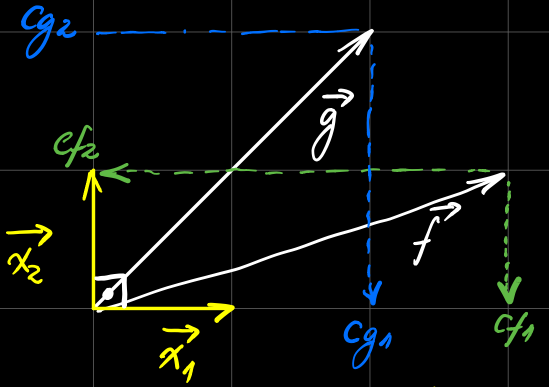
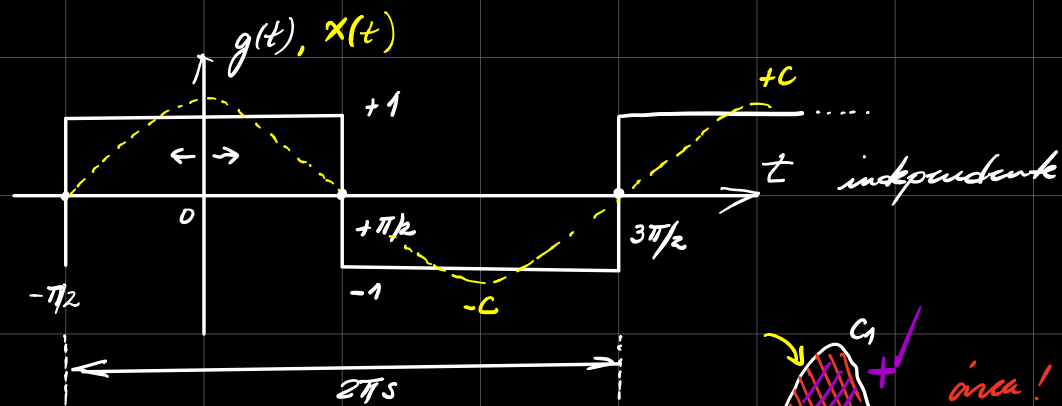
VETORES : SINAIS

$$\vec{g} = c_{g1}\,\vec{x_1} + c_{g2}\,\vec{x_2}$$

$$\vec{f} = c_{f1}\,\vec{x_1} + c_{f2}\,\vec{x_2}$$

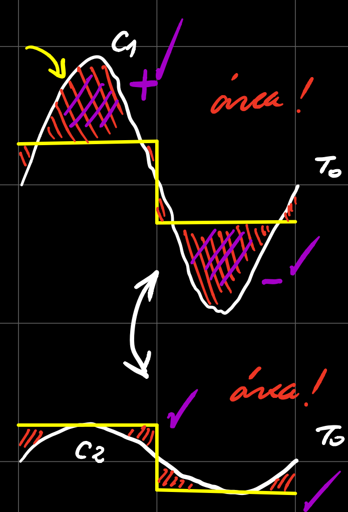


• BASE (versores) $\rightarrow$ $\underbrace{|\vec{x_1}| = |\vec{x_2}| = 1}$



$$g(t) \cong c\,x(t)$$

$$erro(c) = \int_{T_0} \left(g(t) - c\,x(t)\right)^2 dt$$



$$\text{erro}(c) = \int_{T_0} \left(g(t) - c\,x(t)\right)^2 dt \quad \ldots \quad \text{semelhança}$$

