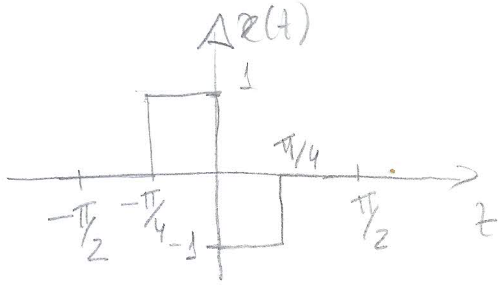
(1)



$T_0 = \pi \quad ; \quad \omega_0 = 2$

SIMETRIA ÍMPAR

(a) (1,0)

$a_0 = a_m = 0$; b_m CALCULADO EM MEIO PERÍODO

$$b_m = \frac{4}{T_0}\int_0^{T_0/2} x(t)\,\text{sen}(m\omega_0 t)\,dt = \frac{4}{\pi}\int_0^{\pi/4}(-1)\,\text{sen}(2mt)\,dt = \frac{4}{\pi}\cdot\frac{1}{2m}\cos(2mt)\Big|_0^{\pi/4}$$

$$= \frac{2}{m\pi}\left[\cos\left(\frac{m\pi}{2}\right) - 1\right] = -\frac{4}{m\pi}\,\text{sen}^2\left(\frac{m\pi}{4}\right) = \begin{cases} -\frac{2}{m\pi}, & m \text{ ímpar} \\ -\frac{4}{m\pi}, & m = 2, 6, 10, \ldots \\ 0, & m = 4, 8, 12, \ldots \end{cases}$$

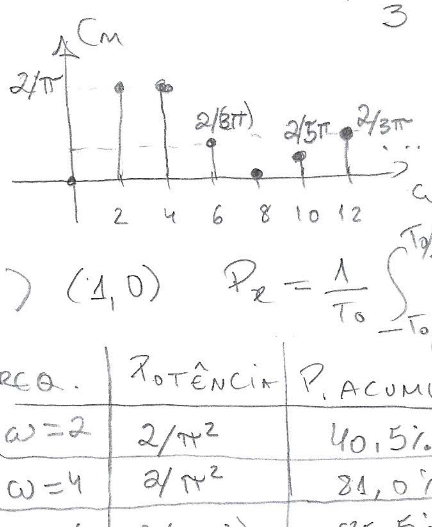
logo:

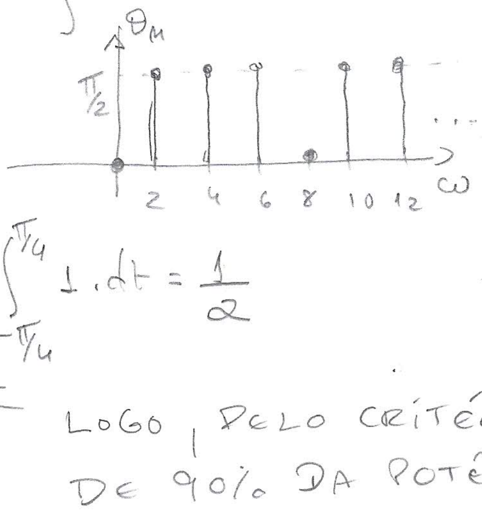
$$x(t) = \frac{2}{\pi}\sum_{m=1}^{\infty}\frac{1}{m}\left[\cos\left(\frac{m\pi}{2} - 1\right)\right]\text{sen}(2mt) \quad \text{ou}$$

$$x(t) = -\frac{4}{\pi}\sum_{m=1}^{\infty}\frac{\text{sen}^2\left(\frac{m\pi}{4}\right)}{m}\,\text{sen}(2mt)$$

(b) (1,0)

$$x(t) = \frac{2}{\pi}\left\{\cos\left(2t + \frac{\pi}{2}\right) + \cos\left(4t + \frac{\pi}{2}\right) + \frac{1}{3}\cos\left(6t + \frac{\pi}{2}\right) + \frac{1}{5}\cos\left(10t + \frac{\pi}{2}\right) + \right.$$
$$\left. + \frac{1}{3}\cos\left(12t + \frac{\pi}{2}\right) + \cdots\right\}$$





(c) (1,0) $P_x = \frac{1}{T_0}\int_{-T_0/2}^{T_0/2}|x(t)|^2 dt = \frac{1}{\pi}\int_{-\pi/4}^{\pi/4} 1 \cdot dt = \frac{1}{2}$

