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$\boxed{3.1-6a}$

1) $f_1(n)\cos^2\left(\frac{\pi n}{4}\right)$ $\qquad \left| \cos^2 x = \frac{1}{2}(1+\cos 2x) \right|$

$$f_1(n)=\cos^2\left(\frac{\pi}{4}n\right) = \frac{1}{2}\left(1+\cos\left(2\cdot\frac{\pi}{4}n\right)\right) = \frac{1}{2}\left(1+\cos\frac{\pi}{2}n\right) = \frac{1}{2}+\frac{1}{2}\cos\left(\frac{\pi}{2}n\right)$$

$$f_1(n)=f_1(n+N)$$

$$\frac{1}{2}+\frac{1}{2}\cos\left(\frac{\pi}{2}n+\frac{\pi}{2}N\right) \Rightarrow \quad \frac{\cancel{\pi}}{2}N = 2k\cancel{\pi} \qquad N=4k \qquad k=1 \qquad \boxed{N=4} \quad \text{PERIODIČAN}$$

2) $f_2(n) = n\sin\left(\frac{\pi}{4}n\right)$

$$f_2(n)\overset{?}{=}f_2(n+N) \qquad (n+N)\sin\left(\frac{\pi}{4}n+\frac{\pi}{4}N\right) \quad - \text{ NIJE PERIODIČAN}$$

(jednakost vrijedi samo za $N=0$ X)

3) $f_3(n) = \cos\left(\frac{\pi}{8}n^2\right)$

$$f_3(n+N) = \cos\left[\frac{\pi}{8}(n+N)^2\right] = \cos\left[\frac{\pi}{8}n^2 + \underbrace{\frac{\pi}{4}nN + \frac{\pi}{8}N^2}\right]$$

$$\frac{\cancel{\pi}}{4}nN + \frac{\cancel{\pi}}{8}N^2 = 2k\cancel{\pi}$$

$$k = \frac{1}{8}nN + \frac{1}{16}N^2 = \frac{N(N+2n)}{16}$$

za $\boxed{N=8}$ – k će biti cijeli broj

PERIODIČAN

$\boxed{3.1-8c}$

$x_1(t) = \cos\left(\frac{\pi}{5}t\right)$

$x_2(t) = \sin\left(\frac{\pi}{5}t\right)$

$$E_1 = \int_{-\infty}^{\infty}\left|\cos\left(\frac{\pi}{5}t\right)\right|^2 dt = \frac{1}{2}\int_{-\infty}^{\infty}\left(1+\cos\left(\frac{2\pi}{5}t\right)\right)dt =$$

$$= \frac{1}{2}\int_{-\infty}^{\infty}dt + \frac{1}{2}\int_{-\infty}^{\infty}\cos\left(\frac{2\pi}{5}t\right)dt =$$

$$= \lim_{T\to\infty}\left[\frac{1}{2}t\Big|_{-T}^{T} + \frac{5}{4\pi}\sin\left(\frac{2\pi}{5}t\right)\Big|_{-T}^{T}\right] = \lim_{T\to\infty}\left[T + \frac{5}{4\pi}\cdot 2\underbrace{\sin\left(\frac{2\pi T}{5}\right)}_{\in[-1,1]}\right] = \infty$$

$$E_2 = \int_{-\infty}^{\infty}\sin^2\left(\frac{\pi}{5}t\right)dt = \frac{1}{2}\int_{-\infty}^{\infty}\left(1-\cos\left(\frac{2\pi}{5}t\right)\right)dt =$$

$$= \frac{1}{2}\int_{-\infty}^{\infty}dt - \frac{1}{2}\cdot\frac{5}{2\pi}\sin\left(\frac{2\pi}{5}t\right)\Big|_{-\infty}^{\infty} = \infty$$

$$P_1 = \lim_{T\to\infty}\frac{1}{2T}\int_{-T}^{T}\cos^2\left(\frac{\pi}{5}t\right)dt = \lim_{T\to\infty}\frac{1}{2T}\left[\frac{1}{2}T+\frac{1}{2}T+\frac{5}{4\pi}\cdot 2\underbrace{\sin\left(\frac{2\pi T}{5}\right)}_{\in[-1,1]}\right]$$

$$\boxed{P_1 = \frac{1}{2}}$$

$$P_2 = \lim_{T\to\infty}\frac{1}{2T}\int_{-T}^{T}\sin^2\left(\frac{\pi}{5}t\right) =$$

$$= \lim_{T\to\infty}\frac{1}{2T}\left[\frac{1}{2}(T+T) - \frac{5}{4\pi}2\sin\left(\frac{2\pi T}{5}\right)\right]$$

$$\Rightarrow \boxed{P_2 = \frac{1}{2}}$$

asistent's pitanje

$$200\sin(50\pi t) = 200\cdot\frac{1}{2j}\left(e^{j50\pi t} - e^{-j50\pi t}\right)$$