variável

$$\frac{d\,\text{erro}(c)}{dc} = 0 \quad \ldots \quad \min_{c}\ \text{erro}(c)$$

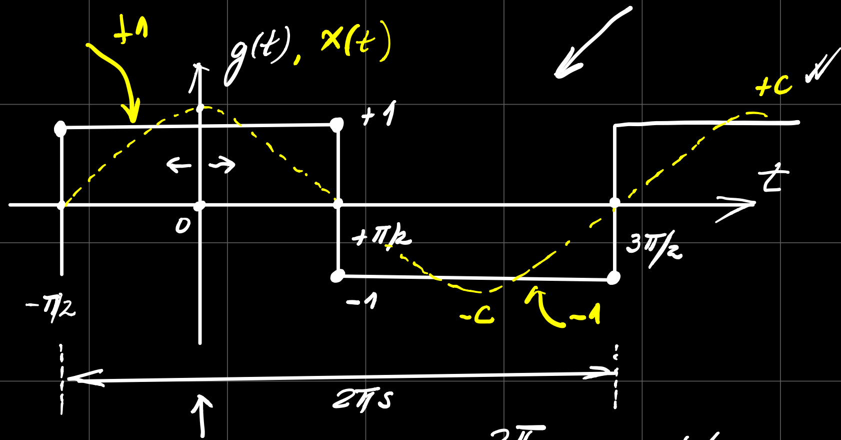
$$\underbrace{\int_{T_0} g^2(t)\,dt}_{c^{te}} - 2c \underbrace{\int_{T_0} g(t)\,x(t)\,dt}_{c^{te}} + c^2 \underbrace{\int_{T_0} x^2(t)\,dt}_{\substack{\text{definidas} \\ = N^{o}}}$$

$$N_1 - 2c\,N_2 + c^2 N_3 \qquad \partial/\partial c$$

$$0 - 2N_2 + 2c\,N_3 = 0 \quad \therefore$$

$$2c\,N_3 = 2N_2 \quad \therefore \quad c = \frac{N_2}{N_3}$$

$$c = \frac{\int_{T_0} g(t)\,x(t)\,dt}{\int_{T_0} x^2(t)\,dt} \quad \ldots \quad \text{periódicos!}$$



$$g(t) = c\,x(t)$$

$$\theta = 0 \qquad \omega_0 = \frac{2\pi}{T_0} = \frac{2\pi}{2\pi} = 1\ \text{rd/s}$$

$$C = \frac{\int_{T_0} g(t)\cdot x(t)\,dt}{\int_{T_0} x^2(t)\,dt}$$

(1) $x(t) = ?$

$$A\cdot\cos(\omega t + \theta) = 1\cdot\cos(t) \quad \therefore \quad x(t) = \cos(t)$$

$$C = \frac{\int_{-\pi/2}^{+\pi/2} \underbrace{+1}_{g(t)}\cdot\cos(t)\,dt + \int_{\pi/2}^{+3\pi/2} \underbrace{-1}_{g(t)}\cdot\cos(t)\,dt}{\int_0^{2\pi} \cos^2(t)\,dt}$$

$$C = \frac{\left.\operatorname{sen}(t)\right|_{-\pi/2}^{+\pi/2} - \left.\operatorname{sen}(t)\right|_{\pi/2}^{+3\pi/2}}{\underbrace{\int_0^{2\pi} 1/2\,dt} + \int_0^{2\pi} \cos(2t)\,dt}$$

$$C = \frac{\overset{1}{1} \overset{+1}{-(-1)} \overset{+1}{-(-1)} \overset{+1}{-(-1)}}{\underbrace{\left.1/2\,t\right|_0^{2\pi}}_{\pi} + \underbrace{\left.\frac{\operatorname{sen}(2t)}{2}\right|_0^{2\pi}}_{0}} = \frac{4}{\pi}$$

$$g(t) = g(t) \simeq \frac{4}{\pi} \cdot \cos t$$

$$\longrightarrow g(t) = \frac{4}{\pi} \cdot \underbrace{\cos(t)}_{\underbrace{n=1}} + \underbrace{\text{erro}}_{} \xrightarrow{n\to\infty} 0$$

Série de Fourier

$$g(t) = a_0 + \sum_{\underbrace{n=1}}^{\infty} a_n \cdot \cos(n\omega_0 t) + b_n \operatorname{sen}(n\omega_0 t)$$

$$\longrightarrow a_n = \frac{2}{T_0} \int_{T_0} g(t) \cdot \cos(n\omega_0 t)\, dt \longleftarrow$$

$$\longrightarrow C_n = \frac{\int_{T_0} g(t) \cdot x_n(t)\, dt}{\int_{T_0} x_n^2(t)\, dt}$$

$\cos(n\omega_0 t)$ e $\operatorname{sen}(n\omega_0 t)$?

