

PSI 2316 – Laboratório de Eletricidade

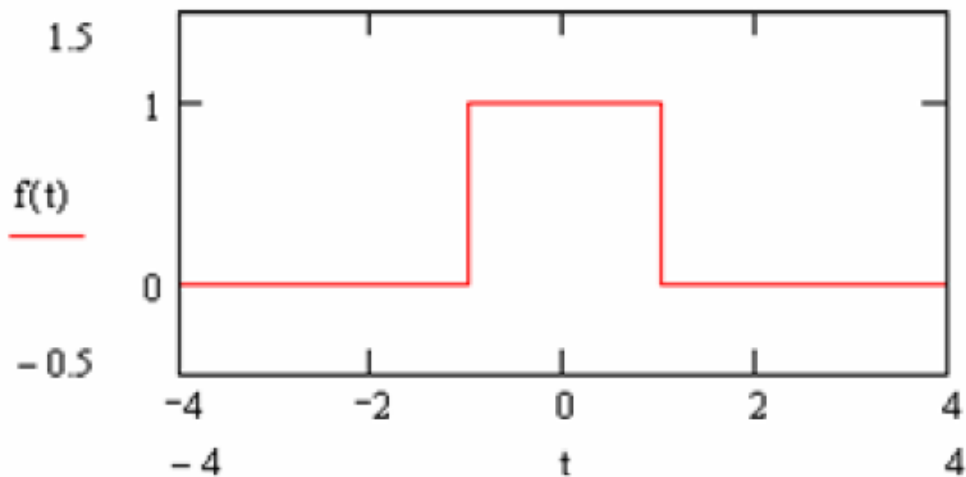
EXPERIÊNCIA 6

ANÁLISE ESPECTRAL

Profa. Elisabete Galeazzo

TRANSFORMADA DE FOURIER DE UMA FUNÇÃO PULSO RETANGULAR

FUNÇÃO PULSO RETANGULAR
(FUNÇÃO PORTA) DE DURAÇÃO "2A



$$f(t) = \begin{cases} 0, & t < -a \\ 1, & -a \leq t \leq a, \\ 0, & t > a \end{cases}$$

$$F(\omega) \equiv \mathfrak{F}\{f(t)\} \equiv \int_{-\infty}^{\infty} f(t)e^{-j\omega t} dt,$$

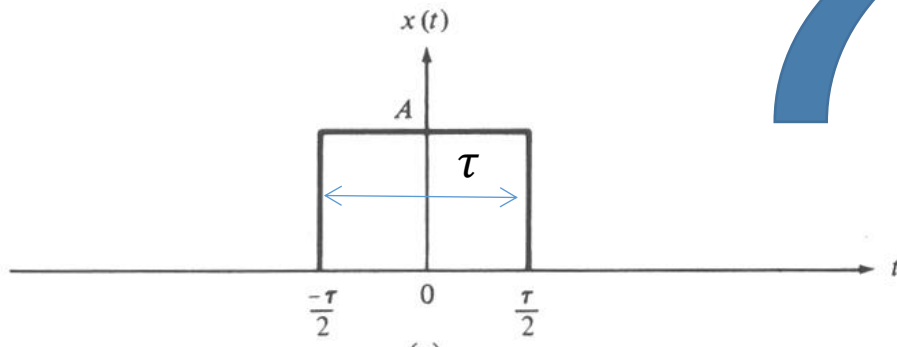
$$F(\omega) = \int_{-\infty}^{-a} 0e^{-j\omega t} dt + \int_{-a}^a 1e^{-j\omega t} dt + \int_a^{\infty} 0e^{-j\omega t} dt,$$

$$F(\omega) = \int_{-a}^a e^{-j\omega t} dt = \frac{e^{-j\omega t}}{-j\omega} \Big|_{-a}^a = \frac{e^{-j\omega a} - e^{j\omega a}}{-j\omega},$$

$$F(\omega) = \frac{e^{j\omega a} - e^{-j\omega a}}{j\omega}.$$

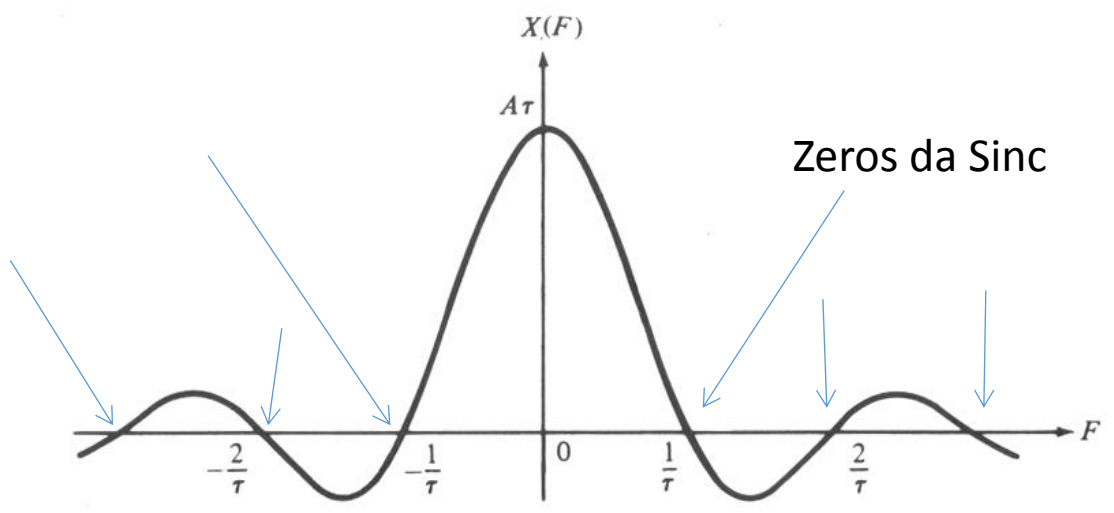
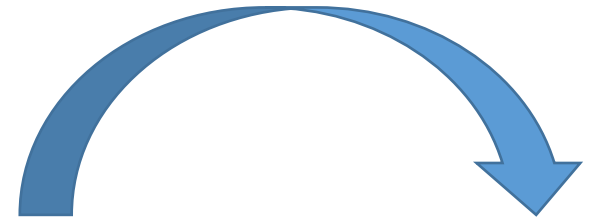
Mas, $e^{j\omega a} - e^{-j\omega a} = 2j\text{sen}(\omega a)$, então:

$$F(\omega) = \frac{2}{\omega} \text{sen}(\omega a)$$



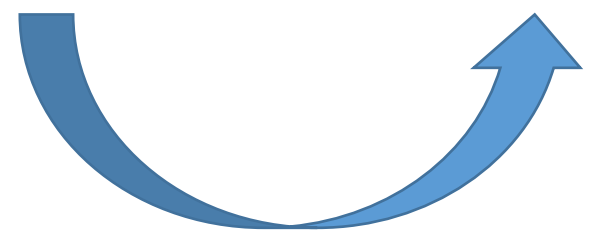
(a)

