UNIVERSIDADE ZAMBEZE

FCT

ENGENHARIA INFORMÁTICA

PROCESSAMENTO DIGITAL DE SINAL

TESTE - 1

DISCENTE:

- BERNARDO AMISSE ASSUMANE

DOCENTE:

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(1) $X[n] = \{2, 4, 0, 3\}$

a) $\sum_{b=-\infty}^{+\infty} X(b)\,\delta(n-b)$

Logo

$X(n) = X(4)\,\delta(n-4) + X(3)\,\delta(n-3) + X(2)\,\delta(n-2) + X(0)\,\delta(n)$

#

② a) $y(n) = x(n) - x(n-1)$

$x_1(n)$

$y_1(n) = x_1(n) - x_1(n-1)$

$x_2(n) = x_2(n-n_0) - x_2(n-n_0)$

$y_2(n) = x_2(n) - x_2(n-1)$

$y_2(n) = x_2(n-n_0) - x_2(n-n_0-1$

$y_1(n-n_0) = x_1(n-n_0) - x_1(n-n_0-1)$

Logo é invariante no tempo

② b) $y(n) = n x(n)$

$x(n) = x(n + n_0)$

$y(n) = n x(n)$

$y(n) = n x(n+n_0)$

$n = n + n_0$

$y_n = n x(n)$

$y(n + n_0) = (n+n_0) x(n+n_0)$

Logo é Variante no tempo

②

c) $y(n) = x(-n)$

$x_1(n)$

$y_1(n) = x_1(-n)$

$x_2(n) = x_2(n-n_0)$

$y_2(n) = x_2(-n)$

$y_2(n) = x_2[-(n-n_0)]$

$y_2(n) = x_2(-n+n_0)$

$y_1(n-n_0) = x_1[-(n-n_0)]$

$y_1(n-n_0) = x_1(-n+n_0)$

Logo é invariante no tempo

d) $y(n) = x(n)\cos(w_o n)$

$x(n) = x(n+n_o) \cdot \cos[w_o(n+n_o)]$

$y(n) = x(n)\cos(w_o n)$

$y(n) = x(n+n_o)\cos[w_o(n+n_o)]$

$n = n + n_o$

$y(n) = x(n)\cos(w_o n)$

$y(n+n_o) = x(n+n_o)\cos[w_o(n+n_o)]$

Logo é Variante no tempo

3) a) $y(n) = n\,x(n)$

$x_1(n)$

$y_1(n) = n\,x_1(n)$

$x_2(n)$

$y_2(n) = n\,x_2(n)$

$x_3(n) = a\,x_1(n) + b\,x_2(n)$

$y_3(n) = n\,x_3(n)$

$y_3(n) = n[a\,x_1(n) + b\,x_2(n)]$

$y_3(n) = n\,a\,x_1(n) + n\,b\,x_2(n)$

$y_3(n) = a\,y_1(n) + b\,y_2(n)$

Logo É linear.

b) $y(n) = x(n^2)$

$x_1(n)$

$y_1(n) = x_1(n^2)$

$x_2(n)$

$y_2(n) = x_2(n^2)$

$x_3(n) = a\,x_1(n^2) + b\,x_2(n^2)$

$y_3(n) = x_3(n^2)$

$y_3(n) = a\,x_1(n^2) + b\,x_2(n^2)$

$y_3(n) = a\,y_1(n^2) + b\,y_2(n^2)$

Logo é linear

c) $y(n) = x^2(n)$

$x_1(n)$

$y_1(n) = x_1^2(n)$

$x_2(n)$

$y_2(n) = x_2^2(n)$

$x_3(n) = a x_1^2(n) + b x_2^2(n)$

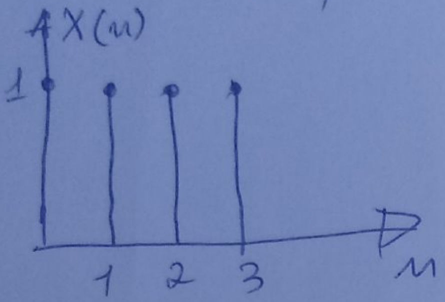
$y_3(n) = a x_1^2(n) + b x_2^2(n$

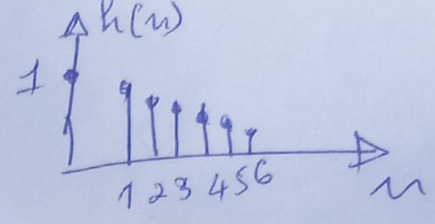
Logo não é linear

4

$$x(n) = \begin{cases} 1, & 0 \leq n \leq 4 \\ 0, & \text{outros} \end{cases}$$

$$h(n) = \begin{cases} \left(\frac{2}{3}\right)^n ; & 0 \leq n \leq 6 \\ 0, & \text{outros} \end{cases}$$





$$y(n) = \sum_{k=-\infty}^{\infty} x(k)\, h(n-k)$$

$n=0 \quad y(0) = x(0)\, h(0) = 1$

$n=1 \quad y(1) = x(0)\, h(1) + x(1) \cdot h(0) = \frac{5}{3}$

$n=2 \quad y(2) = x(0)\, h(2) + y(1) = \frac{19}{9}$

$n=3 \quad y(3) = x(0)\, h(3) + y(2) = \frac{8}{27} + \frac{19}{9} = \frac{65}{27}$