$n = 1, 2, 3, 4, \ldots$

$$x_n(t) = \cos(n\omega_0 t)$$

$$C_n = \frac{\int_{T_0} g(t) \cdot \cos(n\omega_0 t)\, dt}{\underbrace{\int_{T_0} \cos^2(n\omega_0 t)\, dt}}$$

$$\int_{T_0} 1/2\, dt + \int_{T_0} \cos(2n\omega_0 t)\, dt = \frac{T_0}{2} + \underbrace{\left.\frac{\operatorname{sen}(2n\omega_0 t)}{2n\omega_0}\right|_0^{T_0}}_{0}$$

$$C_n = \frac{\int_{T_0} g(t) \cos(n\omega_0 t)\, dt}{T_0/2} =$$

$$c_n = \frac{2}{T_0} \cdot \int_{T_0} g(t) \cdot \cos(n\omega_0 t)\,dt$$

$$\underbrace{a_n}_{} = \frac{2}{T_0} \int_{T_0} g(t) \cdot \cos(n\omega_0 t)\,dt$$

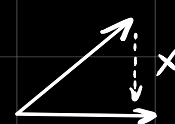
1. Porque n é inteiro, positivo?
2. Porque $x_n(t) \rightarrow \cos(n\omega_0 t)$ e $\operatorname{sen}(n\omega_0 t)$?

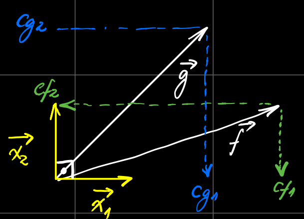
$$g(t) = c_1 . x_1(t) + \text{erro}_1$$

$$\text{erro}_2 < \text{erro}_1$$

$$\longrightarrow g(t) = c_1 \underbrace{x_1(t)}_{\cdot} + \underbrace{c_2 x_2(t)}_{\cdot} + \text{erro}_2$$

$x_1(t)$ e $x_2(t)$





$$C = \frac{\overset{=0\,!}{\int_{T_0} x_1(t) . x_2(t)\,dt}}{\underset{>0}{\int_{T_0} x_1^2(t)\,dt}} = 0$$

$\vec{x_1}, \vec{x_2}$ $\perp$

$\vec{x_1} \odot \vec{x_2} = 0$

$\vec{x_1} = 0 . \vec{x_2}$

$\underbrace{x_1(t)}_{} = c . \underbrace{x_2(t)}_{}$

$c = 0$

$x_1(t) \perp x_2(t)$.!

$$\underbrace{\int_{T_0} x_1(t) . x_2(t)\,dt}_{\text{"produto escalar"}} = 0\,!$$

$$\int_0^{2\pi} \underbrace{\cos(t)} \cdot \underbrace{\cos(nt)}\, dt = 0$$

$$\int_0^{2\pi} \frac{1}{2} \cdot \cos((1+n)t)\, dt + \int_0^{2\pi} \frac{1}{2} \cos((n-1)t)\, dt = 0$$

$$\left.\frac{\sin(1+n)t}{(1+n)}\right|_0^{2\pi} + \left.\frac{\sin(n-1)t}{(n-1)}\right|_0^{2\pi} = 0$$

$n = 2, 3, 4, 5, \ldots$ $\qquad\qquad$ $n = 2, 3, 4, 5, \ldots$

$$0 = \frac{\overset{0}{\sin(1+n)\cdot 2\pi} - \overset{0}{\sin(0)}}{(1+n)} + \frac{\sin(n-1)\cdot 2\pi - \overset{0}{\sin(0)}}{(n-1)}$$

$$g(t) = c_1 \cdot \underbrace{\cos(t)} + c_2 \underbrace{\cos(2t)} + c_3 \underbrace{\cos(3t)} + \ldots$$

- $g(t) = \sum_{n=1}^{\infty} c_n x_n(t)$ SÍNTESE $\qquad$ decomposição

- $c_n = \dfrac{\int_{T_0} g(t) \cdot x_n(t)\, dt}{\int_{T_0} x_n^2(t)\, dt}$ ANÁLISE $\qquad$ Projeções

- $\int_{T_0} x_n(t) \cdot x_m(t)\, dt = 0 \quad m \neq n$ $\qquad$ Base

? ?