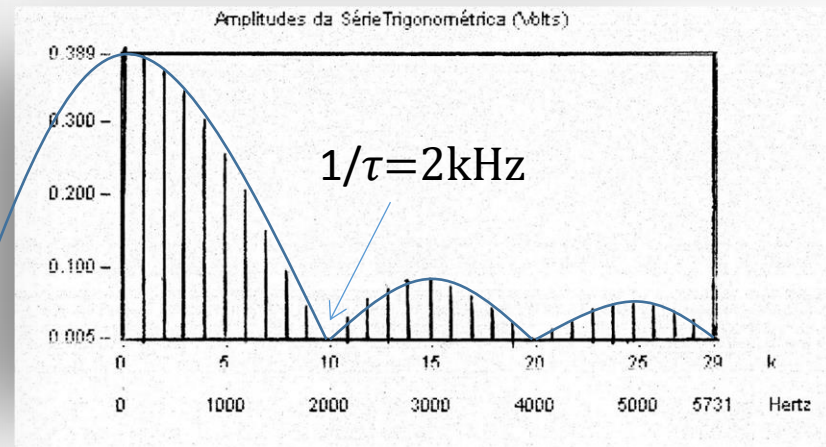
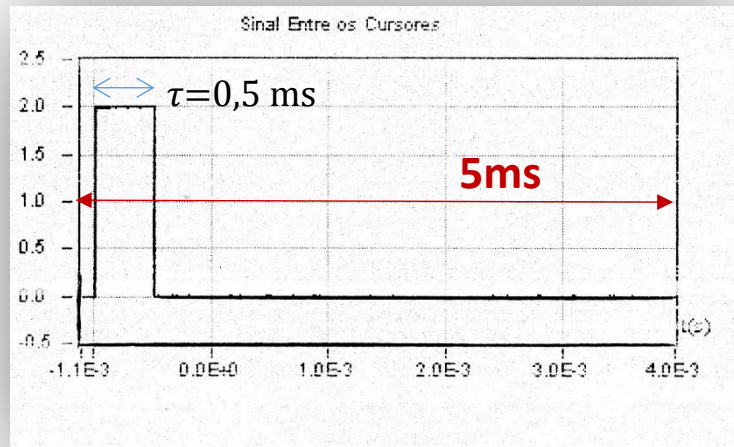
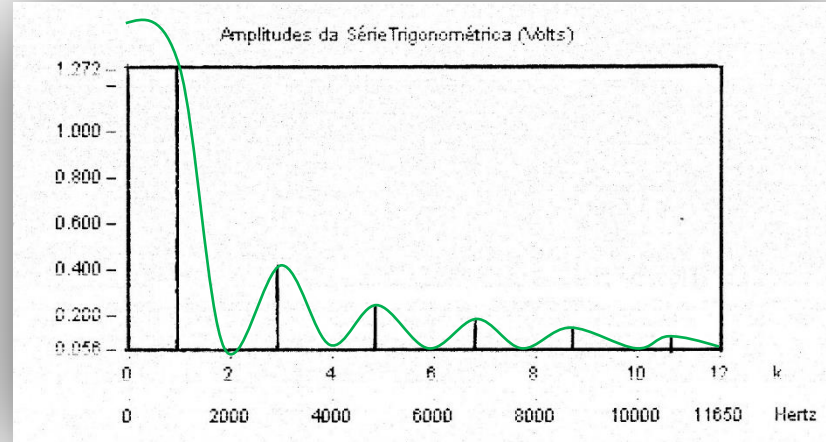
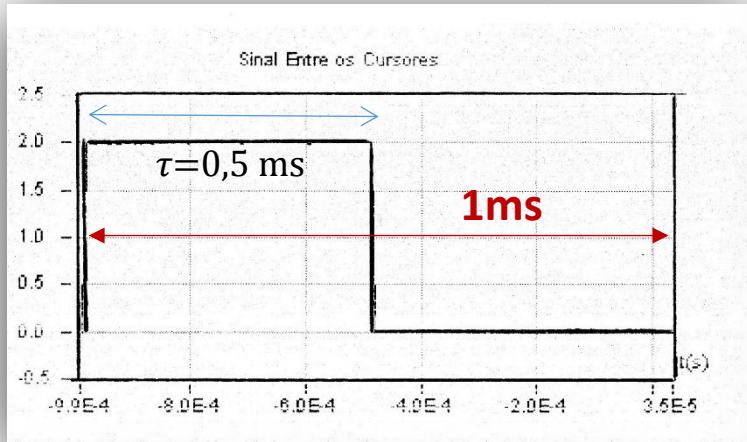
Função Pulso no domínio do tempo:
função limitada

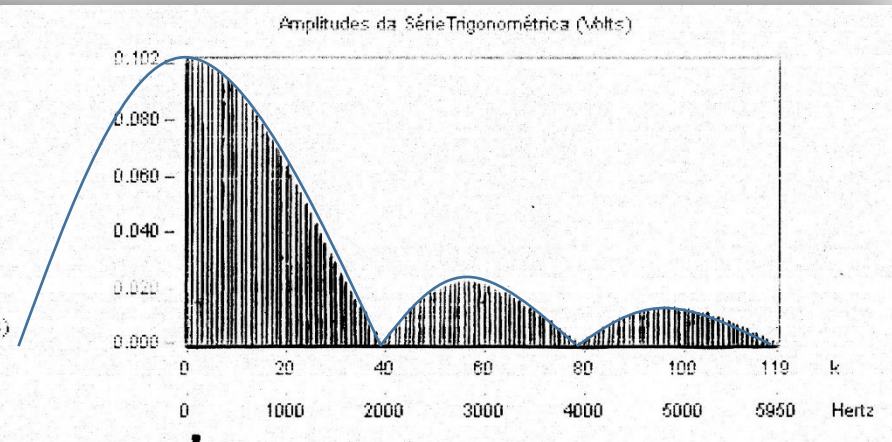
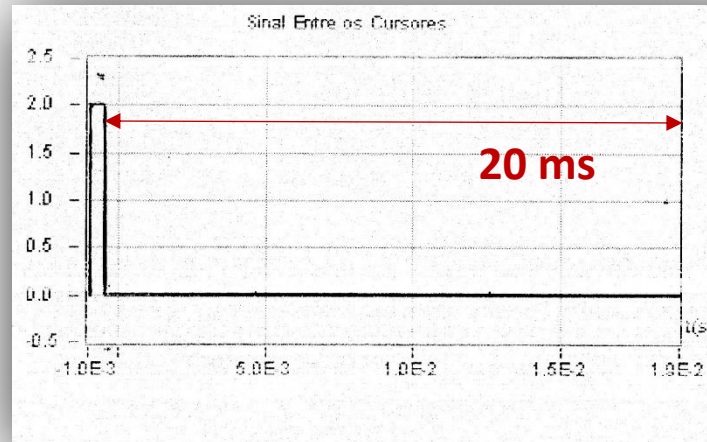
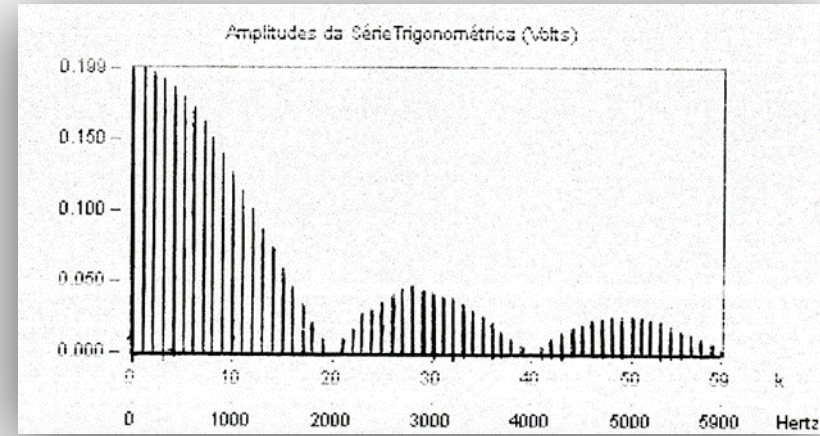
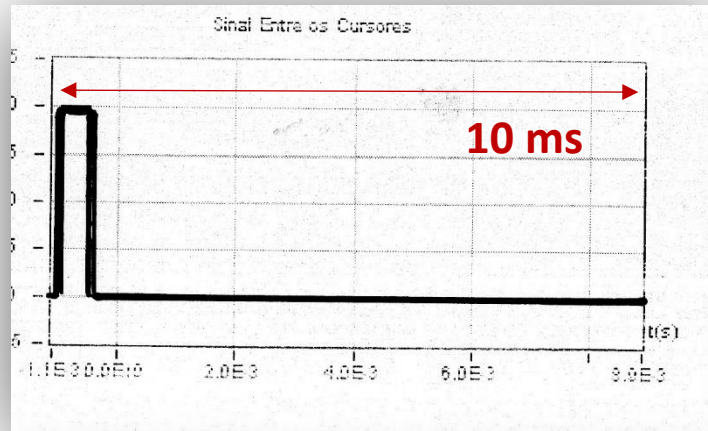