FREQ.	POTÊNCIA	P. ACUMULADA EM % DE P_x
$\omega=2$	$2/\pi^2$	40,5%
$\omega=4$	$2/\pi^2$	81,0%
$\omega=6$	$2/(9\pi^2)$	85,5%
$\omega=10$	$2/(25\pi^2)$	87,2%
$\omega=12$	$2/(9\pi^2)$	91,7%

LOGO, PELO CRITÉRIO DE 90% DA POTÊNCIA DO SINAL, A BANDA ESSENCIAL É

$$\boxed{W = 12 \text{ rad/s}}$$

(2) DA FIGURA

(0,7) $x(t) = 2e^{-j\frac{\pi}{4}}.e^{-3jt} + 4e^{-j\frac{\pi}{2}}.e^{-2jt} + 2e^{-j\frac{3\pi}{4}}.e^{-jt} + 1 +$

$+ 2e^{j\frac{3\pi}{4}}e^{jt} + 4e^{j\pi/2}.e^{2jt} + 2e^{j\pi/4}.e^{3jt}$ ///

DE $\cos\theta = \dfrac{e^{j\theta} + e^{-j\theta}}{2}$

(0,7) $x(t) = 4\cos\left(3t + \frac{\pi}{4}\right) + 8\cos\left(2t + \frac{\pi}{2}\right) + 4\cos\left(t + \frac{3\pi}{4}\right) + 1$ ////

DE $\cos(a+b) = \cos a . \cos b - \operatorname{sen} a . \cos b$

(0,6) $x(t) = 1 - 2\sqrt{2}(\operatorname{sen} t + \cos t) - 8\operatorname{sen} 2t - 2\sqrt{2}(\operatorname{sen} 3t - \cos 3t)$ ///

(3) (a) (0,5)

$X(\omega) = \int_{-\infty}^{\infty} x(t)e^{-j\omega t}dt$, $\omega = 0 \Rightarrow X(0) = \int_{-\infty}^{\infty} x(t)e^{0}dt = \int_{-\infty}^{\infty} x(t)\,dt$ ///

(b) (1,0)

$x(t) = \dfrac{1}{\sigma\sqrt{2\pi}}e^{-\frac{t^2}{2\sigma^2}} \Longleftrightarrow X(\omega) = \dfrac{1}{\sigma\sqrt{2\pi}}\sigma\sqrt{2\pi}\,e^{-\frac{\sigma^2\omega^2}{2}} = e^{-\frac{\sigma^2\omega^2}{2}}$

LOGO $\int_{-\infty}^{\infty} x(t)\,dt = X(0) = e^{-\frac{\sigma^2.0^2}{2}} = e^{0} = 1$ ///

(c) (1,0)

$E_x^{(t)} = \int_{-\infty}^{\infty} x^2(t)\,dt = \dfrac{1}{\sigma^2 2\pi}\int_{-\infty}^{\infty} e^{-\frac{t^2}{\sigma^2}}dt$, $t = \dfrac{u}{\sqrt{2}} \Rightarrow dt = \dfrac{1}{\sqrt{2}}du \Rightarrow$

$E_x^{(t)} = \dfrac{1}{\sigma^2 2\sqrt{2}\pi}\int_{-\infty}^{\infty} e^{-\frac{u^2}{2\sigma^2}}du = \dfrac{1}{\sigma^2 2\sqrt{2}\pi}.\sigma\sqrt{2\pi}$ (ITEM b) $= \dfrac{1}{2\sqrt{\pi}\sigma}$ ///

$E_x^{(\omega)} = \dfrac{1}{2\pi}\int_{-\infty}^{\infty}|X(\omega)|^2 d\omega = \dfrac{1}{2\pi}\int_{-\infty}^{\infty} e^{-\sigma^2\omega^2}d\omega$, $\sigma^2\omega^2 = \dfrac{u^2}{2\sigma^2} \Rightarrow \omega = \dfrac{u}{\sigma^2\sqrt{2}}$

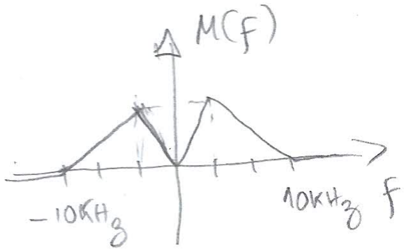
$d\omega = \dfrac{1}{\sigma^2\sqrt{2}}du$