LÁ 440Hz → GAITA BLUES → $g(t)$

DÓ

SOL

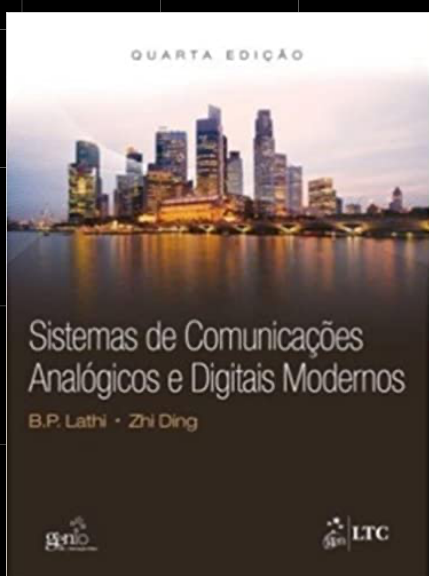
...

Decomposição

[ANÁLISE] ✓

c_n ← parâmetros

SÍNTESE ✓



LIVRO TEXTO

$$\text{erro}(c) = \int_{T_0} \Big(\underbrace{g(t) - c\,x(t)}_{\substack{>0 \\ <0}}\Big)^2 dt$$

$$\int_{T_0} [g(t) - c\,x(t)]^2 dt \leftarrow$$

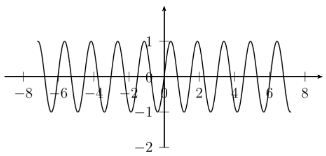


Figura 2: Sinal $g_2(t)$ - teste.

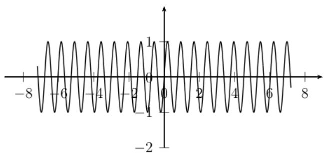


Figura 3: Sinal $g_3(t)$ - teste.

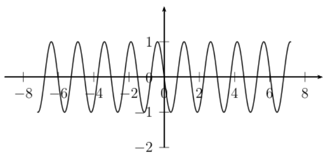


Figura 4: Sinal $g_4(t)$ - teste.

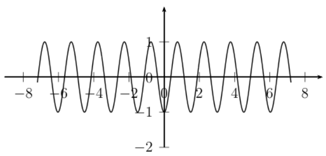


Figura 5: Sinal $g_5(t)$ - teste.

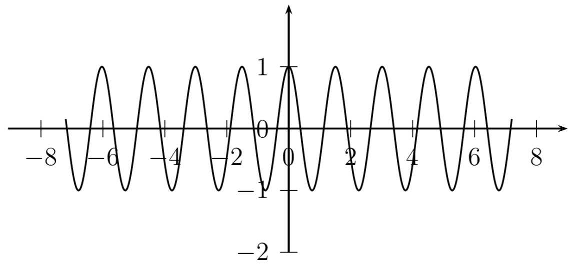


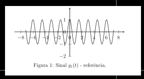
Figura 1: Sinal $g_1(t)$ - referência.

1

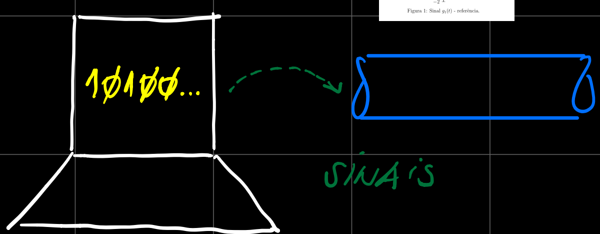
(·) ATIVIDADE 01

As tecnologias de transmissão digital utilizam um mapeamento entre os valores lógicos 1 e 0 e suas respectivas representações temporais em sinais $g_1(t)$ e $g_0(t)$ respectivamente. O que for escolhido para o transmissor é utilizado para o receptor que terá o papel de identificar se o sinal corresponde ao nível lógico 1 ou 0. Neste sentido, para facilitar o ***trabalho*** do receptor devemos escolher dois sinais que sejam ***diferentes***. Como medir a diferença entre os sinais escolhidos? podemos utilizar como ***métrica*** a projeção do sinal $g_1(t)$ no $g_0(t)$ tentando escolher um valor que facilite a identificação. Desta forma, se definirmos como referência o sinal $g_1(t)$, a projeção pode ser calculada pela equação 1.

