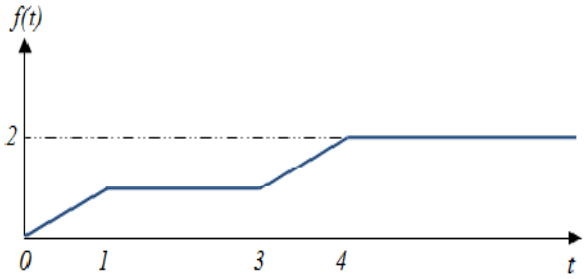
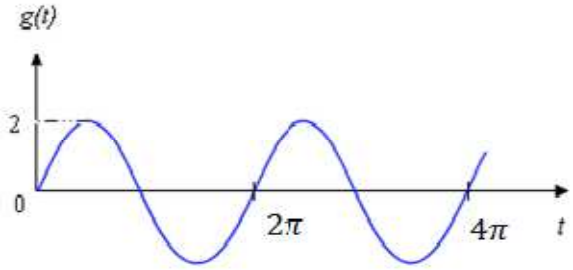
TD 1 Sampling and Z Transform

Exercise N°1:

1. Perform the graphical sampling of each of the following continuous time (Analog) signals:



(a). with : T=0.5 (sec)



(b). with: $T=\pi/6$ (sec)

2. Plot (represent graphically) the following sampled (discrete) signals :

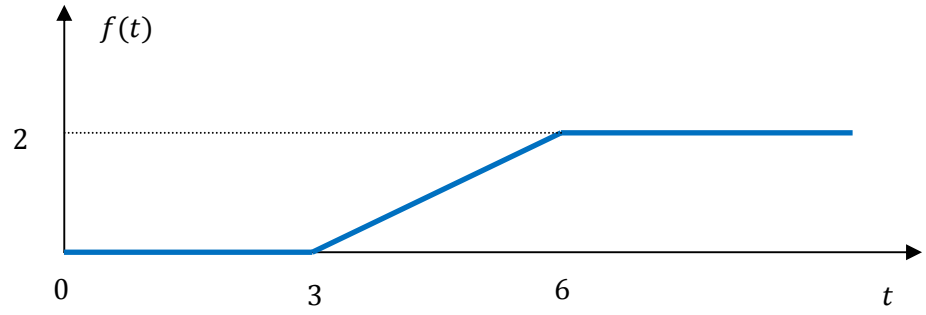
$$f_1^*(t) = \sum_{k=0}^{5} (-1)^k \, T\delta(t - kT)$$

$$f_2^*(t) = \sum_{k=0}^{5} (2)^k \, T\delta(t - kT)$$

With: $T = 1\ sec$

Exercise N°2:

1. Calculate the Z transform of the continuous time signal $f(t)$ defined by the following graph :



We give : T=1 (sec).

2. Calculate the Z transform of the following : $f(t) = e^{-4t} + te^{-2t}$, $\forall\, t \geq 0$ et $\forall\, T > 0$.
3. Calculate the Z transform of $f(t)$ such that: $3\frac{df(t)}{dt} + 2f(t) = u(t), \forall\, t \geq 0\ et\ \forall\, T > 0$, with (t) : represents the continuous time unit step function.
4. Calculate the Z transform of the discrete time signal defined according to the following table :

kT	0	1	2	3	4	5	6	7	8	. . .	∞
$f(kT)$	1	4	6	4	1	0	0	0	0	0	0

Exercise N°3 :

1. Using the **residue** method, calculate the Z transform of the following Laplace transform functions :

$$F_1(s) = \frac{s+3}{(s+1)(s+2)}, \quad F_2(s) = \frac{2s+5}{s^2-3s+2}, \quad F_3(s) = \frac{s}{(s+1)(s^2-1)}, \quad F_4(s) = \frac{1}{s^3}$$

2. Using the ***rational fractions Decomposition*** method, calculate the Z transform of the following Laplace functions :

$$F_1(s) = \frac{s+3}{(s+1)(s+2)}, \quad F_2(s) = \frac{1}{(s+1)(s+2)(s+3)}, \quad F_3(s) = \frac{1}{s^2(s-1)}$$

Exercise N° 4:

1. Determine the first elements (samples) of the sequence $\{s(k)\}$ for each of the following Z transforms:

$$S(z) = \frac{z}{z-1}, \quad S(z) = \frac{z}{(z+1)(z^2-1)}, \quad S(z) = \frac{1}{z^3-2z}$$

2. By using the rational fractions decomposition method, determine the corresponding discrete signal of the following Z functions :

a) $F_1(z) = \frac{z+1}{z+2}$, $F_2(z) = \frac{1}{z^2-1}$, $F_3(z) = \frac{(1-\alpha)z^{-1}}{(1-z^{-1})(1-\alpha z^{-1})}$, with : $\alpha = e^{-\alpha T}$, T is the sampling period.

b) $G_1(z) = \frac{1}{z-0.5}$, $G_2(z) = \frac{z-0.5}{z^2-9z+8}$, $G_3(z) = \frac{2(z+2)}{z^2+3.5z-2}$,

Exercise N° 5

Given the following Z transform functions:

$$F(z) = \frac{z^{-1}}{(1-z^{-1})(1-1.3z^{-1}+0.4z^{-2})}, \quad F(z) = \frac{z^{-1}(0.5-z^{-1})}{(1-0.5z^{-1})(1-0.8z^{-1})^2}$$

- Determine both the initial and final value of $f(kT)$.
- Calculate the inverse Z transform: $f(kT) = Z^{-1}\{F(z)\}$ of each function.