Gabarito PCOM 1ºEE 2017.1 **P01**

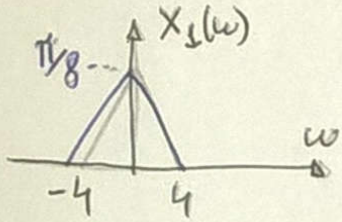
01

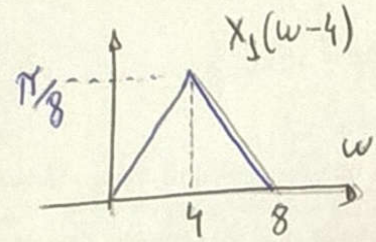
a) $\text{sinc}(Wt) \overset{\mathcal{F}}{\longleftrightarrow} \frac{\pi}{W}\Pi\left(\frac{\omega}{W}\right)$. Se $x_1(t) = \text{sinc}^2(2t)$ ∴

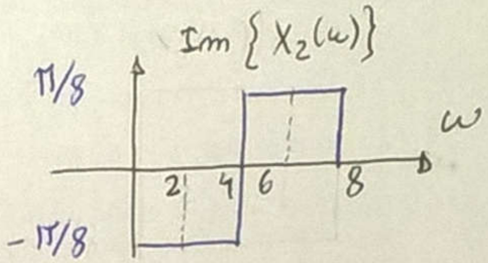
$$X_1(\omega) = \frac{1}{2\pi}\left(\frac{\pi}{2}\Pi\left(\frac{\omega}{2}\right)\right) * \left(\frac{\pi}{2}\Pi\left(\frac{\omega}{2}\right)\right) = \frac{\pi}{8}\Lambda\left(\frac{\omega}{4}\right) = \frac{\pi}{8}\cdot\begin{cases} 1+\omega/4, & -4 \le \omega < 0 \\ 1-\omega/4, & 0 \le \omega \le 4 \\ 0, & \text{c.c.}\end{cases}$$

b) Desde que $jt\,x(t) \overset{\mathcal{F}}{\longleftrightarrow} \frac{d}{d\omega}X(\omega)$ e $x(t)e^{j\omega_0 t} \overset{\mathcal{F}}{\longleftrightarrow} X(\omega-\omega_0)$

$$X_2(\omega) = -j\frac{d}{d\omega}X_1(\omega-4) = -\frac{j\pi}{8}\left(\Pi\left(\frac{\omega}{2}-2\right) - \Pi\left(\frac{\omega}{2}-6\right)\right)$$







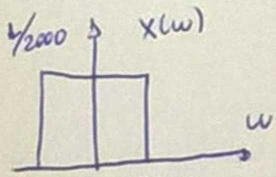
02

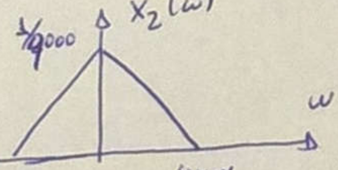
a) se $x(t) = \text{sinc}(2000\pi t)$, então $X(\omega) = \frac{1}{2000}\Pi\left(\frac{\omega}{2000\pi}\right)$

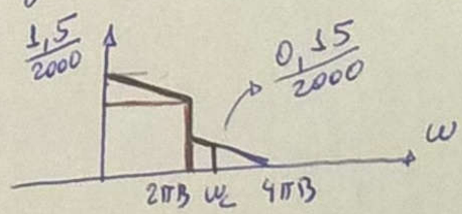
A largura de banda de $X(\omega)$ é $B_1 = 1\,KHz$

$$y(t) = \text{sinc}(2000\pi t) + \frac{1}{2}\text{sinc}^2(2000\pi t)$$

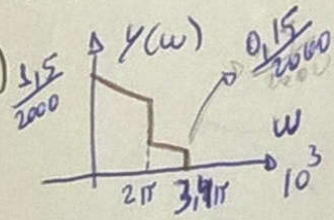
A largura de banda de $x^2(t)$ é $B_2 = 2\,KHz$; $X_2(\omega) = \frac{1}{2}X(\omega) * X(\omega)$







b)



