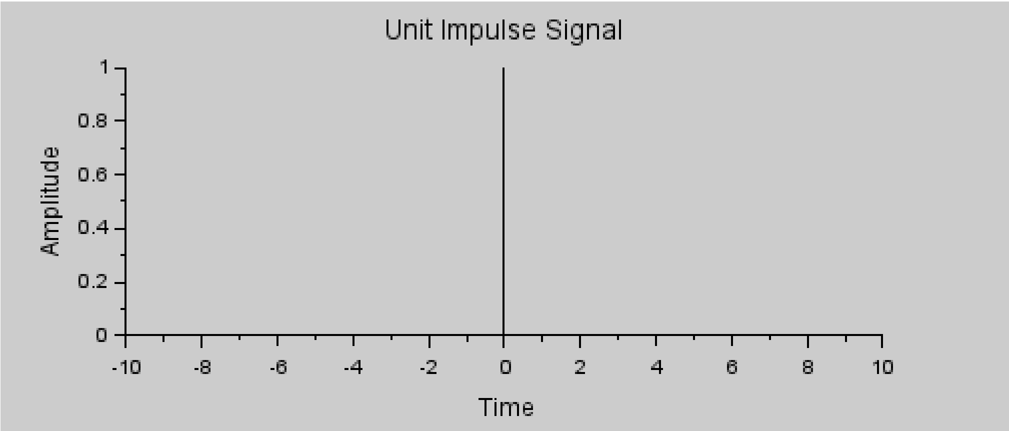
1. Generation of Common Discrete Time Signals

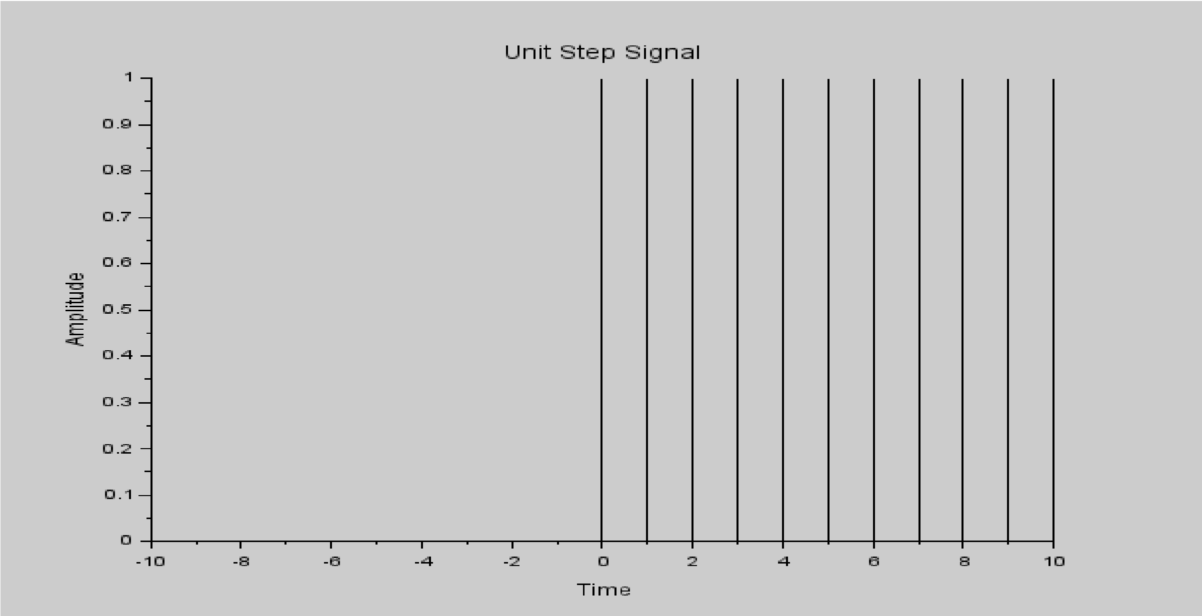
Program:

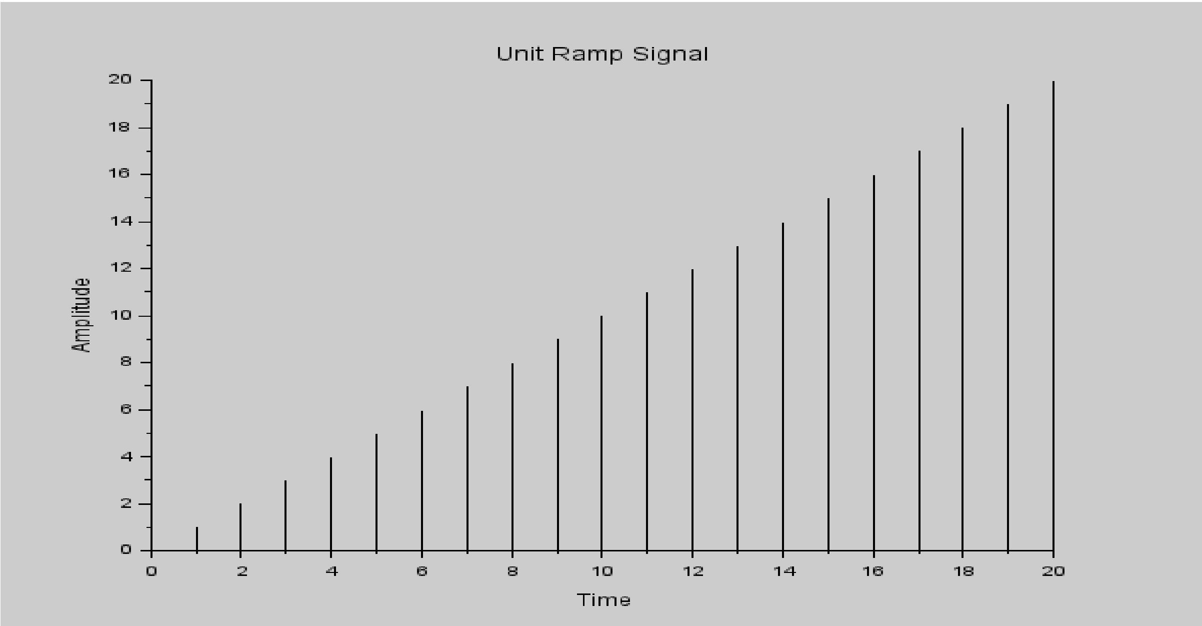
```
// Clear workspace and close all figures
clear all;
close;

// UNIT IMPULSE SIGNAL
N = 10; // Limit for the signal
t_impulse = -N:N;
x_impulse = [zeros(1, N), 1, zeros(1, N)]; // Impulse at t=0
figure;
plot2d3(t_impulse, x_impulse);
xlabel("Time");
ylabel("Amplitude");
title("Unit Impulse Signal");

// UNIT STEP SIGNAL
t_step = -N:N;
x_step = [zeros(1, N), ones(1, N + 1)]; // Step starts at t=0
figure;
plot2d3(t_step, x_step);
xlabel("Time");
ylabel("Amplitude");
title("Unit Step Signal");

// UNIT RAMP SIGNAL
t_ramp = 0:20; // Define positive time range
x_ramp = t_ramp; // Ramp is a linearly increasing function
figure;
plot2d3(t_ramp, x_ramp);
xlabel("Time");
```

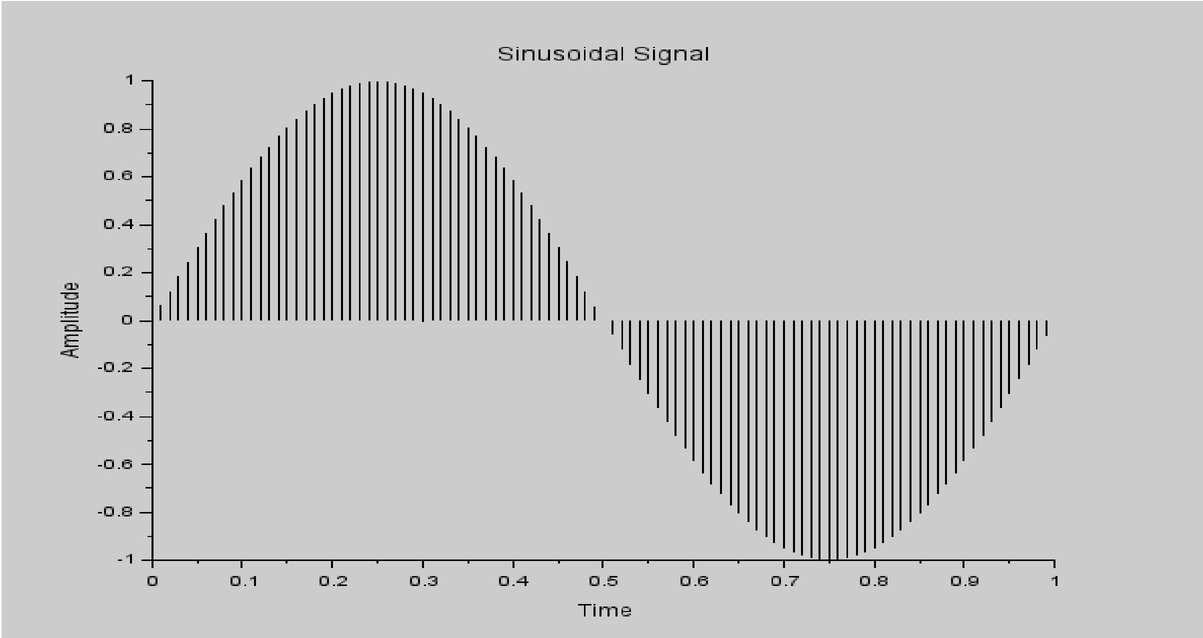
```
ylabel("Amplitude");
title("Unit Ramp Signal");

// SINUSOIDAL SIGNAL
t_sine = 0:0.01:1; // Time range for high resolution
x_sine = sin(2 * %pi * t_sine); // Sinusoidal function
figure;
plot2d3(t_sine, x_sine);
xlabel("Time");
ylabel("Amplitude");
title("Sinusoidal Signal");

// EXPONENTIAL SIGNAL
t_exp = 0:0.1:5; // Time range for exponential decay
x_exp = exp(-t_exp); // Exponential decay function
figure;
plot2d3(t_exp, x_exp);
xlabel("Time");
ylabel("Amplitude");
title("Exponential Signal");
```