$n=4 \quad y(4) = x(0)\, h(4) + y(3) = \frac{16}{81} + \frac{65}{27} = \frac{211}{81}$

$n=5 \quad y(5) = x(0)\, h(5) + y(4) = \frac{32}{243} + \frac{211}{81} = \frac{665}{243}$

$n=6 \quad y(6) = x(0)\, h(6) + y(5) = \frac{64}{729} + \frac{665}{243} = \frac{2059}{729}$

$$y(n) = \sum_{k=-\infty}^{+\infty} x(k)\, h(n-k)$$

#

(5) a) $x_1(t) = e^{-at} \cdot u_1(t), \; a>0$

$$X(jw) = \int_0^{\infty} e^{-at} \cdot e^{-j \cdot w \cdot t} \, dt$$

$$= -\frac{1}{(a+jw)} \cdot e^{-(a+jw)t} \Big|_0^{\infty}$$

$$X(jw) = \frac{1}{(a+jw)} \;, a>0$$

$$|X(jw)| = \frac{1}{\sqrt{a^2+w^2}} \;, \; \angle X(jw) = -\arctg\left(\frac{w}{a}\right)$$

b) $x(t) = e^{-a|t|}, \; a>0$

$$X(jw) = \int_0^{\infty} e^{-a|t|} \cdot e^{-jwt} \, dt$$

$$X(jw) = \frac{1}{(a-jw)} \cdot e^{(a-jw)t} \Big|_{-\infty}^{0} + \frac{1}{-(a+jw)} e^{-(a+jw)t} \Big|_0^{\infty}$$

$$X(jw) = \frac{1}{(a+w)} + \frac{1}{(a+w)}$$

$$X(jw) = \frac{2a}{(a^2-w^2)}$$

$$|X(jw)| = \frac{2a}{|(a^2-w^2)|}$$

#

(6) a) $X_1(t) = \text{Sen}\, wt \cdot u_1(t)$

$$X_1(s) = \int_0^{\infty} \text{Sen}(wt)\, e^{-st}\, dt$$

$$X_1(s) = \int_0^{\infty} \frac{e^{jwt} - e^{-jwt}}{2j} \cdot e^{-st}\, dt = \frac{w}{s^2+w^2}$$

$$R\{s\} > 0$$

b) $X_2(t) = \cos wt \cdot u_2(t)$

$$\frac{d(\text{Sen}\, wt)}{dt} = w \cos wt$$

$$\mathcal{L}\left[\frac{d\, x(t)}{dt}\right] = w\, \mathcal{L}(\cos wt) \cdot \text{Sen}\, 0$$

$$= w\, \mathcal{L}(\cos wt)$$

$$= s \cdot \frac{w}{s^2+w^2} = w \frac{s}{s^2+w^2}$$

c) i. $x(t) = e^{-3,5t}$, $t > 0$.