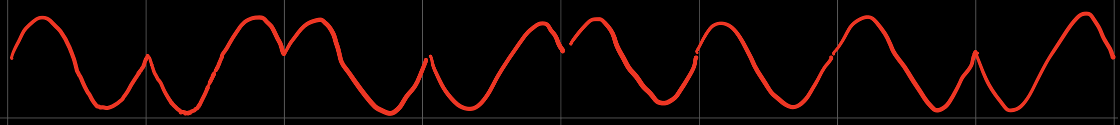
$$c_{10} = \frac{\int_T g_1(t) g_0(t) dt}{\int_T g_1(t)^2 dt} \tag{1}$$

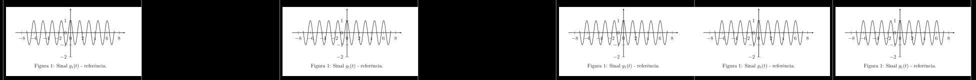


= 1



... 1 Ø 1 Ø 1 1 1 Ø





? ? ?

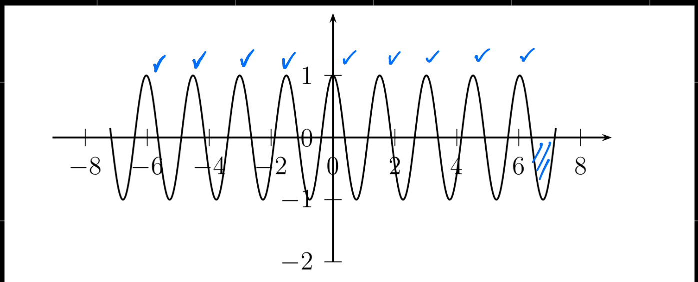


Figura 1: Sinal $g_1(t)$ - referência.

$T_1 = \frac{14s}{9,5}$, + cos

f

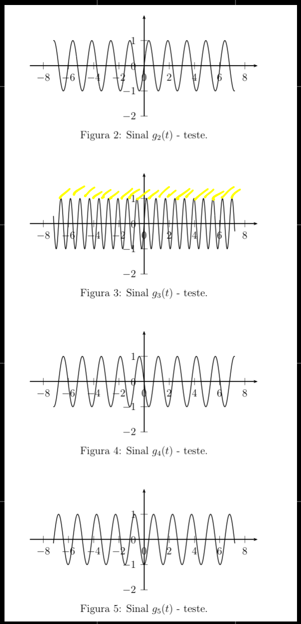


Figura 2: Sinal $g_2(t)$ - teste.

Figura 3: Sinal $g_3(t)$ - teste.

Figura 4: Sinal $g_4(t)$ - teste.

Figura 5: Sinal $g_5(t)$ - teste.

+ sen , $T = 14/9.5 \longrightarrow f$

+ sen , $T = 14/19 \longrightarrow 2f$ ✓

- sen , $T = 14/9.5 \longrightarrow f$

- cos , $T = 14/9.5 \longrightarrow f$

r T

$$C_{12} = \frac{\int_0 \cos(\omega t) . \operatorname{sen}(\omega t)\, dt}{\int_0^T \cos^2(\omega t)\, dt}$$

$$cos(\alpha)cos(\beta) = \frac{1}{2}[cos(\alpha+\beta) + cos(\alpha-\beta)]$$
$$sin(\alpha)cos(\beta) = \frac{1}{2}[sin(\alpha-\beta) + sin(\alpha+\beta)]$$
$$sin(\alpha)sin(\beta) = \frac{1}{2}[cos(\alpha-\beta) - cos(\alpha+\beta)]$$

$$\underbrace{1/2 \cdot \int_0^T \operatorname{sen}(\overset{0}{0})\, dt}_{0} + 1/2 \int_0^T \operatorname{sen}(2\omega t)\, dt = 0$$

$$1/2 \cdot \left(- \frac{\cos(2\omega t)}{2\omega} \cdot \Big|_0^T \right) =$$

$$1/4\omega \cdot \left(- \underbrace{\overset{-1}{\cos(2\omega . T)}}_{\cos(4\pi)=1} + \overset{+1}{\cos(2\omega \cdot 0)} \right) = 0$$