(b)

Domínio da frequência:
Espectro contínuo







PROPRIEDADE DE DESLOCAMENTO EM FREQUÊNCIA

O espectro em frequência de uma função $f(t)$ é transladado
→ ao multiplicar $f(t)$ por função cosseno

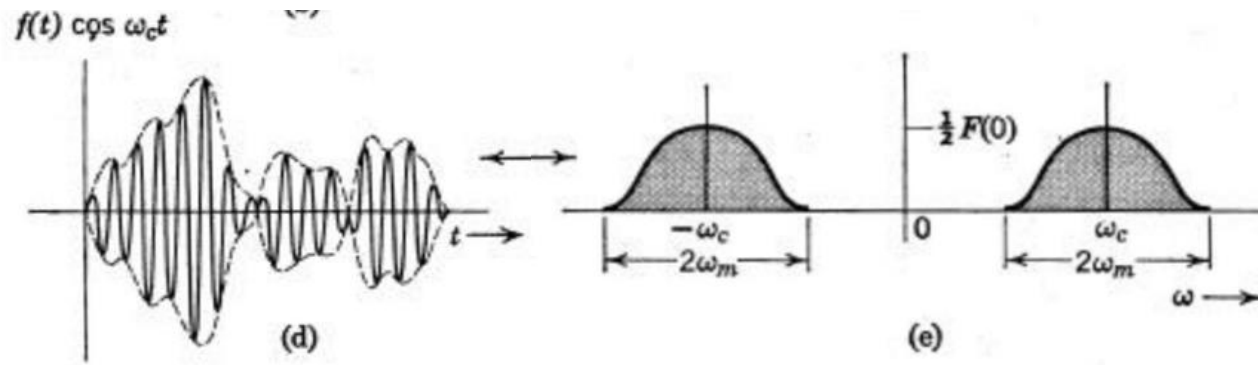
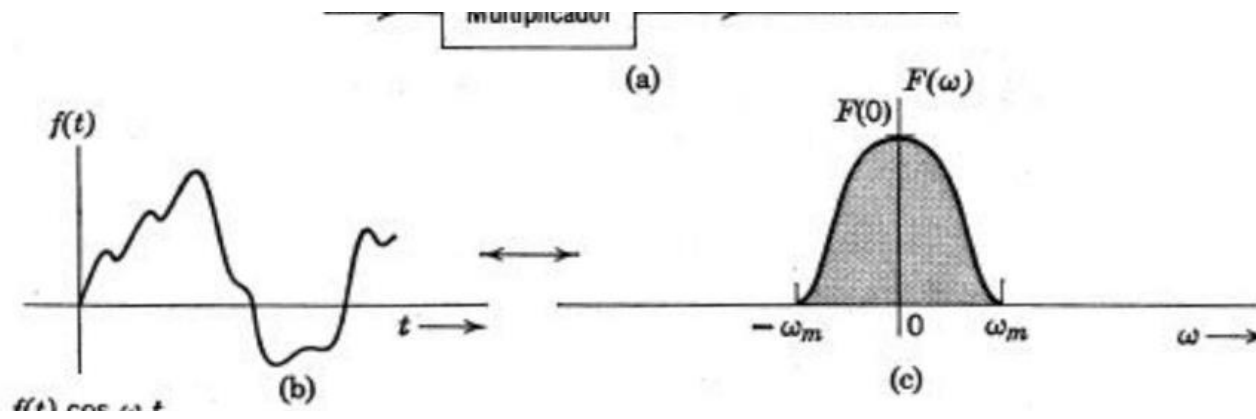
Dado $f(t) \rightarrow F(\omega)$; onde: $F(\omega) = \int_{-\infty}^{\infty} f(t)e^{-j\omega t} dt$

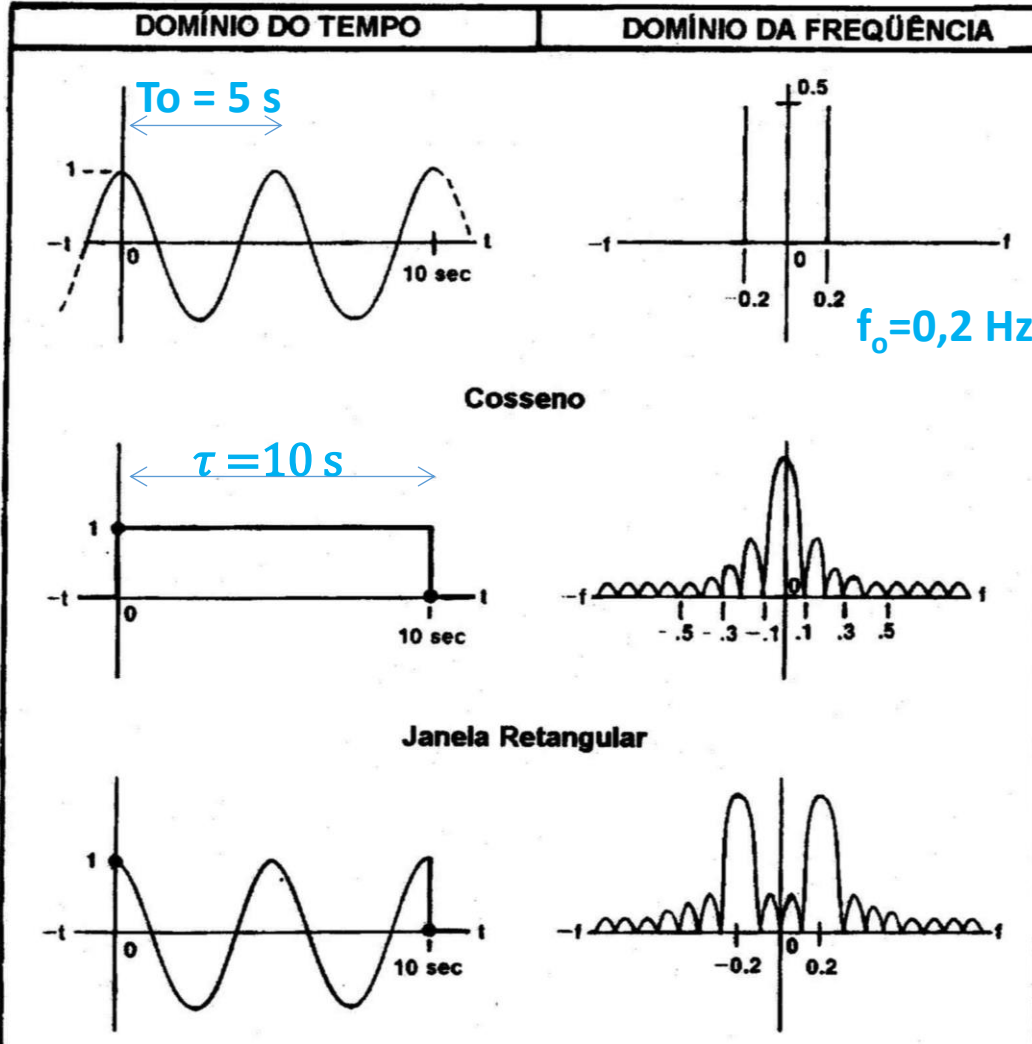
Como: $f(t).\cos(\omega_0 t) = \frac{1}{2}[f(t).e^{j\omega_0 t} + f(t).e^{-j\omega_0 t}]$

