

Exame normal 2023 (apenas em 2ª frequência)

4)

$$X_{FT}(\omega) = \begin{cases} 0, & \omega < -30\pi \vee \omega > 30\pi \\ 1 - \left| \frac{\omega}{2\pi} \right|, & -30\pi \leq \omega \leq 30\pi \end{cases}$$

a) $\omega_{\max} = 30\pi$ $\omega = 2\pi f \Leftrightarrow 15 = f$

b) $\omega_d > 2\omega_{\max}$
 $\omega_d > 60\pi$

c) $C_m = x e^{j\theta}$

$f_d = 40 \text{ Hz}$ $N = 200$

$\omega_d = 2\pi f_d = 2\pi \cdot 40 = 80\pi \text{ rad/s}$

$X_{DFT}[n] = f_d X_{FT}\left(n \frac{\omega_d}{N}\right)$

$X_{DFT}[0] = 40 X_{FT}(0) = 40$

$X_{DFT}[1] = 40 \times \frac{4}{5} = 32$

$X_{DFT}[2] = 40 \times \frac{3}{5} = 24$

5) a) $f_d = 2 \text{ kHz}$

Solust = 415 Hz

$\Delta t = 200 \text{ ms} = 0,2 \text{ s}$

$\Delta f = \frac{1}{\Delta t} = \Delta f = \frac{1}{0,2} = 5$

$K = \frac{415}{5} \approx 83$

b) 10ª janela

$N = f_d \Delta t = 2000 \times 0,2 = 400$

$9N \leq n < 10N \Leftrightarrow$

$3600 \leq n < 4000$

$C_{-9} = 1$, $C_{-4} = 0,5j$, $C_0 = 1$, $C_4 = -0,5j$ e $C_9 = 1$

$C_9 = 2 |c_9| = 2 \times 1 = 2$ $\theta_9 = 2\pi$

$C_4 = 2 |c_4| = 2 |0,5j| = 1$ $\theta_4 = -\frac{\pi}{2}$

$C_0 = 1$ $\theta_0 = 2\pi$

$\omega_0 = \frac{2\pi}{N} = \frac{2\pi}{400} = \frac{\pi}{200}$

$\sum_{m=0}^{\infty} C_m \cos(m\omega_0 t + \theta_m) \Leftrightarrow$

$\Leftrightarrow 1 \cos(2\pi t) + 1 \cos\left(4\frac{\pi}{200} t - \frac{\pi}{2}\right) + 2 \cos\left(9\frac{\pi}{200} t + 2\pi\right) \Leftrightarrow$

$\Leftrightarrow 1 + \cos\left(\frac{\pi}{50} t - \frac{\pi}{2}\right) + 2 \cos\left(\frac{9\pi}{200} t\right)$

6)

$f_d = 1000 \text{ Hz}$

nível 3

duração = $\frac{1000}{2048} = \frac{125}{256} \times \frac{1}{4} = \frac{125}{1024}$
 $N = 2048$

n	0-511	512-1023	1024-1535	1536-2047
A partir de d3:	$f \in [61,9, 125] \text{ Hz}$, $C = 2$	$f \in [61,9, 125] \text{ Hz}$, $C = 1$		
A partir de a3:	$f = 49,12 \text{ Hz}$, $C = 1$	$f = 40,96 \text{ Hz}$, $C = 1$	$f = 0 \text{ Hz}$, $C = 1$ $f = 16,39 \text{ Hz}$, $C = 1$	$f = 0 \text{ Hz}$, $C = -1$ $f = 32,78 \text{ Hz}$, $C = 1$

$6 \times \frac{125}{2048}$

$5 \times \frac{1024}{125}$

$2 \times \frac{1024}{125}$

$4 \times \frac{1024}{125}$



