

## Title: Realization of IIR and FIR Digital Filter.

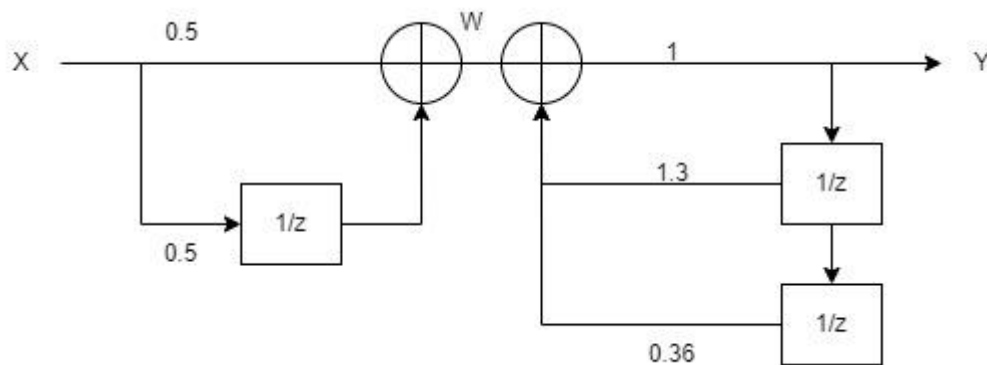
**AIM:** Realization of Digital Filter using Matlab.

**Objective:** Realization of IIR and FIR Digital Filter using Matlab using MATLAB.

For given transfer function perform Direct form I and direct form II IIR filter realizations in Matlab.