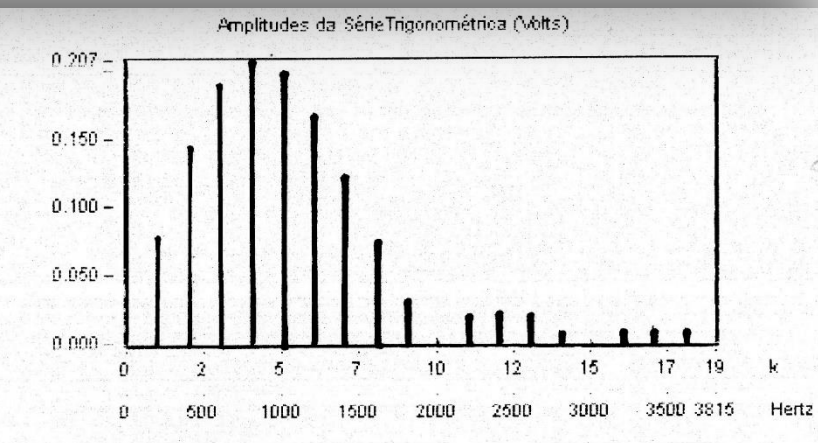
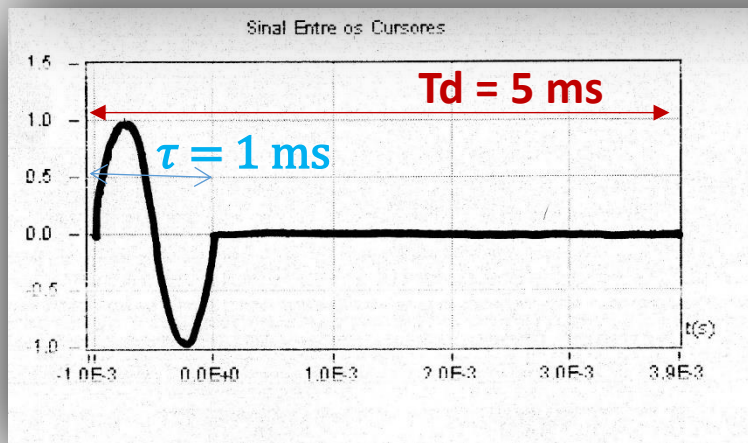
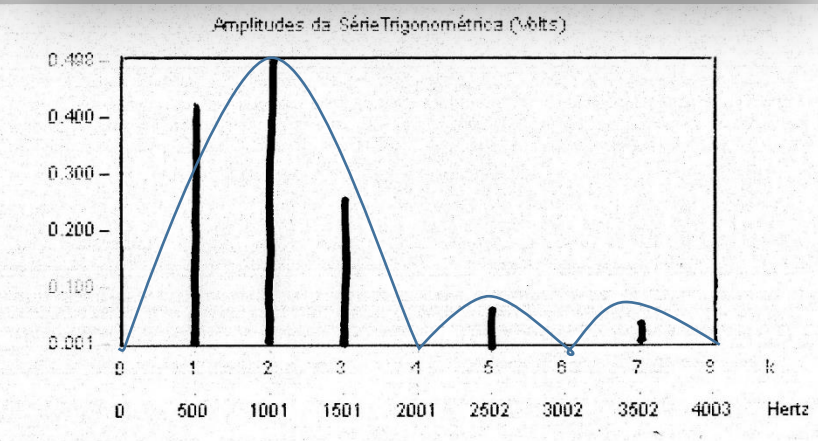
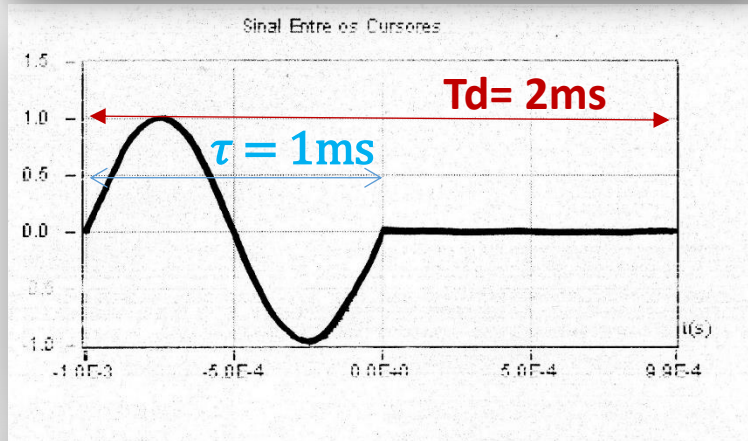
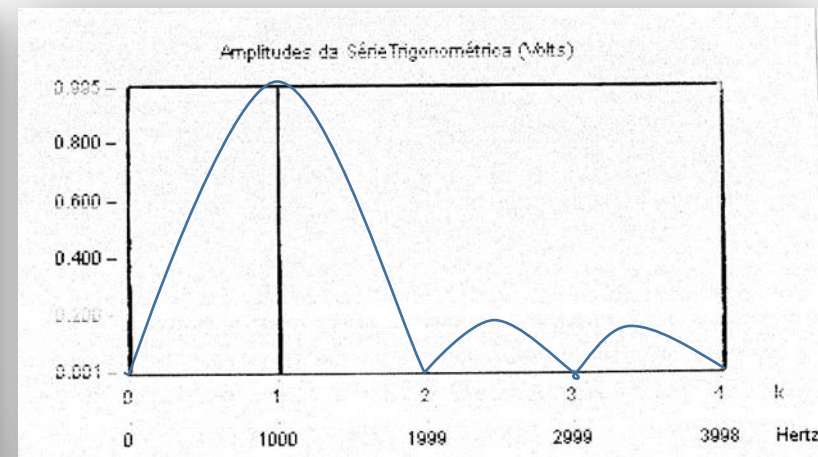
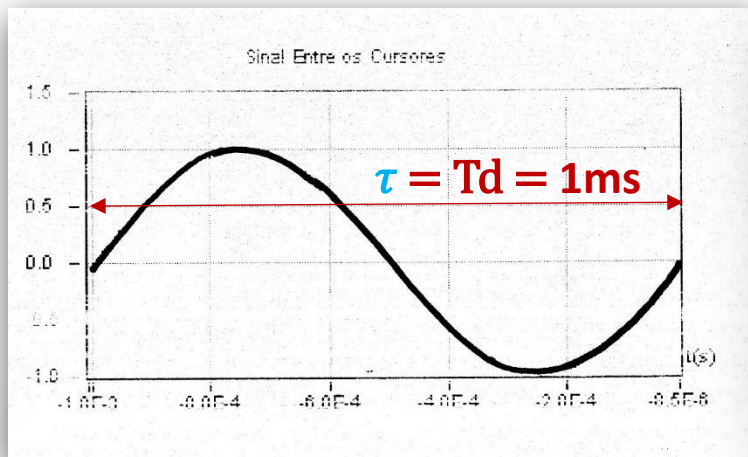
Então:

