

$$\mu_y = 0, ZV = E[Y]$$

a)  $\mu_x = 0,8V = E[X]$

$$\mu_y = \mu_x \int_{-\infty}^{\infty} h(t) dt = \mu_x H(0)$$

Pela transformada:

$$h(t) \leftrightarrow H(w)$$

$$e^{-at} u(t) \leftrightarrow \frac{1}{a+jw} \Rightarrow e^{-ut} u(t) \leftrightarrow \frac{1}{u+jw}$$

$$\therefore H(w) = \frac{1}{u+jw} \Rightarrow H(0) = \frac{1}{u} \Rightarrow \frac{\mu_y}{H(0)} = \mu_x \Rightarrow \mu_x = 4 \cdot 0,2$$

$$\therefore \mu_x = 0,8V$$

Pela integral

$$\int_0^{\infty} e^{-ut} dt \frac{(-u)}{(-u)} = -\frac{1}{u} e^{-ut} \Big|_0^{\infty} = -\frac{1}{u} (0 - 1). \quad \therefore \int_{-\infty}^{\infty} h(t) dt = \frac{1}{u} \Rightarrow \text{que leva ao mesmo resultado}$$

b) Saída  $\Rightarrow Y(t)$

$$\text{DEP: } S_y(w) = S_x(w) \cdot |H(w)|^2$$

$$S_x(w) = \tilde{f}[e^{-5|t|}] = \frac{2 \cdot 5}{5^2 + w^2} \quad \therefore S_x(w) = \frac{10}{25 + w^2}$$

$$|H(w)| = \left| \frac{1}{u+jw} \right| = \frac{1}{\sqrt{u^2+w^2}} = \frac{1}{\sqrt{16+w^2}} \Rightarrow |H(w)|^2 = \frac{1}{16+w^2}$$

$\hookrightarrow$  módulo de um n° complexo:  $|Z| = \sqrt{(\text{Re}[Z])^2 + (\text{Im}[Z])^2}$

$$\therefore S_y(w) = \frac{10}{(25+w^2)(16+w^2)} \quad [W/\text{rad/s}]$$

$$\text{Como } W = Z\pi f \Rightarrow S_y(f) = \frac{10}{((Z\pi f)^2 + 25)(16 + (Z\pi f)^2)} [W/\text{Hz}]$$

c)  $R_y(t) = \mathcal{F}^{-1}[S_y(w)]$

Manipulando: Se  $X = w^2$

$$S_y(X) = \frac{10}{(25+X)(16+X)} = \frac{A}{25+X} + \frac{B}{16+X} = \frac{A(16+X) + B(25+X)}{(25+X)(16+X)}$$

$$\Rightarrow A(16+X) + B(25+X) = 10$$

$$\text{p/ } X = -25 \Rightarrow -9A = 10, \therefore A = -\frac{10}{9}$$

$$\text{p/ } X = -16 \Rightarrow 9B = 10, \therefore B = \frac{10}{9}$$

$$\Rightarrow S_y(w) = -\frac{10}{9} \cdot \frac{1}{25+w^2} + \frac{10}{9} \cdot \frac{1}{16+w^2}$$

$$R_y(t) = -\frac{10}{9} \cdot \mathcal{F}^{-1}\left[\frac{1}{25+w^2}\right] + \frac{10}{9} \cdot \mathcal{F}^{-1}\left[\frac{1}{16+w^2}\right]$$

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em \*:  $\frac{1}{5^2+w^2} \cdot \frac{2.5}{2.5} = \frac{1}{10} \cdot \frac{2.5}{5^2+w^2} \leftrightarrow 1 e^{-5|t|}$

em \*:  $\frac{1}{4^2+w^2} \cdot \frac{2.4}{2.4} = \frac{1}{8} \cdot \frac{2.4}{4^2+w^2} \leftrightarrow \frac{1}{8} e^{-4|t|}$

$$\therefore R_y(t) = -\frac{1}{9} e^{-5|t|} + \frac{5}{36} e^{-4|t|}$$

d)  $P_x = R_x(0) = e^{-50} \cdot P_x = 1W$

$$P_y = R_y(0) = -\frac{1}{9} \cdot e^{-50} + \frac{5}{36} e^{-40}, \therefore P_y = \frac{1}{36} W$$