$$a. H(z) = \frac{0.5(1-z^{-1})}{(1+1.3z^{-1}+0.36z^{-2})}$$

**Direct Form I**



### Matlab Program

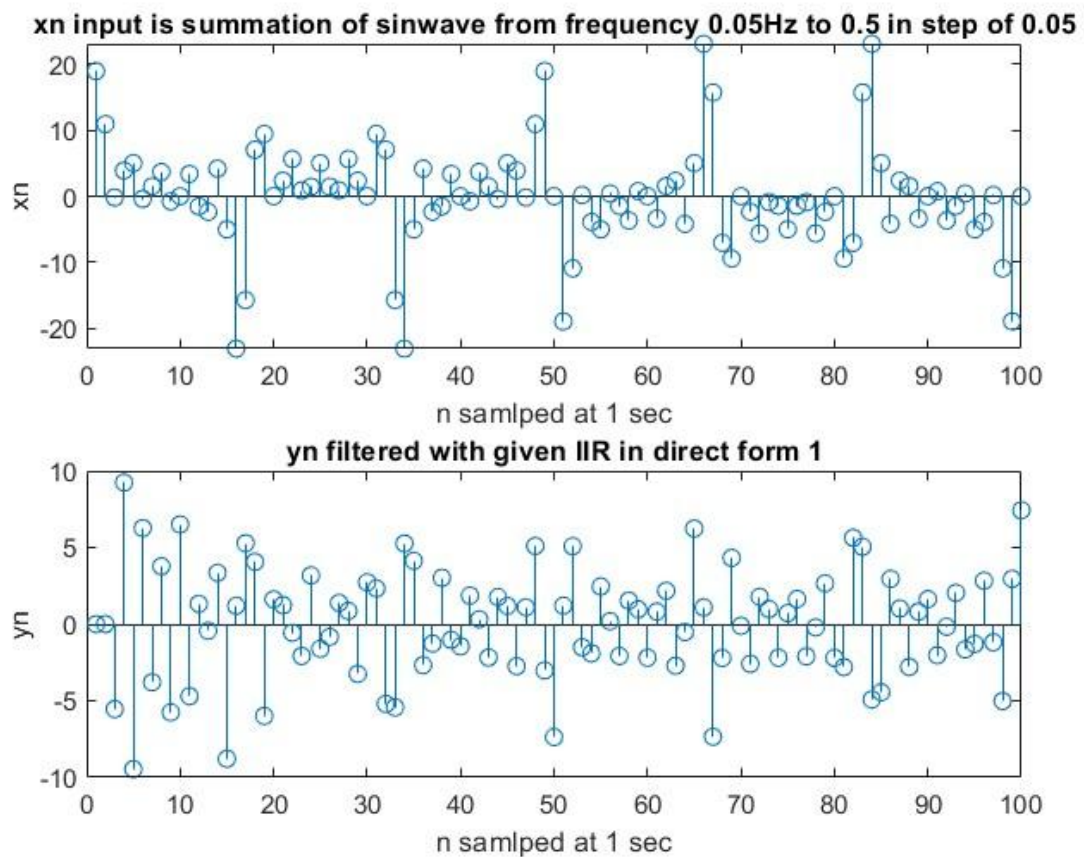
```
clear;clc;close;
b0 = 0.5;
b1 = -0.5;
a0 = 1;
a1 = 1.3;
a2 = 0.36;
n = 1:100;
xn=zeros(1,100);
wn= zeros(1,100);
yn=zeros(1,100);
A = 5;
%xn input is summation of sine wave from frequency 0.05Hz to 0.5 in step of 0.05
freq =0;
for i= 0:10
    freq = freq+0.05;
    W = 2*pi*freq;
    xn = xn+A*sin(W*n);
    freq= freq+0.01;
end
subplot(2,1,1);
stem(n,xn);
xlabel('n sampled at 1 sec');
```

```

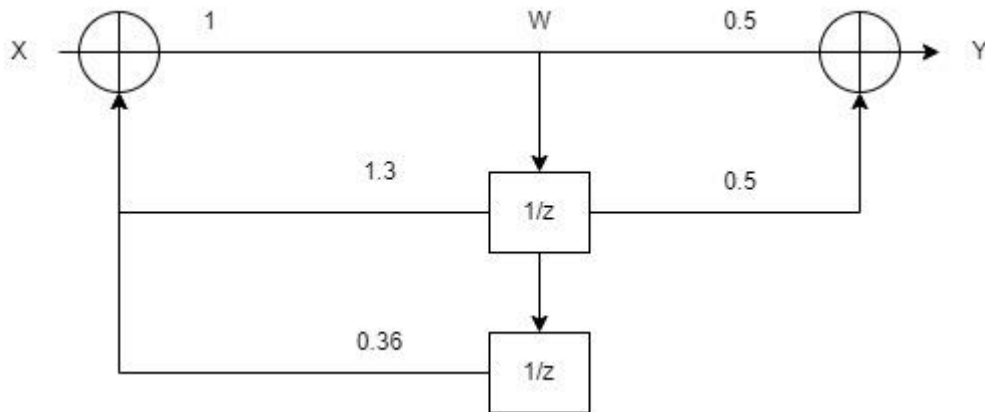
ylabel('xn');
title("xn input is summation of sine wave from frequency 0.05Hz to 0.5 in
step of 0.05");
for n=2:100
    wn(n) = b0*xn(n)+b1*xn(n-1);
end
for n = 3:100
    yn(n) = a0*wn(n)-a1*yn(n-1)-a2*yn(n-2);
end
n = 1:100;
subplot(2,1,2);
stem(n,yn);
xlabel('n sampled at 1 sec');
ylabel('yn');
title('yn filtered with given IIR in direct form 1');

