Signals and Systems Laboratory
Indian Institute of Technology Jammu
Experiment No.-1

Objective- (a) Basics of python. (b) Plotting of basics signals.
Apparatus- Python.
Theory-
1. Unit Impulse Function:
A continuous-time unit impulse function is denoted by $\delta(t)$ and can be expressed as,

$$\delta(t) = \begin{cases} 0 & t \neq 0 \\ \infty & t = 0 \end{cases}$$

A discrete-time unit impulse function is denoted by $\delta(n)$ and can be expressed,

$$\delta(n) = \begin{cases} 1 & n = 0 \\ 0 & n \neq 0 \end{cases}$$

2. Unit Step Function;
A continuous-time unit step function is denoted by u(t) and can be expressed as,

$$u(t) = \begin{cases} 0 & \text{for } t < 0 \\ 1 & \text{for } t > 0 \end{cases}$$

A discrete-time unit step function is denoted by u(n) and can be expressed as,

$$u(n) = \begin{cases} 0 & \text{for } n < 0 \\ 1 & \text{for } n \geq 0 \end{cases}$$

3. Unit Ramp Function:
A continuous-time unit ramp function is denoted by r(t) and can be expressed as,

$$r(t) = \begin{cases} 0 & \text{for } t < 0 \\ t & \text{for } t > 0 \end{cases}$$

A discrete-time unit ramp function is denoted by r(n) and can be expressed as,

$$r(n) = \begin{cases} 0 & \text{for } n < 0 \\ n & \text{for } n \geq 0 \end{cases}$$

4. Unit Parabolic Signal:
A continuous-time parabolic signal is denoted by p(t) and can be expressed as,

$$p(t) = \begin{cases} \frac{t^2}{2} & \text{for } t \geq 0 \\ 0 & \text{for } t < 0 \end{cases}$$

A discrete-time parabolic signal is denoted by p(n) and can be expressed as,

$$p(n) = \begin{cases} \frac{n^2}{2} & \text{for } n \geq 0 \\ 0 & \text{for } n < 0 \end{cases}$$

5. Exponential Signal:

A continuous-time real exponential signal is defined for every instant of time and can be expressed as,

$$x(t) = Ae^{\alpha t}$$

where, A and α both are real. Here, the parameter A is the amplitude of the exponential signal measured at t=0 and the parameter α can be either positive or negative.
Depending upon the value of α, we obtain different exponential signals as-

- When $\alpha = 0$, the exponential signal x(t) is a signal of constant magnitude for all times.
- When $\alpha > 0$, i.e., α is positive, then the exponential signal x(t) is a growing exponential signal.
- When $\alpha < 0$, i.e., α is negative, then the signal x(t) is a decaying exponential signal.

A discrete-time exponential signal is defined at discrete instants of time and can be expressed as,

$$x(n) = \begin{cases} a^n & \text{for all n} \end{cases}$$

Depending upon the value of a, we obtain different exponential signals as-

- When $a < 1$, the exponential signal x(n) grows exponentially.
- When $0 < a < 1$, the exponential signal x(n) is decays exponentially.
- When $a < 0$, the exponential signal x(n) takes alternating signs.

6. Random Signals:
Non-deterministic signals are called random signals. A non-deterministic signal is one whose occurrence is always random in nature. The pattern of such a signal is quite irregular. For example, thermal noise generated in an electric circuit. Such a noise signal has probabilistic behaviour.
Algorithm-

a. Start the process.
b. Generate unit impulse, unit step, unit ramp, exponential, parabolic, sine waveform, cosine waveform, random signal.
c. Execute the program.
d. Plot the output for each function.
e. Stop the process.

Observations-
Result- Generated unit impulse, unit step, unit ramp, exponential, parabolic signal, sine waveform, cosine waveform, and random signal using python.
Precautions:-

- Program must be written carefully to avoid errors.
- Programs can never be saved as standard function name.
- Commands must be written in proper format.