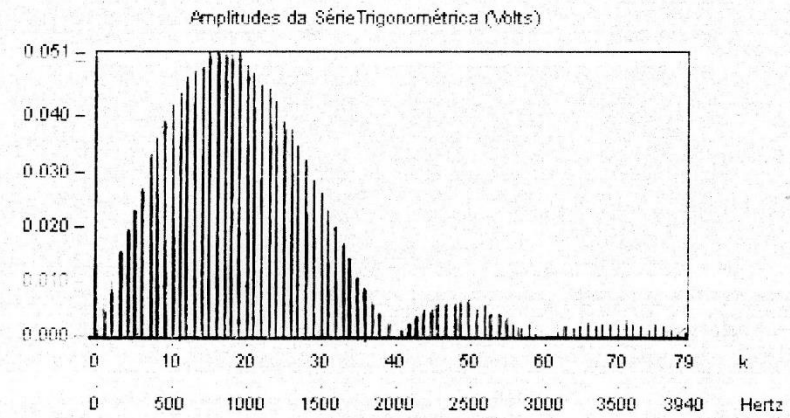
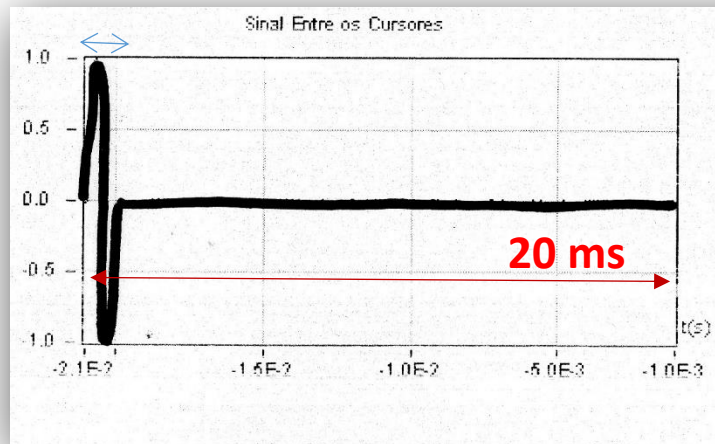
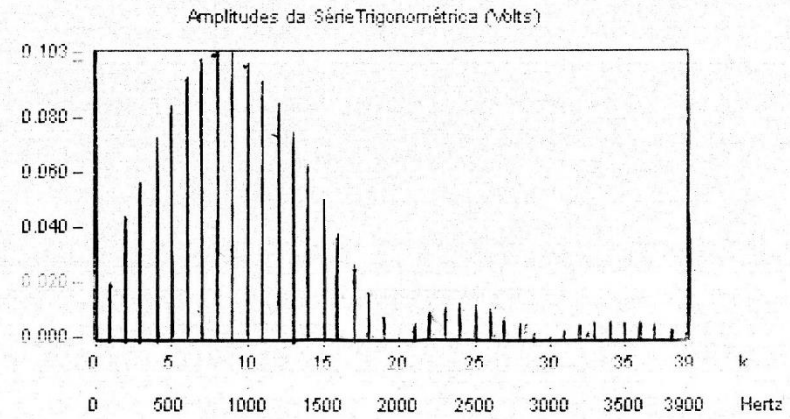
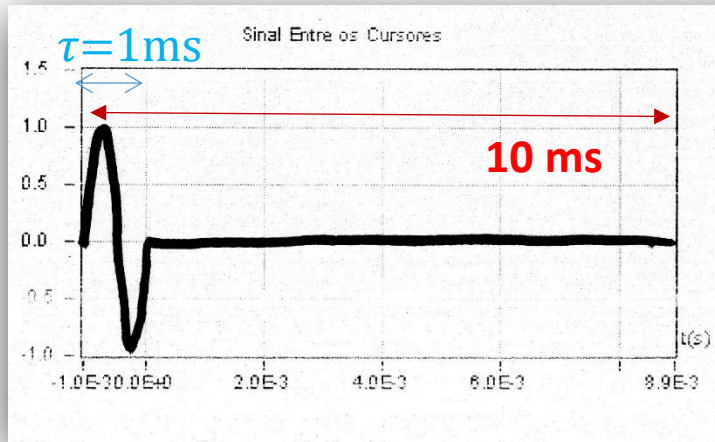
$$f(t).\cos(\omega_0 t) \Rightarrow \frac{1}{2}[F(\omega + \omega_0) + F(\omega - \omega_0)]$$

Exemplo:

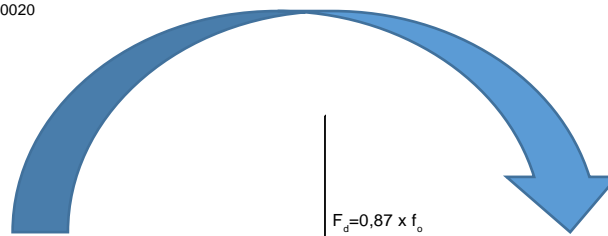
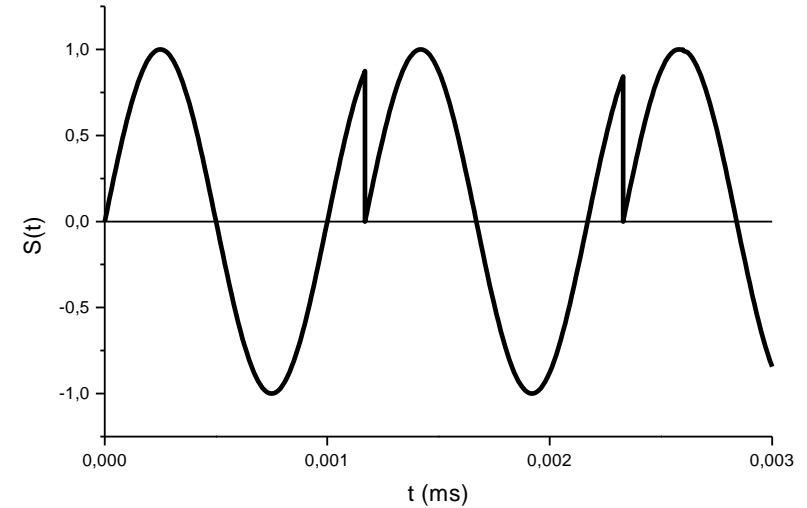
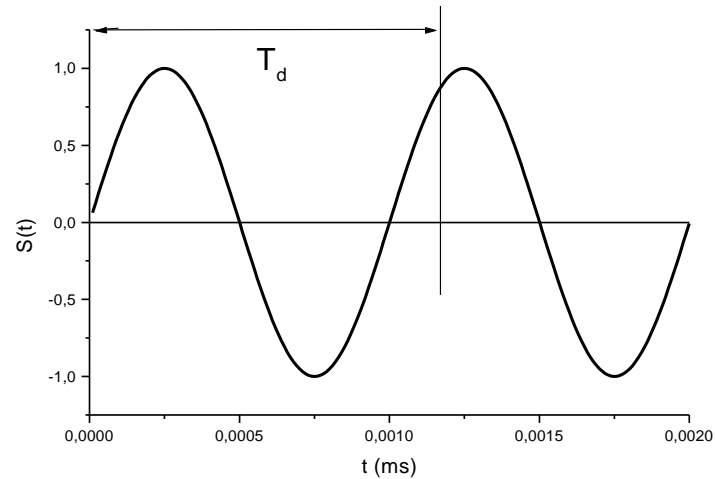




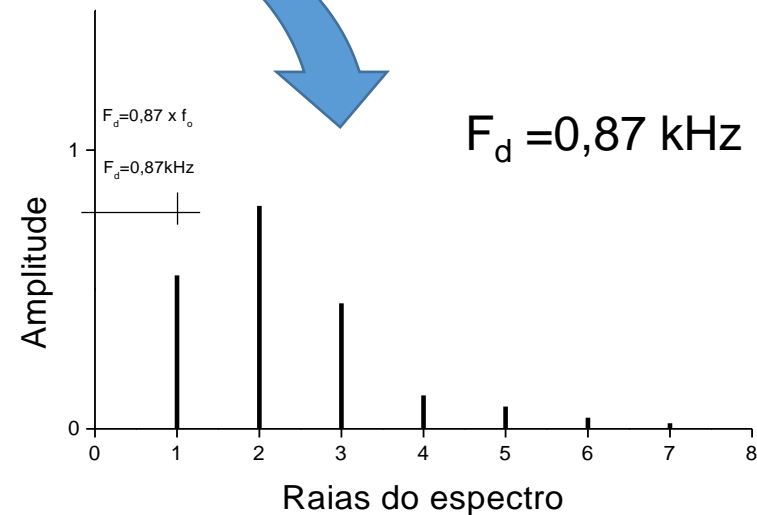




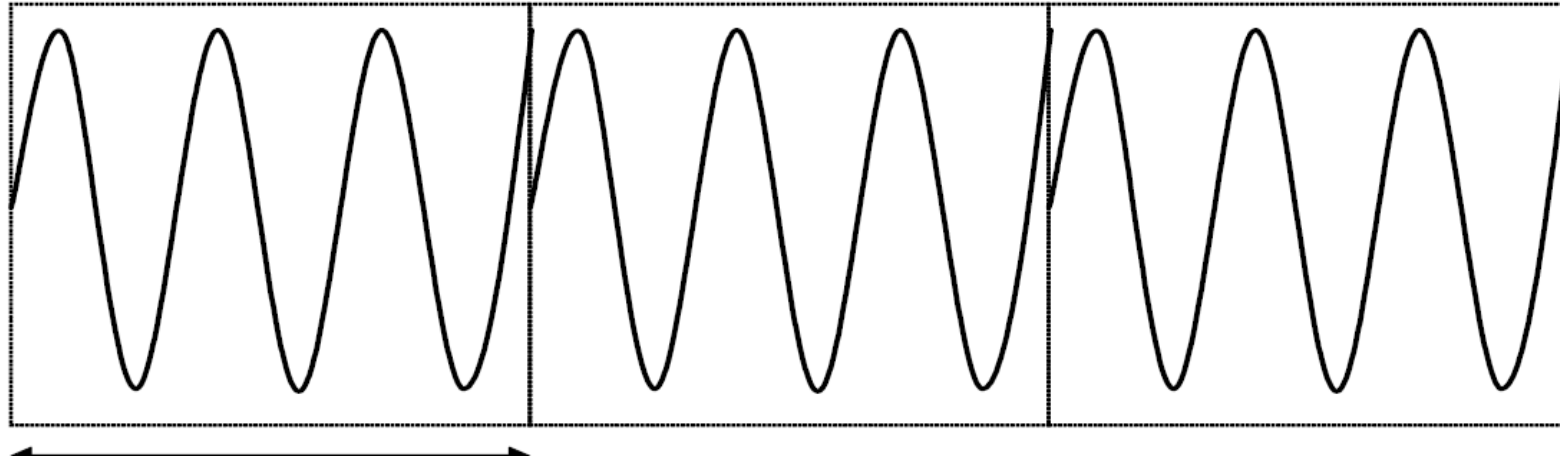
Efeito de vazamento → OCORRE → JANELAMENTO ≠ N^o EXATO DE PERÍODOS



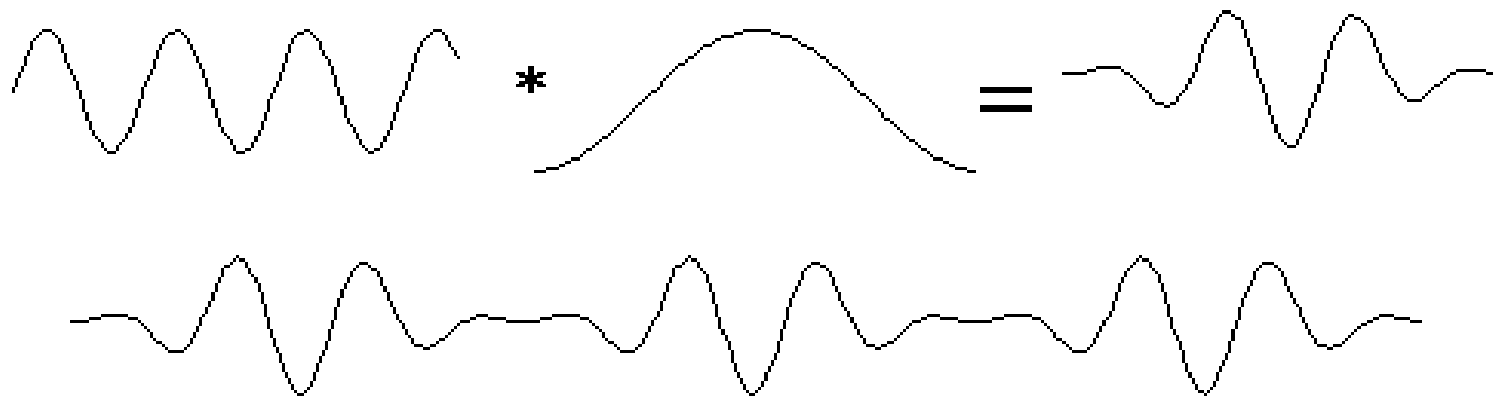
Alargamento do espectro original devido ao alto conteúdo harmônico contido nas transições abruptas