```

## Output



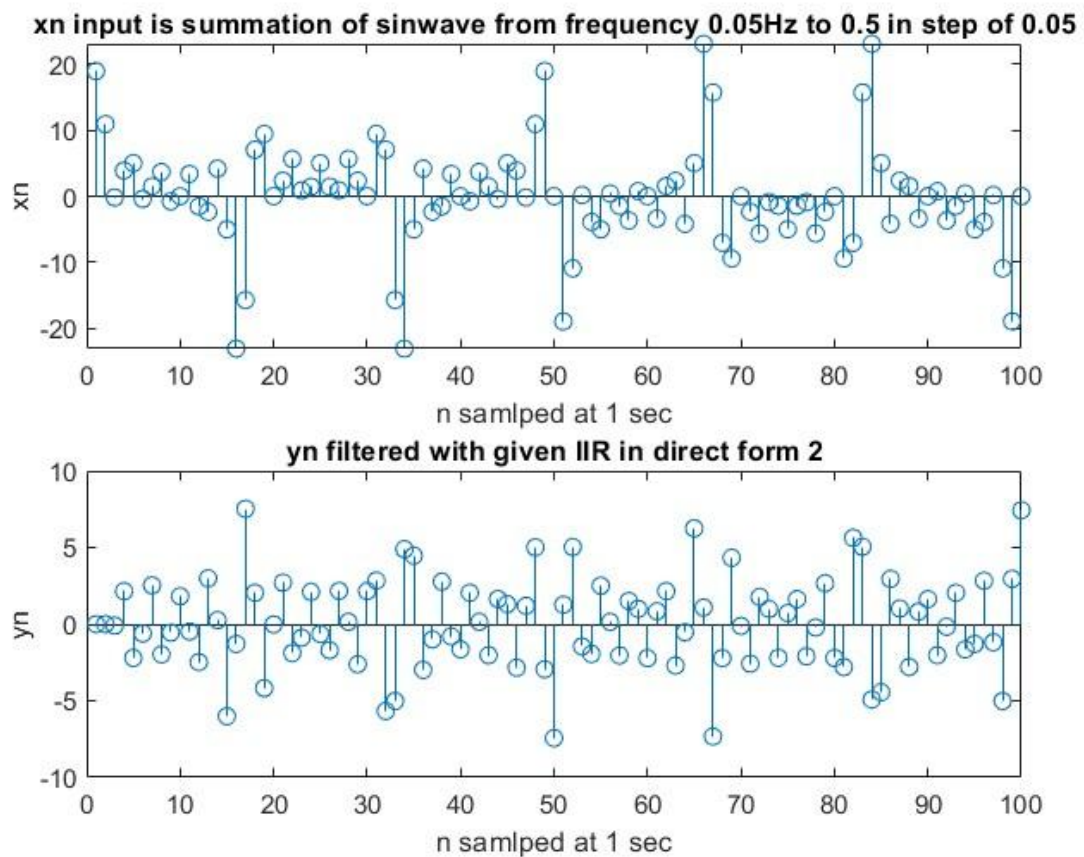
### Direct Form II



### Matlab Program

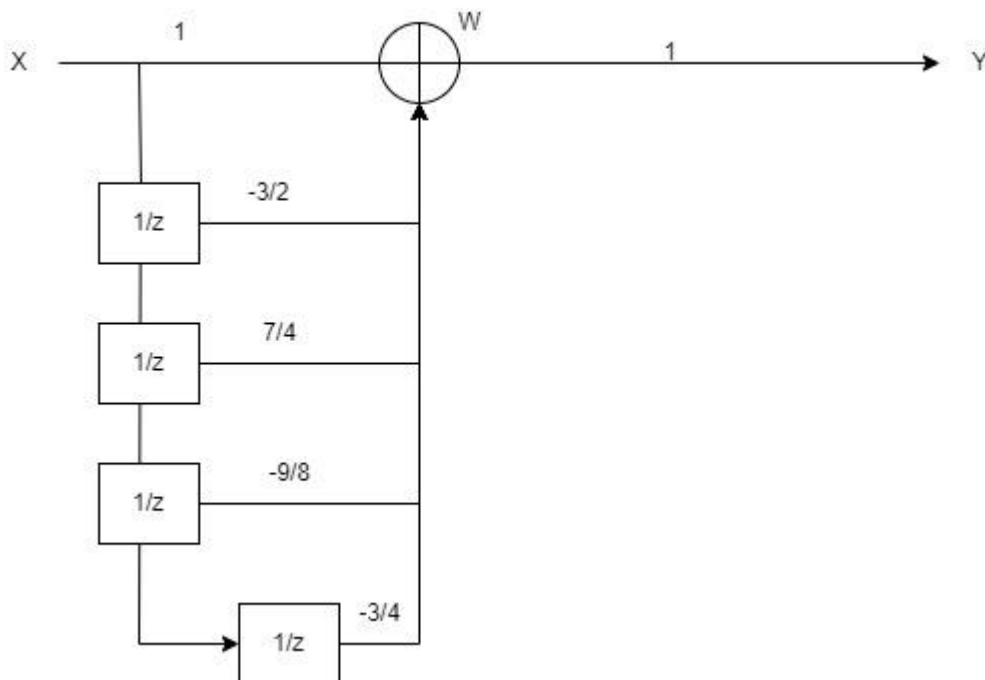
```
clear;clc;close;
b0 = 0.5;
b1 = -0.5;
a0 = 1;
a1 = 1.3;
a2 = 0.36;
n = 1:100;
xn=zeros(1,100);
wn= zeros(1,100);
yn=zeros(1,100);
A = 5;
%xn input is summation of sine wave from frequency 0.05Hz to 0.5 in step of
0.05
freq =0;
for i= 0:10
    freq = freq+0.05;
    W = 2*pi*freq;
    xn = xn+A*sin(W*n);
    freq= freq+0.01;
end
subplot(2,1,1);
stem(n,xn);
xlabel('n sampled at 1 sec');
ylabel('xn');
title("xn input is summation of sine wave from frequency 0.05Hz to 0.5 in
step of 0.05");
for n =3:100
wn(n) = a0*xn(n)-a1*wn(n-1)-a2*wn(n-2);
end
for n=2:100
    yn(n) = b0*wn(n)+b1*wn(n-1);
end
n = 1:100;
subplot(2,1,2);
stem(n,yn);
xlabel('n sampled at 1 sec');
ylabel('yn');
title(' yn filtered with given IIR in direct form 2');
```