$$2\omega . T = 2 . \frac{2\pi}{T} . T = 4\pi$$

$$\therefore \; C_{1,2} = 0$$

$$C_{13} = \frac{\int_{T_0} \cos(\omega t) . \operatorname{sen}(2\omega t)\, dt}{\int_{T_0} \cos^2(\omega t)\, dt} = 0$$

$$C_{14} = \frac{-\int_{T_0} \cos(\omega t) . \operatorname{sen}(\omega t)\, dt}{\int_{T_0} \cos^2(\omega t)\, dt} = 0$$

$$\int_{T_0} \cos^2(\omega t) dt$$

$$C_{15} = \frac{-\int_{T_0} \cos(\omega t) . \cos(\omega t)\, dt}{\int_{T_0} \cos^2(\omega t)\, dt} = -1 \quad !!$$

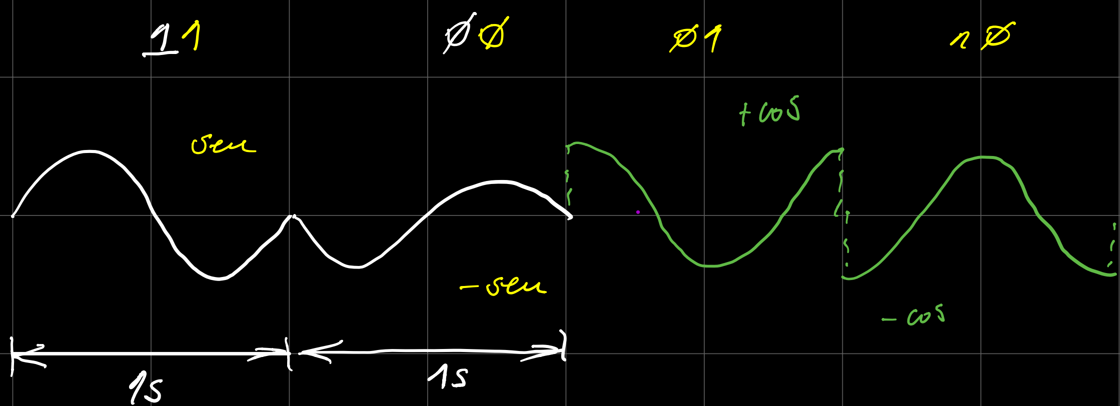
c12	0
c13	0
c14	0
c15	−1 ⇐

teste

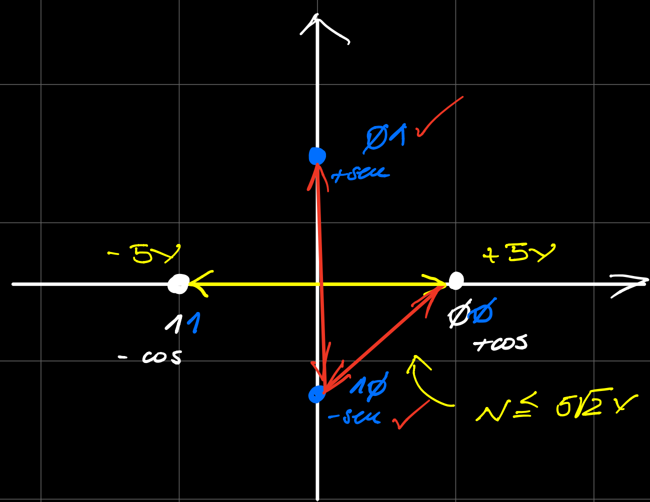
ref. $g_1(t)$

$$\frac{\int_{T_0} g?(t)\cdot x(t)\,dt}{\int_{T_0} x^2(t)\,dt}$$

$g_1(t)$

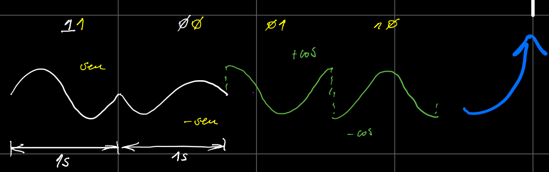


$$Rb = \frac{1\,\text{bit}}{s} \xrightarrow[2x]{} Rb = \frac{2\,\text{bits}}{s}$$



