Serie N°. 3 (Sampling)

Exercice 01 :

Consider the sinusoidal signal s(t)=sin(2πFt) with a period T=1 ms.

Let $s_e(t)$ be the sampled signal with a sampling interval T_e=0.1 ms.

1. Represent the signals s(t) and $s_e(t)$ for one period T.
2. Let S(f) be the Fourier transform of s(t) such that $S(f) = \frac{1}{2j}[\delta(f-F) - \delta(f+F)]$.

   a. Represent S(f).

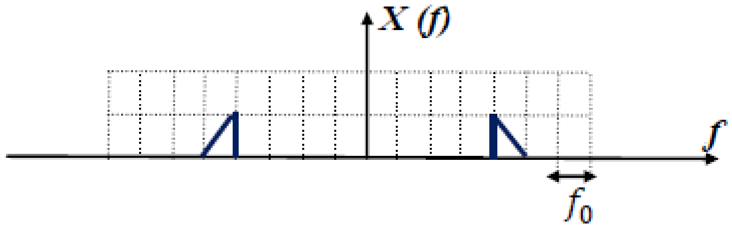
   b. Give the expression of the Fourier transform of $s_e(t)$: $S_e(f)$.

   c. Represent $S_e(f)$ for $-2 \leq n \leq 2$.

Exercice 2:

Given the signal whose spectrum is represented in the figure below, we sample this signal ideally. Plot the spectrum of the sampled signal in the cases where the sampling frequency is:

- $f_e = 2 f_0$
- $f_e = 3 f_0$
- $f_e = 10 f_0$



- Each graduation represents f_0.
- Give the smallest sampling frequency that avoids overlap.

Exercice 3:

Consider the signal s(t)=a1cos(2πf1t)+a2cos(2π3f1t) with f1>0. The signal se(t) is the sampled signal s(t) (ideal sampling) with a frequency fefe.

1. Is the signal s(t) periodic? If yes, give its period.
2. Give the expression of S(f) (Fourier Transform of s(t).
3. Give the expression of Se(f) (Fourier transform of se(t).
4. Choose f1=20 Hz, a1=1, a2=2, and fe=100 Hz. Plot on the same graph the magnitude of S(f) and (1/fe).Se(f) between 0 and fe.
5. Explain the differences between S(f) and Se(f). What is the effect of sampling on the signal spectrum ?
6. Can we correctly reconstruct s(t) from the samples of the digitized signal? Why?