ii. $y(t) = e^{3,5t}$, $t > 0$

i. $X(s) = \int_0^{\infty} e^{-st} \cdot e^{-(-3,5)t}\, dt$

$$x(s) = \int_0^{\infty} e^{-t(s-3,5)}\, dt$$

$$X(s) = -\frac{1}{(s-3,5)}\Big|_0^{\infty}$$

$$X(s) = \frac{1}{s-3,5} \quad \#$$

ii. $y(s) = \int_0^{\infty} e^{-st} \cdot e^{-3,5t}\, dt$

$$y(s) = \int_0^{\infty} e^{-t(s+3,5)}\, dt$$

$$y(s) = -\frac{1}{(s+3,5)}\Big|_0^{\infty}$$

$$y(s) = \frac{1}{s+3,5} \quad \#$$

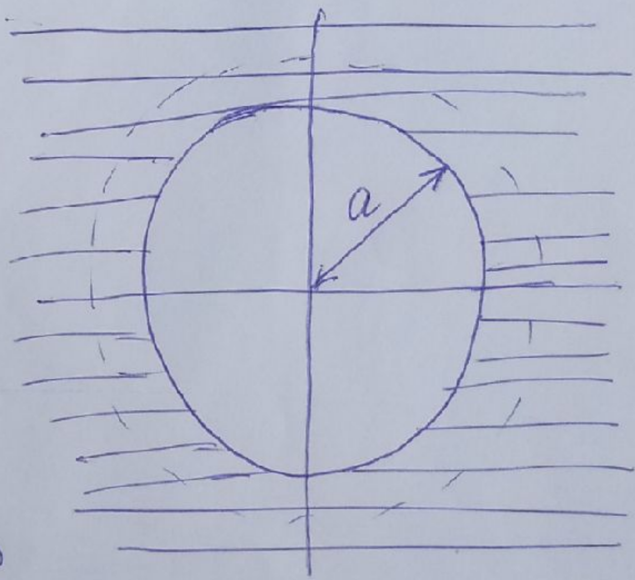
⑦ a) $h(n) = \begin{cases} \frac{1}{3}, & -1 \leq n \leq 1 \\ 0, & \text{outros} \end{cases}$

$$= \frac{1}{3}(z + 1 + z^{-1}); \; z \neq 0$$

$$H(z) = \sum_{-\infty}^{+\infty} \frac{1}{3} z^{-n} \; ; \; z \neq 0$$

$$H(z) = \frac{1}{3} z^{-1} + \frac{1}{3} z^{0} + \frac{1}{3} z^{1} \; ; \; z \neq 0$$

b) $h(n) = \begin{cases} a^{n}, & n \geq 0 \\ 0, & \text{outros} \end{cases}$



$$H(z) = \sum_{-\infty}^{+\infty} a^{n} \cdot z^{-n}$$

$$H(z) = \sum_{-\infty}^{+\infty} (a z^{-1})^{n}$$

$$H(z) = \frac{(a z^{-1})^{-\infty} - (a z^{-1})^{\infty}}{1 - a z^{-1}}$$

$$H(z) = \frac{0}{1 - a z^{-1}} = 0$$

$|a z^{-1}| < 1$

$\Longleftrightarrow |z| > |a|$

Para $|a| < 1$

O Sistema é Estavel.

c) $h(n) = \begin{cases} r^n \cos(w_0 n), & n \geq 0 \\ 0, & \text{outros} \end{cases}$

$$\cos(w_0 n) = \frac{e^{jw_0 n} + e^{-jw_0 n}}{2}$$

$$H(z) = \sum_{-\infty}^{+\infty} r^n \cos(w_0 n) z^{-n}$$

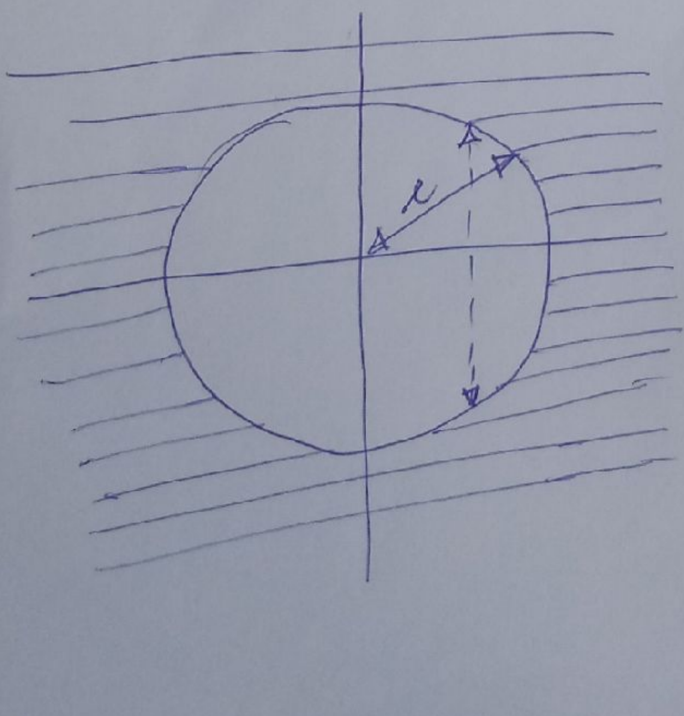
$$H(z) = \sum_{-\infty}^{+\infty} (r z^{-1})^n \cos(w_0 n)$$

$$H(z) = \sum_{-\infty}^{+\infty} \frac{1}{2} (r z^{-1})^n (e^{jw_0 n} + e^{-jw_0 n})$$

$$H(z) = \frac{1}{2} \sum_{-\infty}^{+\infty} (r z^{-1}) e^{jw_0 n} + \frac{1}{2} \sum_{-\infty}^{+\infty} (r z^{-1}) e^{-jw_0 n}$$

$$H(z) = \frac{1}{2} \sum_{-\infty}^{+\infty} (r z^{-1})^n (e^{jw_0 n}) + \frac{1}{2} \sum (r z^{-1} e^{-jw_0})^n$$

$$H(z) = 0$$



$z - re^{jw_0} = 0 \wedge z - re^{-jw_0} = 0$

$z = re^{jw_0} \wedge z = re^{-jw_0}$

$|z| > |r|$