Época Normal 2020

⑥ $$X_{DTFT}(\omega) = \sum_{q=-\infty}^{+\infty} \begin{cases} 0, & \omega < (20\pi q - 6\pi) \vee \omega > (20\pi q + 6\pi) \\ \dfrac{(\omega - 20\pi q - 10\pi)(\omega - 20\pi q + 10\pi)}{2\pi^2}, & \text{otherwise} \end{cases}$$

a)
$$T_s\, X_{DTFT}(\omega) = \sum_{k=-\infty}^{+\infty} X_{FT}\left(\omega - k\frac{2\pi}{T_s}\right)$$

$$\Rightarrow -\frac{k\,2\pi}{T_s} = -20\pi k$$

$$\Rightarrow T_s = \frac{1}{10} \qquad f_s = 10\,Hz$$

b) $$C_0 = \frac{X_{FT}(0)}{T_0} \times T_s \qquad \Omega_0 = \frac{2\pi}{N} \Leftrightarrow N = \frac{2\pi}{\frac{\pi}{5}} \Leftrightarrow N = 10$$

$$\Rightarrow C_0 = \frac{(-10\pi)(10\pi)}{2\pi^2} \times T_s \qquad 10 = \frac{T_0}{T_s} \Leftrightarrow \frac{10}{10} = T_0 \Rightarrow T_0 = 1\,s$$

$$= -\frac{50}{10} = -5$$

c) Passa-Banda

⑦ $f_1 = 2000\ Hz$ Mi (330 Hz) Lá (440 Hz)

a) $f_k = k \cdot \Delta f$ $\quad \Delta f = \frac{f_1}{N}$

$\Rightarrow f_k = \frac{k}{t_{janela}}$ $\quad \Rightarrow \Delta f = \frac{2000}{2000 \cdot t_{janela}} = \frac{1}{t_{janela}}$

$330 = \frac{k}{t_{janela}} \Rightarrow$ $330 = 31k$ ✓ $\quad 440 = 31k$ ✗

$330 = 151k$ ✓ $\quad 440 = 151k$ ✗

$330 = 20k$ ✗ $\quad 440 = 20k$ ✓

$330 = 22{,}1k$ ✓ $\quad 440 = 22{,}1k$ ✓

R: $\frac{1}{22}$ s

b) $\Delta t = 0{,}25\ s$

$N = t_{janela} \times f_1 = 0{,}25 \times 2000 = 500$

$\Omega_0 = \frac{2\pi}{500} = \frac{\pi}{250}$ rad $\quad k = 3{,}5$

c) $X_{DFT}[k] = -250j\,\delta[k+5] - 500\,\delta[k+3] - 500\,\delta[k-3] + 250j\,\delta[k-5]$

$x[n] = \sum_{m=0}^{M} C_m \cos(m\Omega_0 n + \theta_m) = C_3 \cos(3\Omega_0 n + \theta_3) +$

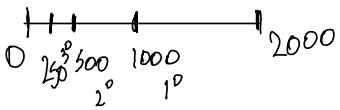
$C_5 \cos(5\Omega_0 n + \theta_5)$

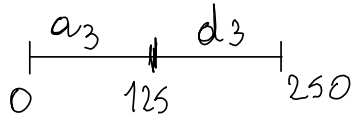
$c_3 = \frac{X[3]}{500} = -\frac{500}{500} \rightarrow C_3 = 2|c_3| = -2$, $\theta_3 = \pi$

Substituir

$c_5 = \frac{250j}{500} = \frac{j}{2} \rightarrow C_5 = 1$, $\theta_5 = \pi/2$

⑧- $f_1 = 2000\,Hz$



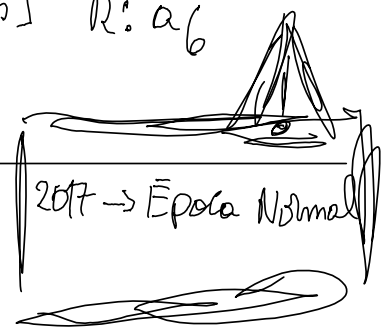


d_3	$f \in [125, 250]$ $C = 2$		$f \in [125, 250]$ $C = 1$	
a_3	$f = 0Hz, C = 1$	$f = 0Hz, C = 1$ $f = 8Hz, C = 2$	$f = 0$ $C = 2$	$f = 0Hz, C = 3$ $f = 1Hz$ $C = 1$

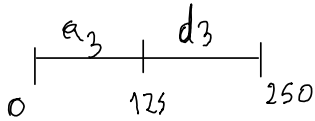
b)

$a_4 \rightarrow [0; 62,5]$ $a_6 \rightarrow [0; 15,625]$ R: a_6

$a_5 \rightarrow [0; 31,25]$ $a_7 \rightarrow [0;$

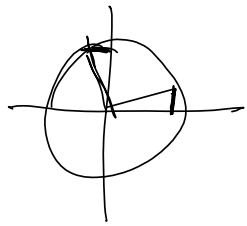


$f_1 = 2000Hz$ $\left[0, \frac{2000}{2^3}\right] = [0, 250]$



d_3	$f \in [125, 250[$ $C = 3$		$f \in [125, 250[$ $C = 2$	
a_3	$f = 0Hz, C = 2$ $f = 16Hz, C = 1$	$f = 12Hz$ $C = 2$	$f = 0Hz$ $C = 2$	$f = 0Hz, C = 2$ $f = 20Hz, C = 2$

