PTC2324: Processamento Digital de Sinais I

Respostas: Lista de exercícios 4

MDM,FRMP-2014

1. (a) $\pi e^{-j\frac{\pi}{4}}\delta\left(\omega - \frac{\pi}{3}\right) + \pi e^{j\frac{\pi}{4}}\delta\left(\omega + \frac{\pi}{3}\right)$

   (b) $4\pi\delta(\omega) + \pi e^{j\frac{\pi}{8}}\delta\left(\omega - \frac{\pi}{6}\right) + \pi e^{-j\frac{\pi}{8}}\delta\left(\omega + \frac{\pi}{6}\right)$

2. $x(n) = 1 + \cos(\frac{\pi}{2}n)$

3. $\omega_c = \dfrac{3\pi}{4}$ rad

4. (b)   i. $y(n) = 0$

   ii. $y(n) = \dfrac{\sin\left(\frac{\pi}{2}n\right)}{2\pi n} + \dfrac{\cos\left(\frac{\pi}{2}n\right) - 1}{\pi^2 n^2}$

   iii. $y(n) = \dfrac{\sin\left(\frac{\pi}{2}n\right)}{\pi^2 n^2} - \dfrac{\cos\left(\frac{\pi}{2}n\right)}{2\pi n}$

   iv. $y(n) = 2\left(\dfrac{\sin\left(\frac{\pi}{4}n\right)}{\pi n}\right)^2$

   v. $y(n) = \dfrac{1}{4}\dfrac{\sin\left(\frac{\pi}{2}n\right)}{\pi n}$

5. $h(n) = \dfrac{1 - \cos(\pi n)}{\pi n} = \dfrac{2\sin^2\left(\frac{\pi}{2}n\right)}{\pi n} = \begin{cases} 0, & \text{se } n \text{ é par} \\ \frac{2}{\pi n}, & \text{se } n \text{ é ímpar} \end{cases}$

6. (a) $g(n)$ corresponde a um filtro passa-altas com faixa de passagem $\pi - \omega_c < |\omega| < \pi$.

   (b) $y(n) = \displaystyle\sum_{k=1}^{p}(-1)^k a(k)y(n-k) + \sum_{k=0}^{q}(-1)^k b(k)x(n-k)$

7. (a) $h(n) = (-1)^n \dfrac{\sin\left(\frac{\pi}{4}n\right)}{\pi n}$

   (b) Para $-\pi \leq \omega < \pi$, temos $H_1(e^{j\omega}) = \begin{cases} \frac{1}{2}, & \text{se } |\omega| < \frac{\pi}{2} \\ 0, & \text{caso contrário} \end{cases}$

8. (a) $X_1(e^{j\omega}) = \dfrac{8e^{j\omega 3}}{1 - \frac{1}{2}e^{-j\omega}}$

   (b) $X_2(e^{j\omega}) = \dfrac{\alpha\sin(\omega_o)e^{-j\omega}}{1 - 2\alpha\cos(\omega_o)e^{-j\omega} + \alpha^2 e^{-j\omega 2}}$

   (c) $X_3(e^{j\omega}) = \dfrac{1}{1 - \frac{1}{4}e^{-j\omega 2}}$

9. $x(n) = \dfrac{\sin\left(\frac{3\pi}{4}n\right) - \sin\left(\frac{\pi}{4}n\right)}{\pi n}$

10. $h(n)$ corresponde a um filtro passa-altas com faixa de passagem $\frac{\pi}{3} < |\omega| < \pi$.

11. $H(e^{j\omega}) = \dfrac{e^{-j\omega} + 3e^{-j\omega 2} + 2e^{-j\omega 3}}{2 - e^{-j\omega 2}}$