$V = 10V$

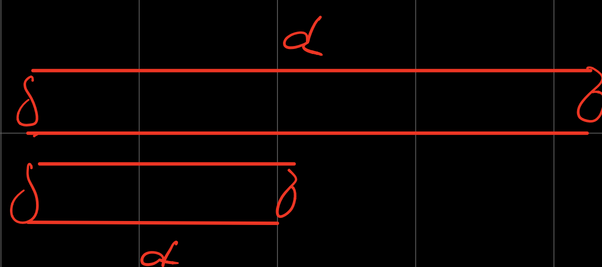
$Rb = \frac{1bit}{s}$



ganho: taxa $\frac{bits}{s}$

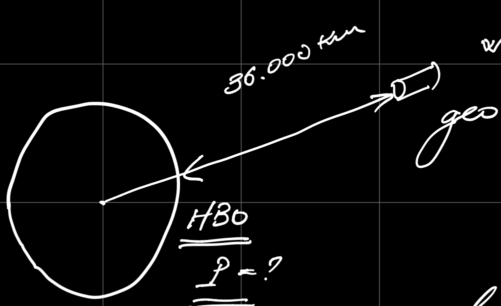
reduçã: sensibilidade

$Rb = \frac{1bit}{s} \xrightarrow[2x]{} Rb = \frac{2bits}{s}$



W → lâmpada

200W

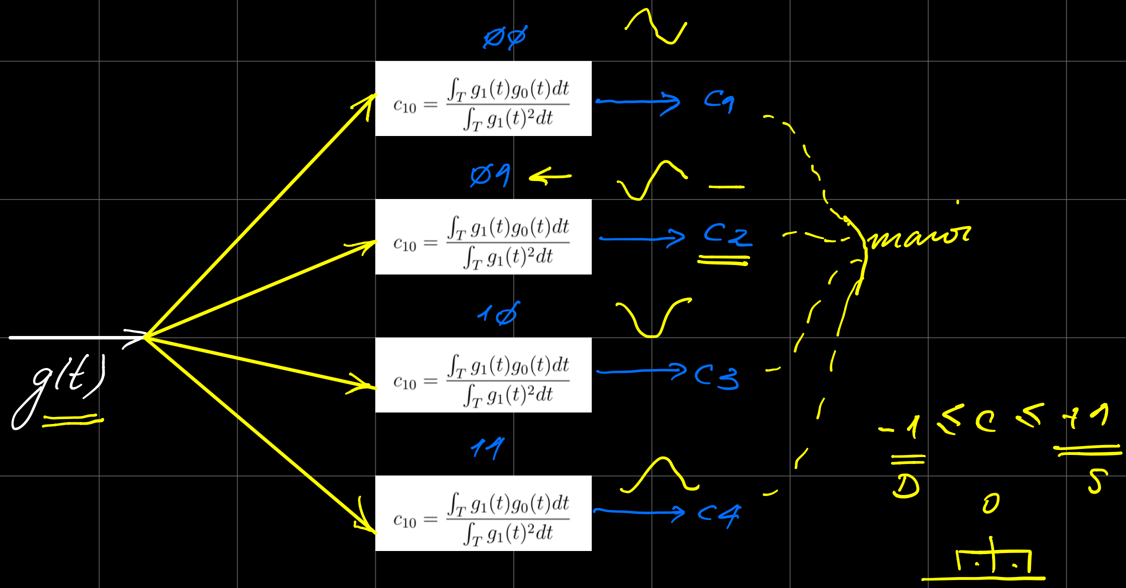


HBo

P = ?

celular $10^{-13} W = 0.1pW$

≃ 2μV



g(t)
00
$c_{10} = \frac{\int_T g_1(t) g_0(t) dt}{\int_T g_1(t)^2 dt}$
c1
01
$c_{10} = \frac{\int_T g_1(t) g_0(t) dt}{\int_T g_1(t)^2 dt}$
c2
10
$c_{10} = \frac{\int_T g_1(t) g_0(t) dt}{\int_T g_1(t)^2 dt}$
c3
11
$c_{10} = \frac{\int_T g_1(t) g_0(t) dt}{\int_T g_1(t)^2 dt}$
c4
-1 ≤ c ≤ +1
D
0
S