A reta da parte direita de $X_2(\omega)$ é

$$X_2(\omega) = \frac{-1}{8\pi\cdot 10^6}\cdot\omega + \frac{1}{2\cdot 10^3}$$

$$\frac{-\omega_c}{8\pi\cdot 10^6} + \frac{1}{2\cdot 10^3} = \frac{0,15}{2\cdot 10^3} \Rightarrow \frac{\omega_c}{8\pi\cdot 10^6} = \frac{0,85}{2\cdot 10^3}$$

$$\omega_c = 4\pi\cdot 0,85\cdot 10^3 \text{ rad/s} = 2\pi\cdot 1,7\cdot 10^3 \text{ rad/s}$$

sua largura de banda será

$$\boxed{B = 1,7\,KHz}$$ a)

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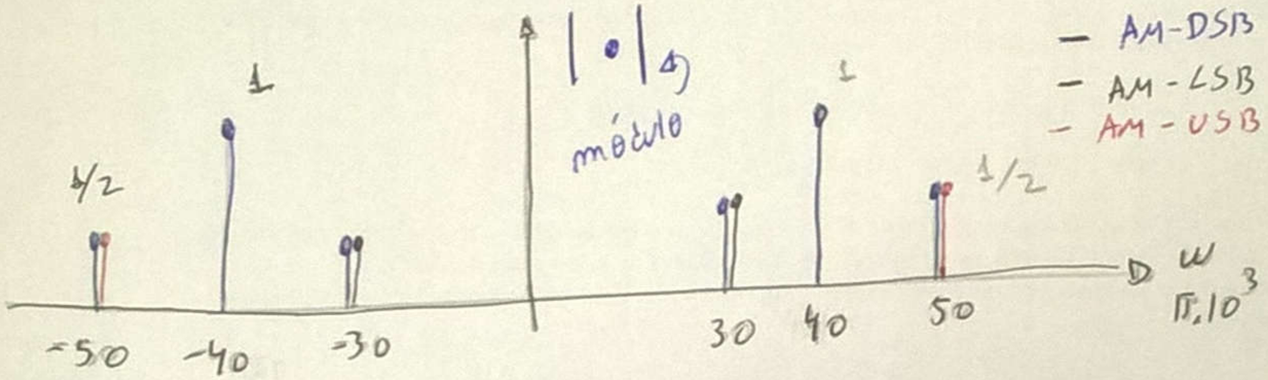
03

Para um par de sinais, tanto o AM-SSB como o QAM tem a maior eficiência espectral, uma vez que precisam apenas da soma da largura de banda dos sinais em banda base como largura de banda passante.

O AM-DSB requer maior energia, pois além das bandas laterais (as duas) sempre é transmitida uma portadora cuja a amplitude é maior do que a máxima amplitude dos sinais em banda base.

04

a)



b) $m_h(t) = \cos(10^4 \pi t)$ $m(t) = \text{Sen}(10^4 \pi t)$

$$\varphi_{DSB}(t) = \cos(4 \cdot 10^4 \pi t) + \text{Sen}(10^4 \pi t) . \cos(4 \cdot 10^4 \pi t) = (1 + \text{Sen}(10^4 \pi t)) \cos(4 \cdot 10^4 \pi t)$$

$$\varphi_{LSB}(t) = \text{Sen}(10^4 \pi t) . \cos(4 . 10^4 \pi t) + \cos(10^4 \pi t) \text{Sen}(4 . 10^4 \pi t) = \text{Sen}(30 \pi . 10^3 t)$$

$$|\phi_{LSB}(w)| = \frac{1}{2} \delta(w + 30\pi . 10^3) + \frac{\delta}{2}(w - 30\pi . 10^3)$$

$$\varphi_{USB}(t) = \text{Sen}(10^4 \pi t) \cos(4 . 10^4 \pi t) - \cos(10^4 \pi t) \text{Sen}(4 . 10^4 \pi t) = \text{Sen}(50 \pi 10^3 t)$$

$$|\phi_{USB}(w)| = \frac{1}{2} \delta(w + 50\pi . 10^3) + \frac{1}{2} \delta(w - 50\pi . 10^3)$$