|_{t=0}^1 = \frac{2}{\omega} \cdot j (e^{-j\omega} - 1) = \frac{2}{\omega} j (\cos(\omega) - j \sin(\omega) - 1) =$$

$$= \frac{2}{\omega} (\sin(\omega) - j(1 - \cos(\omega))) = \frac{2}{\omega} (\sin \omega - j(\cos^2 \frac{\omega}{2} + \sin^2 \frac{\omega}{2} - (\cos^2 \frac{\omega}{2} - \sin^2 \frac{\omega}{2}))) =$$

Matlab kod: `syms t w`
`F = int(2*exp(-i*w*t), t, 0, 1)`

6. Izračunaj srednju snagu za $f(t) = \sin(2t) + \cos(3t + \frac{\pi}{2})$.
 Napiši matlab kod za izračun ovo gore.

⑥

$$\left. \begin{array}{l} \sin(2t) \rightarrow T_1 = \frac{2\pi}{2} = \pi \\ \cos(3t + \frac{\pi}{2}) \rightarrow T_2 = \frac{2\pi}{3} = \frac{2\pi}{3} \end{array} \right\} T = 2\pi \quad (\text{Trebamo za matlab kod})$$

$$f(t) = \frac{1}{2j} (e^{j2t} - e^{-j2t}) + \frac{1}{2} (e^{j(3t + \frac{\pi}{2})} + e^{-j(3t + \frac{\pi}{2})}) =$$

$$= \frac{1}{2} \cdot e^{j2t} \cdot e^{j\frac{\pi}{2}} + \frac{1}{2} e^{-j2t} \cdot e^{j\frac{\pi}{2}} + \frac{1}{2} e^{j\frac{\pi}{2}} \cdot e^{j3t} + \frac{1}{2} e^{-j3t} \cdot e^{-j\frac{\pi}{2}}$$

$$P = \left(\frac{1}{2}\right)^2 \cdot 4 = 1$$

Matlab kod: `syms t`
`f = sin(2*t) + cos(3*t + pi/2);`
`P = int((abs(f))^2, t, -pi, pi)/(2*pi)`

7. Temeljni period za $x(t) = \sin(\frac{3}{2}t) + \cos(\frac{2}{3}t - \frac{\pi}{3})$? I matlab kod za skiciranje ovog signala na intervalu $[0,60]$.

7.

$$\sin\left(\frac{3}{2}t\right) \rightarrow T_1 = \frac{2\pi}{\frac{3}{2}} = \frac{4\pi}{3}$$

$$\cos\left(\frac{2}{3}t - \frac{\pi}{3}\right) \rightarrow T_2 = \frac{2\pi}{\frac{2}{3}} = 3\pi$$

$$\left. \begin{array}{l} T_1 = \frac{4\pi}{3} \\ T_2 = 3\pi \end{array} \right\} \boxed{T = 12\pi}$$

Matlab kod: `syms t`
`x = sin(3*t/2) + cos(2*t/3 - pi/3);`
`ezplot(X,[0,30])`

8. Temeljni period za $f(n) = \sin(\frac{\pi}{3}n + \frac{\pi}{4}) + \cos(\frac{\pi}{5}n - \frac{\pi}{3})$? I matlab kod za skiciranje ovog signala na intervalu $[0,30]$.

8.

$$\cos\left(\frac{\pi}{3}n + \frac{\pi}{4}\right) \rightarrow N_1 = \frac{2\pi}{\frac{\pi}{3}} = 6$$

$$\sin\left(\frac{\pi}{5}n - \frac{\pi}{3}\right) \rightarrow N_2 = \frac{2\pi}{\frac{\pi}{5}} = 10$$

$$\left. \begin{array}{l} N_1 = 6 \\ N_2 = 10 \end{array} \right\} \boxed{N = 30}$$

Matlab kod: `syms n`
`n=[0:1:30];`
`x = cos(pi*n/3 + pi/4) + sin(pi*n/5 - pi/3);`
`stem(x)`

9. CTFT od $f(t) = \mu(t) - \mu(t-2)$. I matlab kod za to.

9.

$$F(j\omega) = \int_{-\infty}^{\infty} f(t) e^{-j\omega t} dt = \int_0^2 e^{-j\omega t} dt = \frac{1}{-j\omega} \cdot e^{-j\omega t} \Big|_0^2 = \frac{1}{\omega} j (\cos(2\omega) - j \sin(2\omega) - 1) =$$

$$= \frac{1}{\omega} (\sin(2\omega) + j \cos(2\omega) - j) = \frac{1}{\omega} (2 \sin(\omega) \cos(\omega) + j \cos^2(\omega) - j \sin^2(\omega) - j \cos^2(\omega) + j \sin^2(\omega))$$

$$= \frac{1}{\omega} (2 \sin(\omega) \cos(\omega) - 2j \sin^2(\omega)) = \underline{\underline{\frac{2 \sin(\omega)}{\omega} (\cos(\omega) - j \sin(\omega))}}$$

Matlab kod: `syms t w`
`F = int(exp(-i*w*t), t, 0, 2)`