Operação de Janelamento

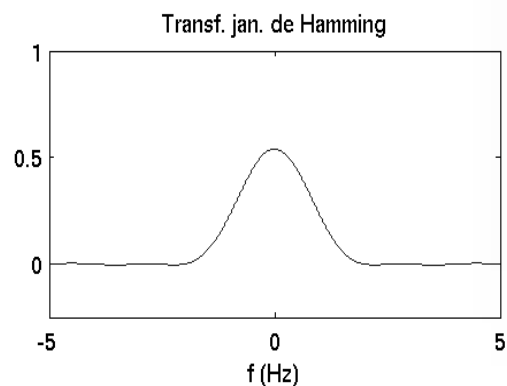
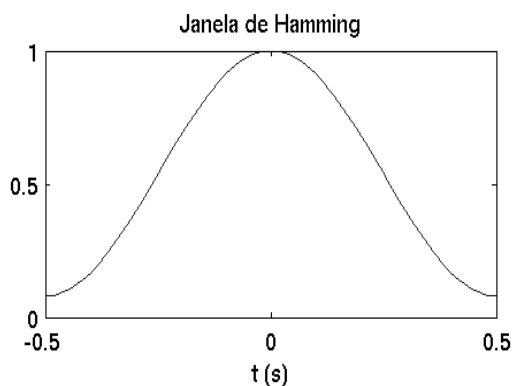
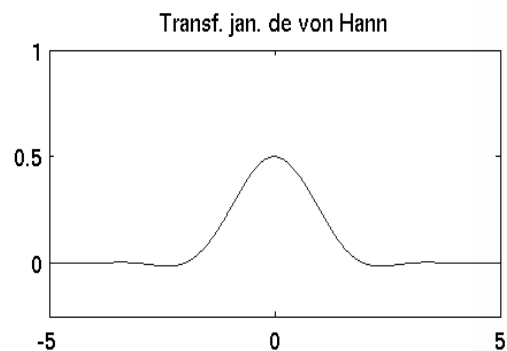
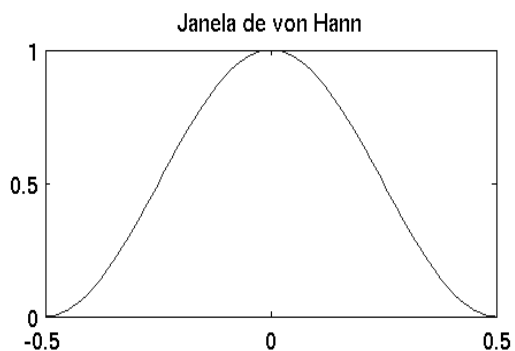
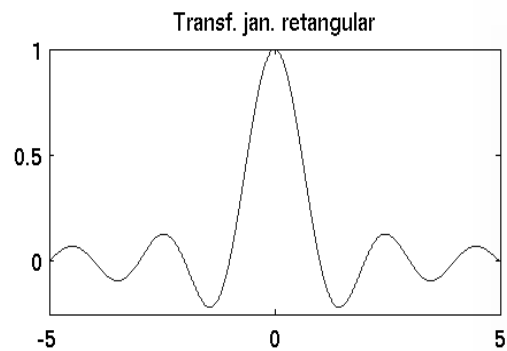
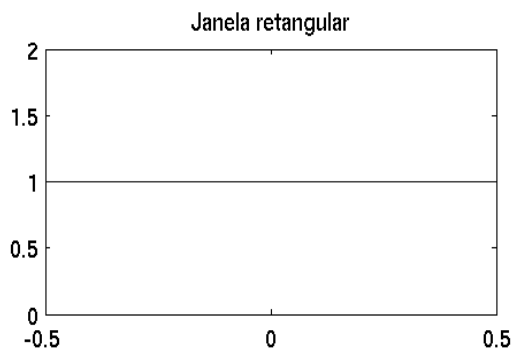


Aplicado para minimizar o efeito de descontinuidades



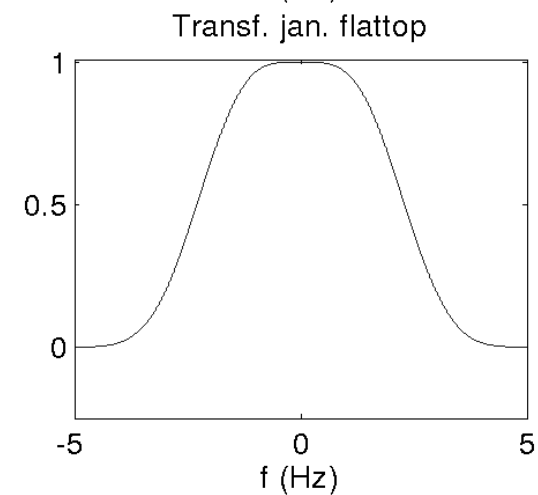
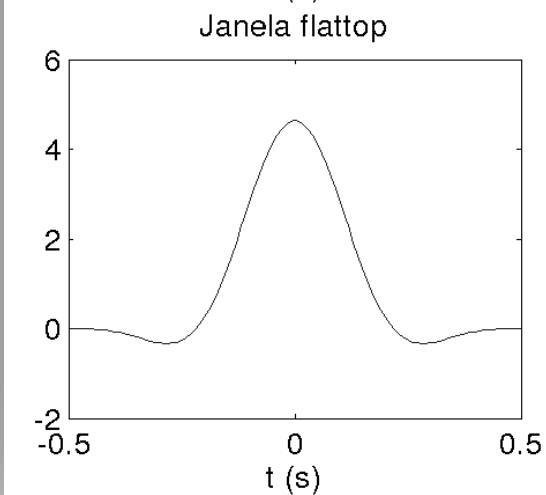
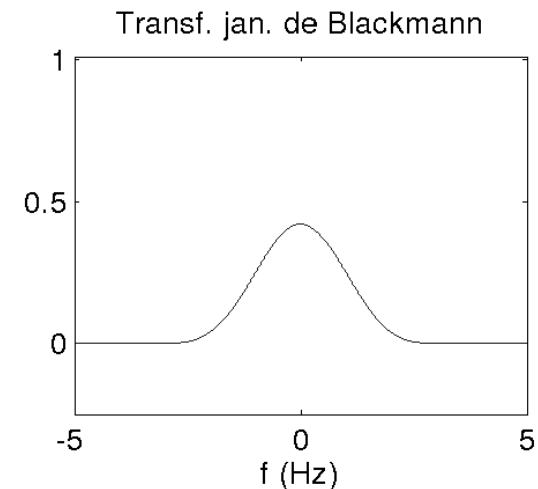
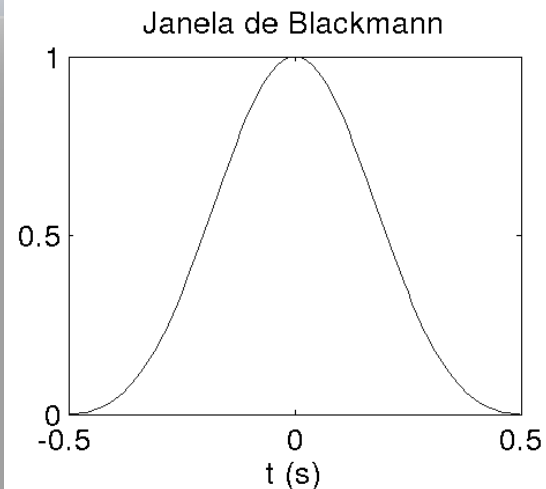
DOMÍNIO DO TEMPO
(FUNÇÃO $f(t)$)

