Tutorial # 1

Exercise 1 :

1- For each analog signal x_a(t), calculate its Z transform (ZT).

$x_a(t) = u(t)$

$x_a(t) = e^{-at}u(t)$ with $u(t) = \begin{cases} 1 & t > 0 \\ 0 & otherwise \end{cases}$

$x_a(t) = t\,u(t)$

2- Now from every discrete signal $x(n)$, determine its ZT by means of ZT properties.

$x(n) = a^n$

$x(n) = n - 5$

$x(n) = n+1$

$x(n) = (n + 2)^2$

$x(n) = 2^n n^2$

Exercise 2 :

We have a discrete system with the following differential relationship.

$$y(n) = -0.9y(n-5) + x(n)$$

Where $x(n)$ is a white Gaussian with a unit power.

1- Give the Z response and plot the localization of their poles and zeros.
2- Has this system a minimum phase and what can be said about its stability.
3- Deduce the frequency response of the system.
4- Calculate the system spectrum (i.e., magnitude and phase) and characterize it.

Exercise 3 :

1- Use the table method to calculate the sequence $x(n)$ from the following functions:

$$X(z) = \frac{2z(z+2)}{(z-2)^3} \quad \text{and} \quad X(z) = \frac{z^2 - 2z + 1}{(z-a)^2}$$

2- Determine the IZT of X(z) using the partial-fraction expansion method.

$$X(z) = \frac{z^2 - 2z + 1}{(z-a)^2}$$

3- Use the power-series method to compute $x(n)$ from $X(z)$.

$$X(z) = \frac{(1 - e^{-aT})z}{(z-1)(z - e^{-aT})}$$

4- Use the residues method to compute IZT of the function, $X(z) = \dfrac{6 - 9z^{-1}}{1 - 2.5z^{-1} + z^{-2}}$.