Experiment No: 1 Date: 01/08/2024

Simulation of Basic Test Signals

Aim

To generate continuous and discrete signals

1. Impulse signal
2. Unit step signal
3. Ramp signal
4. Sinusoidal signal
5. Cosine signal
6. Bipolar signal
7. Unipolar signal
8. Exponential signal
9. Triangular Wave

Theory

1. **Impulse:** The simplest signal is the unit impulse signal which is defined as
$$\delta(t) = \begin{cases} 0, & \text{if } t \neq 0 \\ \infty, & \text{if } t = 0 \end{cases}$$

2. **Step:** The general form of step function is
$$u(t) = \begin{cases} 1 \; for \; t \geq 0 \\ 0 \; for \; t < 0 \end{cases}$$

3. **Ramp:** This signal is given by,
$$r(t) = \begin{cases} t \; for \; t \geq 0 \\ 0 \; for \; t < 0 \end{cases}$$

4. **Sine:** A sinusoidal sequence is defined as,
$$x(t) = Asin(\omega t + \varphi)$$

5. **Cosine:** A Cosine sequence is defined as,
$$x(t) = Acos(\omega t + \varphi)$$

6. **Bipolar:** A square wave is a type of periodic waveform that alternates between two distinct levels, typically +A and -A in a bipolar signal. It has a 50% duty cycle, meaning the signal spends equal time at both levels. The equation for a bipolar square wave can be written as,
$$\mathrm{p(t)} = \begin{cases} \mathrm{A}, |\mathrm{t}| \leq {}^{\tau}/_{2} \\ 0, \mathrm{Otherwise} \end{cases}$$

7. **Unipolar:** A unipolar square wave is a periodic signal that alternates between 0 and a positive voltage level (e.g., V_max) with abrupt transitions. It has no negative amplitude**.** (A is positive)

$$p(t) = \begin{cases} A, |t| \leq {}^{\tau}/_{2} \\ 0, \text{Otherwise} \end{cases}$$

8. **Exponential**: The decaying exponential is a basic signal in DSP whose general form is

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

9. **Triangular:** A triangular signal is a type of periodic waveform that linearly rises and falls between a maximum and minimum value, forming a triangular shape. The transition between the high and low levels in a triangular wave is gradual, creating a linear slope.

Program

```
%% Experiment Number 1 - SIMULATION OF BASIC TEST SIGNALS


clc;
clear;
close all;


% Unit Impulse
t1=-5:1:5;
y1=[zeros(1,5),ones(1,1),zeros(1,5)];
subplot(3,3,1);
stem(t1,y1);
xlabel('Time Index');
ylabel('Amplitude');
title('Unit Impulse');


% Unit Step
t2=-5:1:5;
y2=[zeros(1,5),ones(1,6)];
subplot(3,3,2);
stem(t2,y2,'DisplayName','Discrete');
xlabel('Time Index');
ylabel('Amplitude');
title('Unit Step');
```

```
%Unit Ramp
t3=0:1:5;
y3=t3;
subplot(3,3,3);
plot(t3,y3,'DisplayName','Continuous');
hold on;
stem(t3,y3,'DisplayName','Discrete');
hold off;
xlabel('Time Index');
ylabel('Amplitude');
title(' Ramp');
legend show;

% Sin
t4=0:0.01:1;
f1=10;
y4=sin(2*pi*f1*t4);
subplot(3,3,4);
plot(t4,y4,'DisplayName','Continuous');
hold on;
stem(t4,y4,'DisplayName','Discrete');
hold off;
xlabel('Time Index');
ylabel('Amplitude');
title('Sin');
legend show;

%Cos
t5=0:0.01:1;
f2=10;
y5=cos(2*pi*f2*t5);
subplot(3,3,5);
plot(t5,y5,'DisplayName','Continuous');
hold on;
stem(t5,y5,'DisplayName','Discrete');
hold off;
xlabel('Time Index');
ylabel('Amplitude');
title('Cos');
legend show;

%Bipolar
t6 = 0:0.001:1;
f3 = 10;
y6 = square(2*pi*f3*t6);
subplot(3,3,6);
plot(t6, y6, '-');
axis([0 1 -2 2]);
xlabel('Time Index');
```

```
ylabel('Amplitude');
title('Bipolar');

% Unipolar
t7 = 0:0.001:1;
f4 = 10;
y7 = sqrt(square(2*pi*f4*t7));
subplot(3,3,7);
plot(t7, y7, '-');
axis([0 1 -2 2]);
xlabel('Time Index');
ylabel('Amplitude');
title('Unipolar');

% Exponential Decay
t9=0:0.01:1;
y9=exp(-t9);
subplot(3,3,8);
plot(t9,y9, '-', 'DisplayName','Continous');
hold on;
stem(t9,y9,'DisplayName','Discrete');
hold off;
axis([0 1 -2 2]);
xlabel('Time Index');
ylabel('Amplitude');
title('Decaying Exponential');
legend show;

% Triangular
t8=0:0.25:50;
f8=5;
subplot(3,3,9);
plot(t8,sin(2*pi*f8*t8), 'DisplayName','Continuous');
hold on;
stem(t8,sin(2*pi*f8*t8),'DisplayName','Discrete');
hold off;
axis([0 10 -1 1]);
xlabel('Time Index');
ylabel('Amplitude');
title('Triangular');
legend show;
```

Result

Simulated Continuous and Discrete waveforms for Basic Test Signals.

Observation