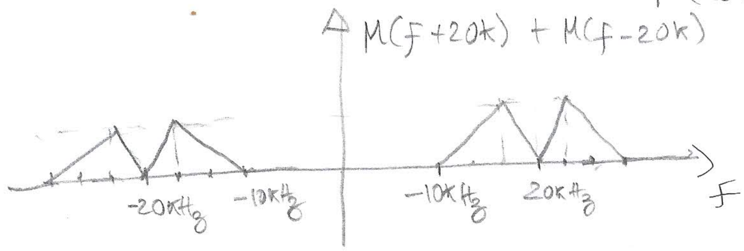
$E_x^{(\omega)} = \dfrac{1}{2\pi}\dfrac{1}{\sigma^2\sqrt{2}}\int_{-\infty}^{\infty} e^{-\frac{u^2}{2\sigma^2}}du = \dfrac{1}{\sigma^2 2\sqrt{2}\pi}\sigma\sqrt{2\pi} = \dfrac{1}{2\sqrt{\pi}\sigma}$ ///

COMO $E_x^{(t)} = E_x^{(\omega)}$, O TEOREMA DE PARSEVAL ESTÁ VERIFICADO.

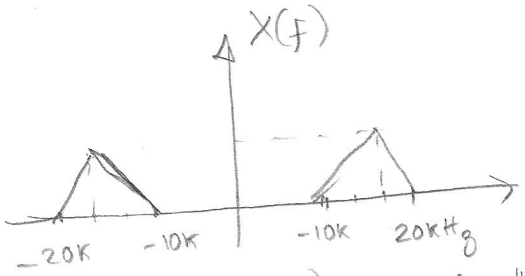
(4) $m(t) \longleftrightarrow M(f), M(\omega) \Rightarrow m(t)2\cos(40.000\pi t) \longleftrightarrow M(f+20k) + M(f-20k)$

ou $M(\omega + 40k\pi) + M(\omega - 40k\pi)$

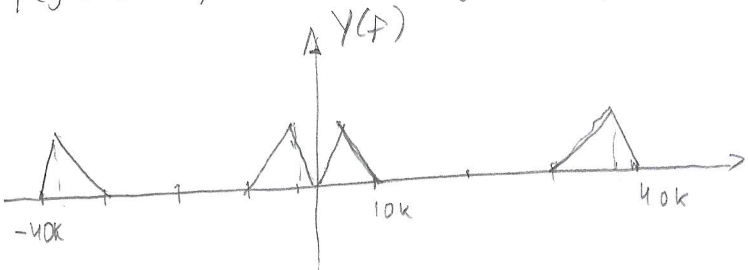


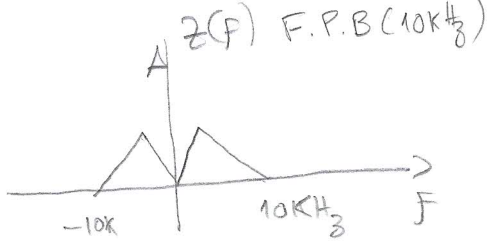


(a)

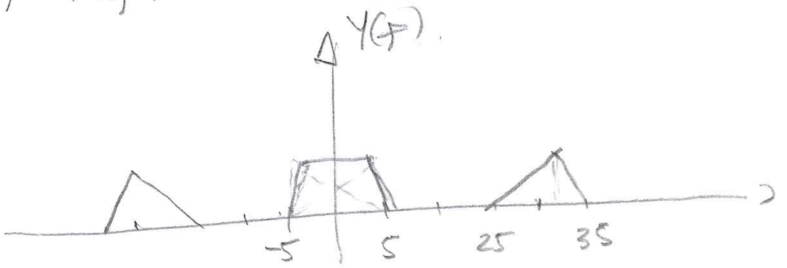


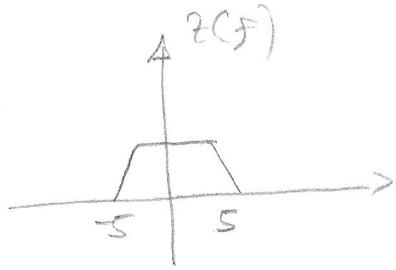
$Y(f) = X(f+20K) + X(f-20K)$





(b) X(f) ÍDEM (a)





(c) EM (b) $Z(f) = M(f) \Rightarrow$ SINAL RECUPERADO

EM (C) $Z(f) \neq M(f) \Rightarrow$ " NÃO RECUPERADO.