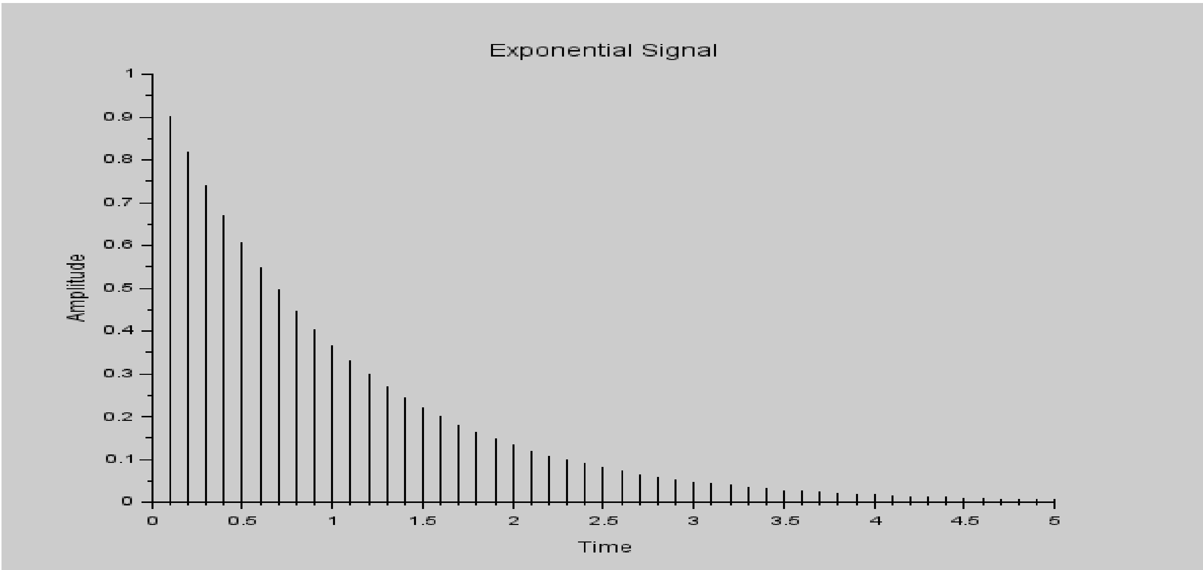
output:




Unit Step Signal
Amplitude
Time
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-10
-8
-6
-4
-2
0
2
4
6
8
10


Unit Ramp Signal
Amplitude
Time
20
18
16
14
12
10
8
6
4
2
0
0
2
4
6
8
10
12
14
16
18
20


Sinusoidal Signal
Amplitude
Time
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1


Exponential Signal
Amplitude
Time
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

2. DIT-FFT and DIF-FFT Algorithm

1. // Define the sequence

```
x_n = [1, -1, -1, -1, 1, 1, 1, -1];

// Compute the FFT using built-in function (DIT-FFT is the standard FFT method)
X_k = fft(x_n);

// Display the result
disp(X_k, "DFT of x[n] using DIT-FFT:");
```

output:

```
exec('C:\Users\91701\Documents\DDT', -1)
      column 1 to 3
  0. + 0.i  -1.4142136 + 3.4142136i   2. - 2.i
      column 4 to 5
  1.4142136 - 0.5857864i   4. + 0.i
      column 6 to 7
  1.4142136 + 0.5857864i   2. + 2.i
      column 8
 -1.4142136 - 3.4142136i
 "DFT of x[n] using DIT-FFT:"
```