## Output



$$b. H(z) = (1 - 0.5z^{-1})^2(1 - z^{-1})^2$$

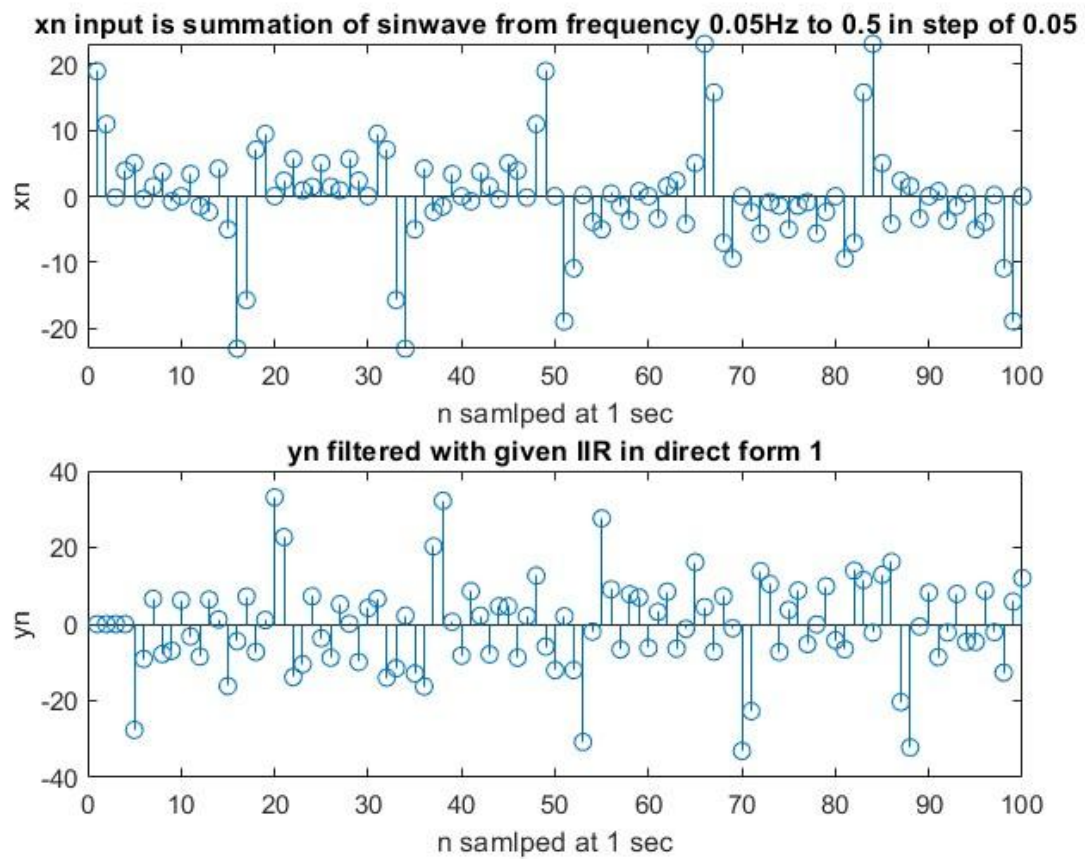
Direct Form I



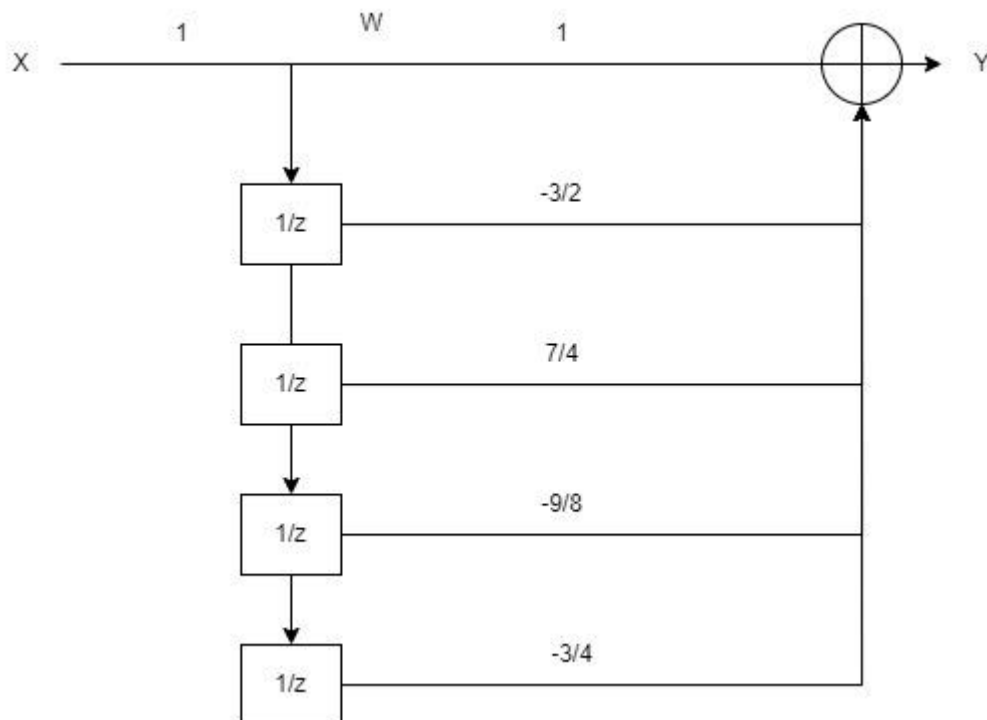
## Matlab Program

```
clear;clc;close;
b0 = 1;
b1 = -3/2;
b2 = 7/4;
b3 = -9/8;
b4 = -3/4;
a0 = 1;
n = 1:100;
xn=zeros(1,100);
wn= zeros(1,100);
yn=zeros(1,100);
A = 5;
%xn input is summation of sine wave from frequency 0.05Hz to 0.5 in step of
0.05
freq =0;
for i= 0:10
    freq = freq+0.05;
    W = 2*pi*freq;
    xn = xn+A*sin(W*n);
    freq= freq+0.01;
end
subplot(2,1,1);
stem(n,xn);
xlabel('n sampled at 1 sec');
ylabel('xn');
title("xn input is summation of sine wave from frequency 0.05Hz to 0.5 in
step of 0.05");
for n=5:100
    wn(n) = b0*xn(n)+b1*xn(n-1)+b2*xn(n-2)+b3*xn(n-3)+b4*xn(n-4);
end
for n =3:100
    yn(n) = a0*wn(n);
end
n = 1:100;
subplot(2,1,2);
stem(n,yn);
xlabel('n sampled at 1 sec');
ylabel('yn');
title('yn filtered with given IIR in direct form 1');
```

