

EXPERIMENT NO: 1

To Study and Analyze Different Signals

Objective:

- A. To demonstrate the elementary analog signals
- B. To demonstrate the different combinations of analog signals
- C. To demonstrate the scaling and shifting properties of signals
- D. To compute the energy or power of different signals

Theory:

A signal is a source of information generally a physical quantity which varies with respect to time, space, temperature or any independent variable. Some examples of signals are human voice, electrocardiogram, sign language, videos etc.

Elementary analog signals:

1- Unit step function

The unit step function $u(t)$ is defined as,

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

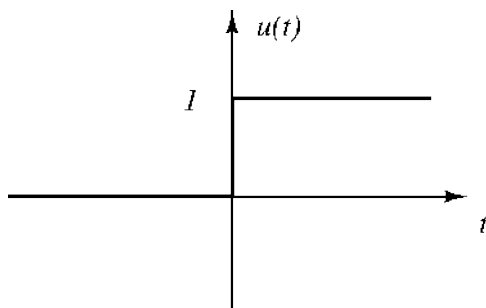


Fig.1. continuous time unit step function

2- Unit impulse function

The unit impulse function has zero width, infinite height and an integral (area) of one.

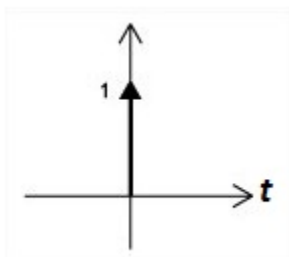


Fig.2. impulse function

3- Ramp signal

The ramp function is defined as

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

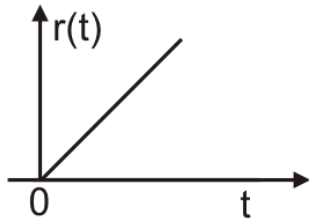


Fig.3. ramp signal

4- Real and complex exponential signal

A real exponential signal is defined as $x(t) = Ae^{\sigma t}$, where both A and σ are real

The complex exponential signal is given by $x(t) = Ae^{st}$, where s is a complex variable and is represented by $s = \sigma + j\omega$

Waveforms to be observed:

Part-A:

- i) $\sin(2\pi f_0 t)$
- ii) e^{2st}
- iii) $u(t)$
- iv) $\text{sign}(t)$
- v) $tu(t)$
- vi) $\delta(t)$
- vii) $u\left(t + \frac{1}{2}\right) - u\left(t - \frac{1}{2}\right)$
- viii) $\text{ramp}(t + 1) - 2\text{ramp}(t) + \text{ramp}(t - 1)$
- ix) $\sin(\pi t) / \pi t$
- x) $\sin(N\pi t) / N\sin(\pi t)$

Part-B:

- i) $x(t) = e^{-2t} \sin(13\pi t) - e^{\frac{t}{8}} \sin(20\pi t)$
- ii) $x(t) = \text{sinc}\left(\frac{t}{2}\right) \cos(17\pi t)$

Part-C:

$$f(t) = \begin{cases} 0; & t < -2 \\ -8 + 3t; & -2 < t < 0 \\ 9 - \frac{t}{7}; & 0 < t < 4 \\ 28 + 2t; & 4 < t < 8 \\ 0; & t > 8 \end{cases}$$

- i) $6f(t - 1)$
- ii) $\left(\frac{2}{3}\right)f\left(\frac{t}{8}\right)$
- iii) $-9f\left(\frac{5t}{3} + 2/7\right)$

Part-D:

- i) $x(t) = \text{tri}\left(2t + \frac{5}{6}\right)$
- ii) A periodic signal of fundamental period 30 described over one period $x(t) = 3t, -15 < t < 15$ and compare these two outputs with theoretical calculations

MATLAB Program:

The student must write the code from .mfile and associated functions used in this section.

Results:

Using an example, the student must clearly mention input arguments used and corresponding output obtained (in the form of numerical values / graphs) in this section separately for **Parts A, B, C, and D**.

Comments on the results:

The student must describe in short the inferences drawn from the experiment and observations from the results obtained in his/ her own words.