2.// Define the sequence

```
x_n = [1, 2, 3, 4, 4, 3, 2, 1];

    // Compute the FFT using built-in function (DIF-FFT is equivalent to FFT here)
X_k = fft(x_n);

    // Display the result
disp(X_k, "DFT of x[n] using DIF-FFT:");
```

output:

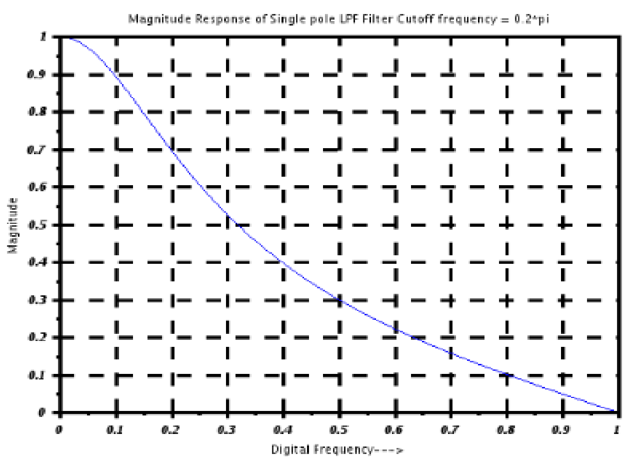
```
exec('C:\Users\91701\Documents\FIT', -1)
      column 1 to 3
  20. + 0.i  -5.8284271 - 2.4142136i   0. + 0.i
      column 4 to 5
 -0.1715729 - 0.4142136i   0. + 0.i
      column 6 to 7
 -0.1715729 + 0.4142136i   0. + 0.i
      column 8
 -5.8284271 + 2.4142136i
 "DFT of x[n] using DIF-FFT:"
```

3. Analog Butterworth Filter

```
//First Order Butterworth Low Pass Filter
clear;
clc;
close;
s = poly(0,'s');
Omegac = 0.2*%pi;
H = Omegac/(s+Omegac);
T =1;//Sampling period T = 1 Second
EXNO:19
Analog Butterworth Filter
DATE:
z = poly(0,'z');
Hz = horner(H,(2/T)*((z-1)/(z+1)))
HW =frmag(Hz(2),Hz(3),512);
W = 0:%pi/511:%pi;
plot(W/%pi,HW)
a=gca();
a.thickness = 3;
a.foreground = 1;
a.font_style = 9;
xgrid(1)
xtitle('Magnitude Response of Single pole LPF Filter Cutoff frequency =
0.2*pi','Digital Frequency--->','Magnitude');
Disp(“Hz”,Hz);
```

Output:

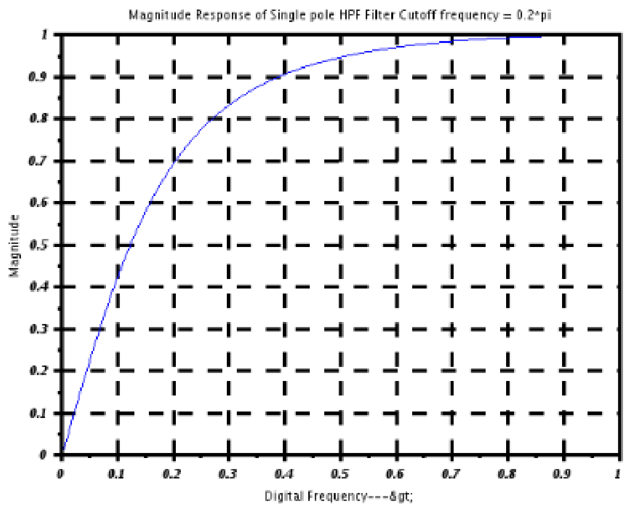
```
Hz =
0.6283185 + 0.6283185z
----------------------
- 1.3716815 + 2.6283185z
```



```
//First Order Butterworth Filter
//High Pass Filter Using Digital Filter Transformation
clear;
clc;
close;
s = poly(0,'s');
Omegac = 0.2*%pi;
H = Omegac/(s+Omegac);
T =1;//Sampling period T = 1 Second
z = poly(0,'z');
Hz_LPF = horner(H,(2/T)*((z-1)/(z+1)));
alpha = -(cos((Omegac+Omegac)/2))/(cos((Omegac-Omegac)/2));
HZ_HPF=horner(Hz_LPF,-(z+alpha)/(1+alpha*z))
HW =frmag(HZ_HPF(2),HZ_HPF(3),512);
W = 0:%pi/511:%pi;
plot(W/%pi,HW)
a=gca();
a.thickness = 3;
a.foreground = 1;
a.font_style = 9;
xgrid(1)
xtitle('Magnitude Response of Single pole HPF Filter Cutoff frequency =
0.2*pi','Digital Frequency---&gt;','Magnitude');
disp("HZ_HPF",HZ_HPF);
```

