Solution TD N° 1 :

Ex 1 :

$t = kT$

$x(kT) = \sin(\pi k \times T) = \sin(\pi k \times 0{,}25)$ Pour $k = 0, \pm 1, \pm 2, \dots \pm k$

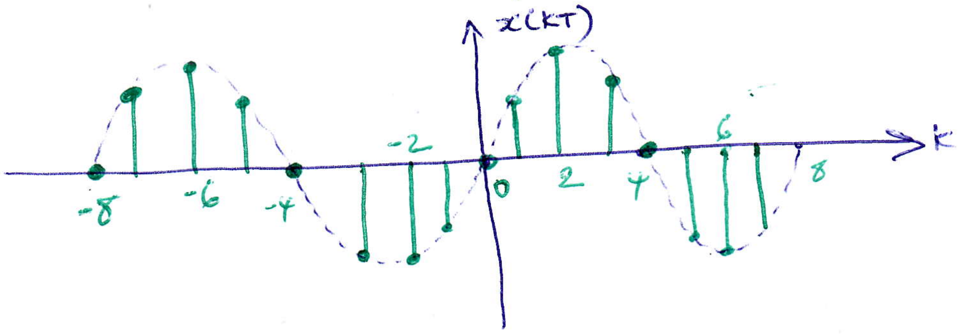
$x(-8T) = 0$ $\quad x(-7T) = \frac{1}{\sqrt{2}}$ $\quad x(-6T) = 1$

$x(-5T) = \frac{1}{\sqrt{2}}$ $\quad x(-4T) = 0$ $\quad x(-3T) = -1/\sqrt{2}$ $\quad x(-2T) = -1$

$x(-T) = -\frac{1}{\sqrt{2}}$ $\quad x(0) = 0$ $\quad x(T) = \frac{1}{\sqrt{2}}$ $\quad x(2T) = 1$

$x(3T) = \frac{1}{\sqrt{2}}$ $\quad x(4T) = 0$ $\quad x(5T) = \frac{-1}{\sqrt{2}}$ $\quad x(6T) = -1$

$x(7T) = -\frac{1}{\sqrt{2}}$ $\quad x(8T) = 0$



Ex 2

① $e(t) = \sum_{k=-\infty}^{+\infty} \delta(t - kTe)$

② S.F complexe (3ᵉ forme)

$$e(t) = \sum_{k=-\infty}^{+\infty} C_n e^{j2\pi n f_e t}$$

$$C_n = \frac{1}{T_e} \int_{-\frac{T_e}{2}}^{T_e/2} \delta(t) e^{-j2\pi f_e t} dt = \frac{1}{T_e} = f_e$$

$$\Rightarrow e(t) = \sum_{n=-\infty}^{+\infty} f_e e^{j2\pi n f_e t}$$

③ $E(f) = \int_{-\infty}^{+\infty} \sum_{n=-\infty}^{+\infty} f_e e^{j2\pi n f_e t} \cdot e^{-j2\pi f t} dt$

$$E(f) = f_e \sum_{n=-\infty}^{+\infty} \int_{-\infty}^{+\infty} e^{-j2\pi (f - n f_e) t} dt$$

$$\boxed{E(f) = f_e \sum_{n=-\infty}^{+\infty} \delta(f - n f_e)}$$

④ $X_e(f) = E(f) * X(f)$

$$X_e(f) = X(f) * f_e \sum_{n=-\infty}^{+\infty} \delta(f - n f_e)$$

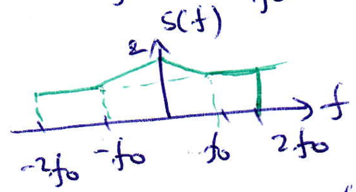
$$X_e(f) = f_e \sum_{n=-\infty}^{+\infty} X(f - n f_e)$$

Ex 3

$4 f_o \operatorname{sinc}(4\pi f_o t) \xrightarrow{TF} P_{4f_o}(f)$ (rect)

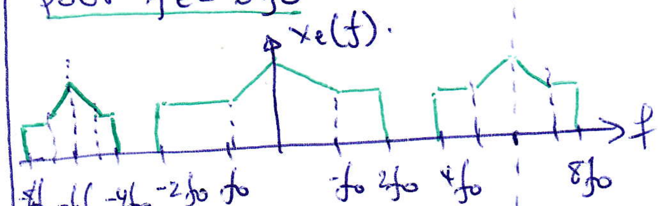
$f_o \operatorname{sinc}^2(\pi f_o t) \xrightarrow{TF} \operatorname{tri}_{2f_o}(f)$

$S(f) = P_{4f_o}(f) + \operatorname{Tri}_{2f_o}(f)$



* La fréquence min $f_e = 4 f_o$

Pour $f_e = 6 f_o$:



Ex 4

La fréquence d'ech utilisé $f_e = 6\,KHz$, ce choix n'est pas judicieux $f_{max} = 4\,KHz \Rightarrow f_e \geq 2 f_{max}$ pour permettre une reconstruction du signal

Ex 5 :

$A \operatorname{sinc}^2\left(\frac{\pi t}{T}\right) \xrightarrow{TF} AT \operatorname{tri}_{\frac{2}{T}}(f)$

$f_{max} = \frac{1}{T} \Rightarrow f_e = \frac{1}{T}$ ne peut pas reconstruire exactement le signal

$[f_e \geq 2 f_{max} = \frac{2}{T}]$