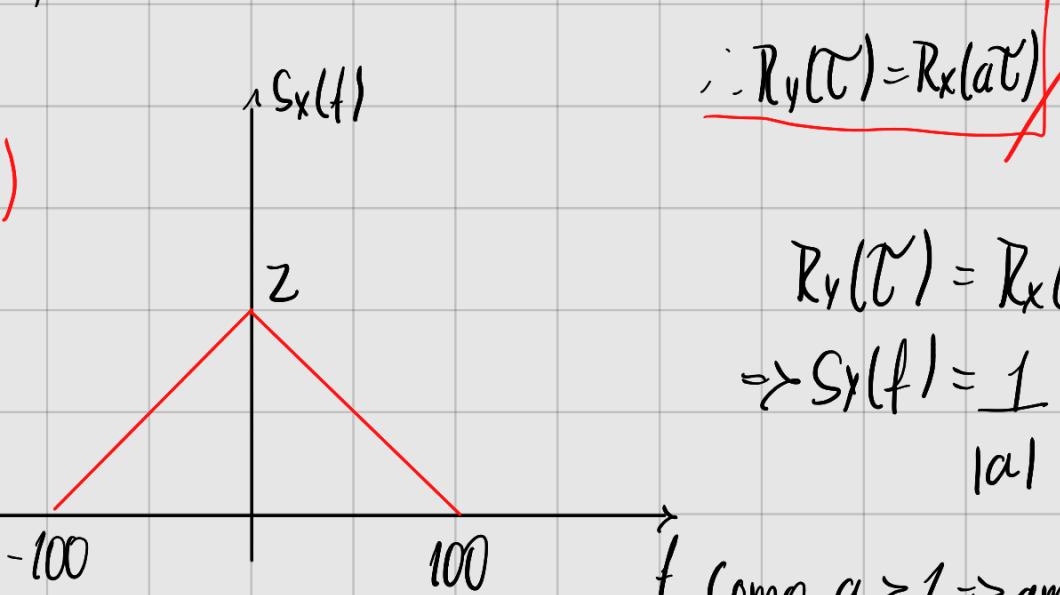
2)  $X(t)$  é WSS e  $\mu_X = 0$   
 $Y(t) = X(at)$ ,  $a > 1$

$$R_x(t, t+\tau) = \overline{X(t)X(t+\tau)} \Rightarrow R_x(at, a(t+\tau)) = \overline{X(at)X(a(t+\tau))} = \overline{X(at)X(at+a\tau)} \\ = R_x(a\tau)$$

o intervalo de tempo entre as duas parcelas é de  $a\tau \Rightarrow R_x(a\tau)$

$$R_y(t, t+\tau) = \overline{Y(t)Y(t+\tau)} = \overline{X(at)X(a(t+\tau))} = R_x(a\tau)$$

b)

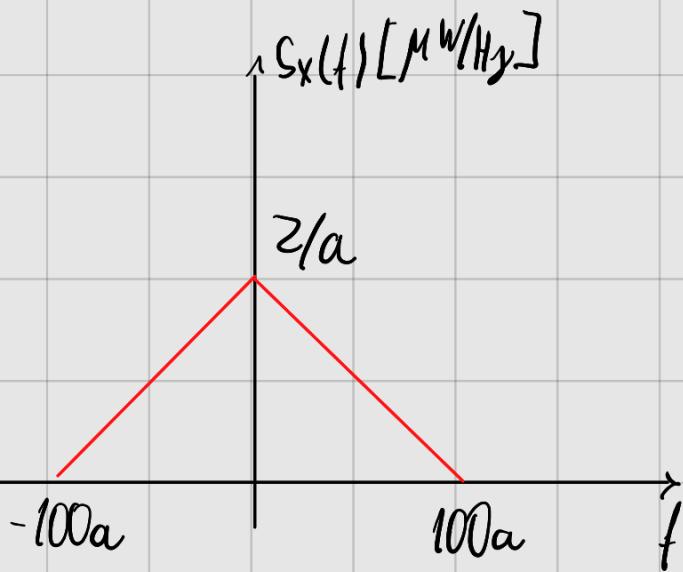


$$R_y(\tau) = R_x(a\tau)$$

$$\Rightarrow S_y(f) = \frac{1}{|a|} S_x\left(\frac{f}{a}\right)$$

Como  $a > 1 \Rightarrow$  amplitude dividida por  $a$   
 $\Rightarrow$  freq. extendida de  $a$

Compressão no tempo  $\Rightarrow$  extensão na frequência



c)  $P_y = \int_{-\infty}^{\infty} S_y(f) df = 2 \cdot 100 \pi \cdot \frac{Z}{\alpha} \cdot \frac{1}{Z} \quad \therefore P_y = 200 \mu W$