Output:

```
HZ_HPF =
- 0.7484757 + 0.7484757z
----------------------
   1.  - 0.4969514 + z
```



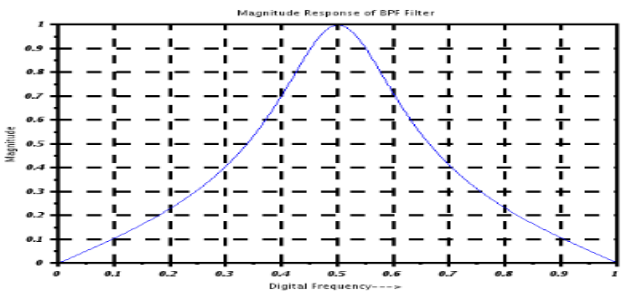

```
clear;
clc;
```

```
close;
omegaP = 0.2*%pi;
omegaL = (2/5)*%pi;
omegaU = (3/5)*%pi;
z=poly(0,'z');
H_LPF = (0.245)*(1+(z^-1))/(1-0.509*(z^-1))
alpha = (cos((omegaU+omegaL)/2)/cos((omegaU-omegaL)/2));
k = (cos((omegaU - omegaL)/2)/sin((omegaU - omegaL)/2))*tan(omegaP/2);
NUM =-((z^2)-((2*alpha*k/(k+1))*z)+((k-1)/(k+1)));
DEN = (1-((2*alpha*k/(k+1))*z)+(((k-1)/(k+1))*(z^2)));
HZ_BPF=horner(H_LPF,NUM/DEN)
disp(HZ_BPF,'Digital BPF IIR Filter H(Z)= ')
HW =frmag(HZ_BPF(2),HZ_BPF(3),512);
W = 0:%pi/511:%pi;
plot(W/%pi,HW)
a=gca();
a.thickness = 3;
a.foreground = 1;
a.font_style = 9;
xgrid(1)
xtitle('Magnitude Response of BPF Filter', 'Digital Frequency--->','Magnitude');
Disp("HZ_BPF",HZ_BPF);
```

Output:

```
H_LPF =
0.245 + 0.245z
--------------
- 0.509 + z
HZ_BPF =
2 3 4
0.245 - 1.577D-17z - 0.245z + 1.577D-17z + 1.360D-17z
-----------------------------------------------------
2 3 4
- 0.509 + 1.299D-16z - z + 6.438D-17z + 5.551D-17z
Digital BPF IIR Filter H(Z)=
2 3 4
0.245 - 1.577D-17z - 0.245z + 1.577D-17z + 1.360D-17z
-----------------------------------------------------
2 3 4
```

1. - 0.509 + 1.299D-16z - z + 6.438D-17z + 5.551D-17z



```
clear;
clc;
close;
omegaP = 0.2*%pi;
omegaL = (2/5)*%pi;
omegaU = (3/5)*%pi;
z=poly(0,'z');
H_LPF = (0.245)*(1+(z^-1))/(1-0.509*(z^-1))
alpha = (cos((omegaU+omegaL)/2)/cos((omegaU-omegaL)/2));
k = tan((omegaU - omegaL)/2)*tan(omegaP/2);
NUM =((z^2)-((2*alpha/(1+k))*z)+((1-k)/(1+k)));
DEN = (1-((2*alpha/(1+k))*z)+(((1-k)/(1+k))*(z^2)));
HZ_BSF=horner(H_LPF,NUM/DEN)
HW =frmag(HZ_BSF(2),HZ_BSF(3),512);
W = 0:%pi/511:%pi;
plot(W/%pi,HW)
a=gca();
a.thickness = 3;
a.foreground = 1;
a.font_style = 9;
xgrid(1)
xtitle('Magnitude Response of BSF Filter','Digital Frequency--->','Magnitude');
Disp("HZ_BSF",HZ_BSF);
```

Output:

```
HZ_BPF =
2
0.7534875 - 9.702D-17z + 0.7534875z
-----------------------------------
2
```

1. 0.5100505 - 9.722D-17z + z