Teste 3
2016/2017



① [a]

② $x[n] = \cos[0] + 2\cos[0{,}05\pi n] + \cos[0{,}09\pi n]$

$\Omega_0 = mdc(0; 0{,}05\pi; 0{,}09\pi) = 0{,}01\pi$

$\Omega_0 = \frac{2\pi}{N} \Rightarrow N = \frac{2\pi}{0{,}01\pi} = 2 \times 100 = 200$ amostras

③ $N = 80$ $\quad m = 3, 7$

$X_{DFT}[3] = -X_{DFT}[-3] = 80j$

$X_{DFT}[7] = X_{DFT}[-7] = -160$

$\Omega_0 = \frac{2\pi}{N} = \frac{2\pi}{80} = \frac{\pi}{40}$

$$x[n] = \sum_{m=0}^{M} C_m \cos(\Omega_0 m n + \theta_m)$$

Substituir

$$= C_3 \cos\left(\frac{3\pi}{40} n + \theta_3\right) + C_7 \cos\left(\frac{7\pi}{40} n + \theta_7\right)$$

$c_3 = \frac{X[3]}{80} = \frac{80j}{80} = j \rightarrow C_3 = 2|c_3| = 2$, $\theta_3 = \pi/2$

$c_7 = \frac{X[7]}{80} = -\frac{160}{80} = -2 \rightarrow C_7 = 2|c_7| = 4$, $\theta_7 = \pi$

④ $T_{total} = 0{,}5\,s$ $\quad N = f_s \cdot T_{total} = 500$ amostras

$f_s = 1000\,Hz$ $\quad f_k = k \cdot \Delta f \Rightarrow f_{24} = 24 \times 2 = 48\,Hz$ //

$\Delta f = \frac{f_s}{N} = \frac{1000}{500} = 2$

⑤ Falso → Para baixo, banda de transição deve ser estreita, zona de passagem plana

⑥ V

⑦ A res. temporal diminui, espectral aumenta?

⑧ $f_s = 1000\,Hz$

$N = t_{janela} \times f_s$

$= 0{,}160 \times 1000$

$= 160$

$Amp = \frac{|DFT|}{N}$

$= \frac{160}{160} = 1$ //

Exame Época Normal 2017

⑤ $X_{FT}(\omega) = \begin{cases} 0, & \omega < -12\pi \vee \omega > 12\pi \\ \frac{(\omega+8\pi)(\omega-8\pi)}{4\pi^2}, & -12\pi \leq \omega \leq 12\pi \end{cases}$

a) $X_{DTFT}[10\pi] = 180 \quad X_{FT}(10\pi) = \frac{18\pi \times 2\pi}{4\pi^2} = \frac{36\pi^2}{4\pi^2} = 9$

$f_s = ? \qquad f_1 = \frac{180}{9} = 20\,Hz$ //

$T_0 = N \times T_s = 1$

b) $f_1 = 40\,Hz \quad \Omega_0 = \frac{\pi}{20}\,rad \quad T_s = \frac{1}{40} \quad N = \frac{2\pi}{\frac{\pi}{20}} = 40$

$c_5 = \frac{1}{1} X_{FT}(10\pi) = 9 \qquad C_5 = 2|c_5| = 18$

c) Passa baixo.

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⑥ $f_s = 4000\,Hz \quad Ré(294Hz) \quad Mi(330Hz)$

a)

294	2
147	3
49	7
7	7
1	

330	2
165	3
55	5
11	11
1	

$294 = 2 \times 3 \times 7^2$

$330 = 2 \times 3 \times 5 \times 11$

$mdc = 6\,Hz$

$\Delta f = 6\,Hz$

R: 1/6 1

b) $t_{janela} = 0{,}25\,s$ $\Delta f = 2\,Hz$ // ← target

$$\Delta f = \frac{f_1}{N} = \frac{4000}{N}$$

$$N = t_{janela} \times f_1$$

$$= 0{,}25 \times 4000$$

$$= 1000$$

$$\Rightarrow \frac{4000}{(1000 + x)} = 2$$

$$\Leftrightarrow 4000 = 2000 + 2x$$

R: Padding com 1000 zeros.

$$\Leftrightarrow x = 1000$$

(7)

0 - 125 - 250

$f_s = 2000\,Hz$

$$\left[0, \frac{2000}{2^3}\right] = [0, 250]$$

	0-499	500 - 999	1000-1499	
d_3	$f \in [125, 250]$ $C = 3$		$f \in [125, 250]$ $C = 2$	
R_3	$f = 0, C = 2$ $f = 16Hz, C = 1$	$f = 12Hz$ $C = 2$	$f = 0\,Hz$ $C = 2$	$f = 0\,Hz, C = 2$