DOMÍNIO DE FREQUÊNCIAS
(TRANSFORMADA $F(S)$)

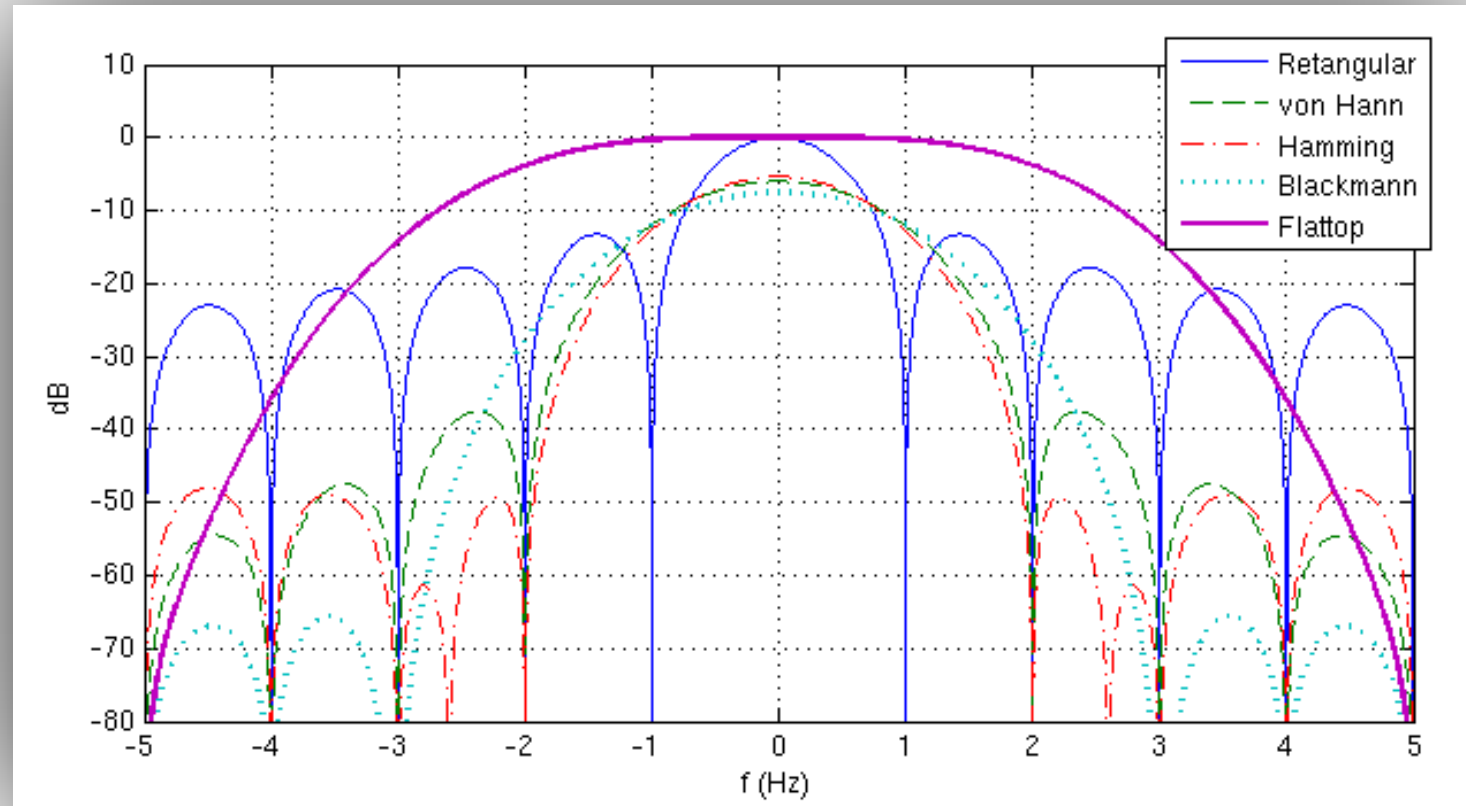


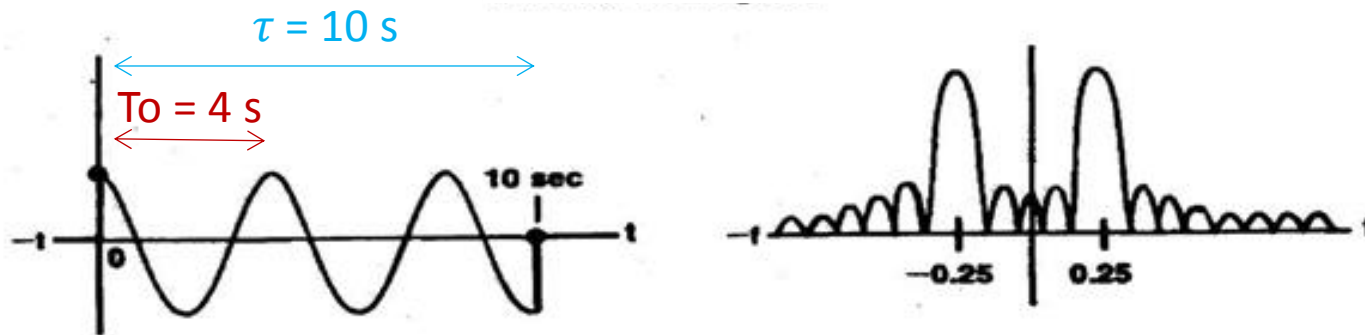
DOMÍNIO DO TEMPO
(FUNÇÃO $f(t)$)

DOMÍNIO DE FREQUÊNCIAS
(TRANSFORMADA $F(S)$)

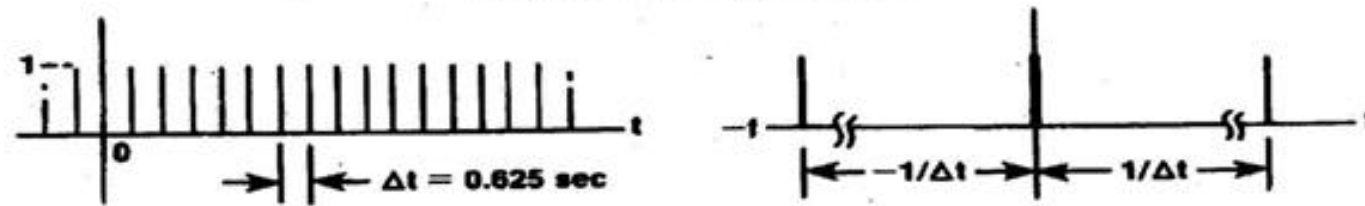


COMPARAÇÃO ENTRE AS TRANSFORMADAS DAS JANELAS USADAS NA TRANSFORMADA DISCRETA DE FOURIER





Cosseno após janelamento



Trem de impulsos para amostragem