$$= \frac{100}{j}\cdot e^{j50\pi t} - \frac{100}{j}e^{-j50\pi t} = \underbrace{100\, e^{j\frac{3\pi}{2}}}_{X_1}e^{j50\pi t} + \underbrace{100\, e^{j\frac{\pi}{2}}}_{X_{-1}}e^{-j50\pi t}$$

$$E = \int_{-\infty}^{\infty}|y(t)|^2 dt$$

$$P = \lim_{T\to\infty}\frac{1}{2T}E$$

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$\boxed{3.2-1a}$

4. $x_1(t) = 220\sin(100\pi t) = 220\cdot\frac{1}{2j}\left[e^{j100\pi t} - e^{-j100\pi t}\right] =$

$\omega_0 = 100\pi$

$T_0 = \frac{1}{50}$

$$= \frac{110}{j}e^{j100\pi t} - \frac{110}{j}e^{-j100\pi t} =$$

$$= -110j\, e^{j(1)\cdot 100\pi t} + 110j\, e^{j(-1)100\pi t} =$$

$$= \underbrace{110\cdot e^{j\frac{3\pi}{2}}}_{X_1}\cdot e^{j(1)100\pi t} + \underbrace{110\, e^{j\frac{\pi}{2}}}_{X_{-1}}\cdot e^{j(-1)100\pi t}$$

$X_1 = 110\cdot e^{j\frac{3\pi}{2}}$ $\qquad |X_1| = 110 \qquad \sphericalangle X_1 = \frac{3\pi}{2}$

$X_{-1} = 110\cdot e^{j\frac{\pi}{2}}$ $\qquad |X_2| = 110 \qquad \sphericalangle X_2 = \frac{\pi}{2}$ $\qquad X_k = 0 \ \forall$ drugi k

5. $x_2(t) = 220\sin(100\pi t) + 50\cos\left(300\pi t + \frac{\pi}{3}\right) =$ $\qquad |\ \omega_0 = 100\pi\ |$

$$= 220\cdot\frac{1}{2j}\left(e^{j100\pi t} - e^{-j100\pi t}\right) + 50\frac{1}{2}\left(e^{j\frac{\pi}{3}}\cdot e^{j300\pi t} + e^{-j\frac{\pi}{3}}e^{-j300\pi t}\right) =$$

$$= \underbrace{-110j}_{X_1}\cdot e^{j(1)100\pi t} + \underbrace{110j}_{X_{-1}}e^{j(-1)100\pi t} + \underbrace{\frac{50}{2}e^{j\frac{\pi}{3}}}_{X_3}e^{j(3)100\pi t} + \underbrace{\frac{50}{2}e^{-j\frac{\pi}{3}}}_{X_{-3}}e^{j(-3)100\pi t} =$$

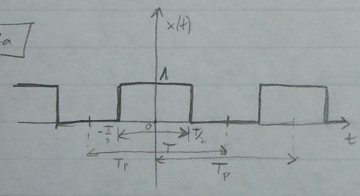
$X_1 = 110\, e^{j\frac{3\pi}{2}}$

$X_{-1} = 110\, e^{j\frac{\pi}{2}}$ $\qquad X_k = 0 \ \forall$ drugi k

$X_3 = 25\, e^{j\frac{\pi}{3}}$

$X_{-3} = 25\, e^{j(-\frac{\pi}{3})}$

$\boxed{3.2-2a}$



$$X_k = \frac{1}{T_p}\int_{-\frac{T}{2}}^{\frac{T}{2}}1 e^{-jk\omega_0 t}dt = \frac{1}{T_p}\frac{1}{-jk\omega_0}e^{-jk\omega_0 t}\Big|_{-\frac{T}{2}}^{\frac{T}{2}} =$$

$$= \frac{1}{-jk\omega_0 T_p}\left[e^{-jk\omega_0\frac{T}{2}} - e^{jk\omega_0\frac{T}{2}}\right] =$$

$$= \frac{1}{jk\omega_0 T_p}\left[e^{jk\omega_0\frac{T}{2}} - e^{-jk\omega_0\frac{T}{2}}\right]\cdot\frac{2}{2} = \frac{\cancel{2}}{k\omega_0 T_p}\sin\left(k\omega_0\frac{T}{2}\right)\cdot\frac{\frac{T}{2}}{\frac{T}{2}} =$$

$$= \frac{T}{T_p}\mathrm{sinc}\left(k\omega_0\frac{T}{2}\right) = \frac{T}{T_p}\mathrm{sinc}\left(k\pi\frac{T}{T_p}\right)$$

$$\omega_0 = \frac{2\pi}{T_p}$$

$$P_X = \sum_{k=-\infty}^{\infty}|X_k|^2 = \frac{T^2}{T_p^2}\sum_{k=-\infty}^{\infty}\mathrm{sinc}^2\left(k\pi\frac{T}{T_p}\right)$$

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