## Output



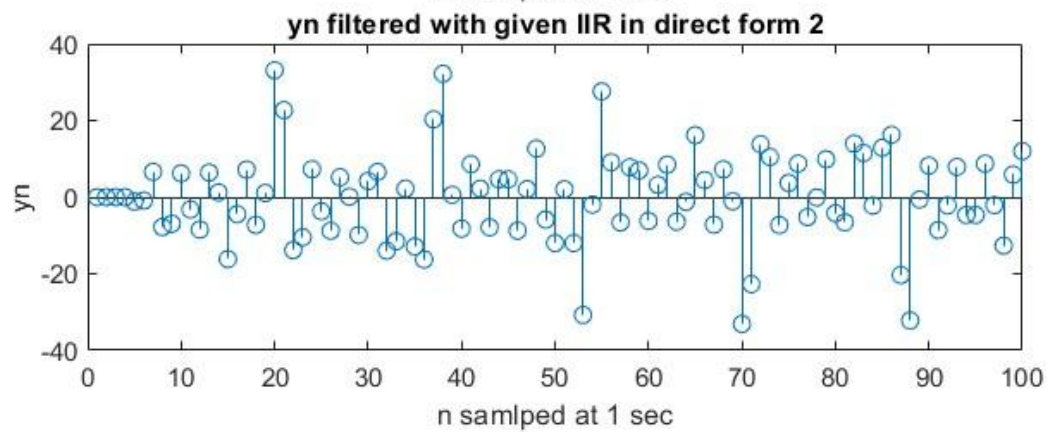
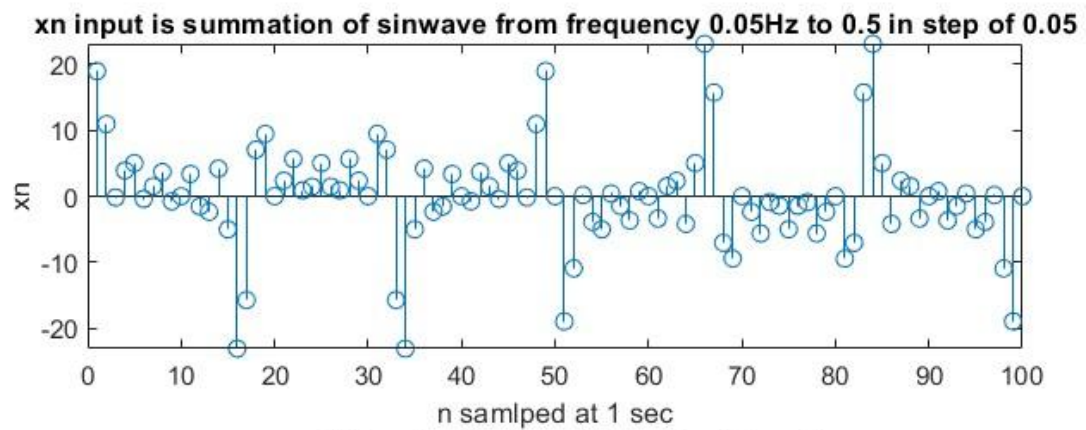
## Direct Form II



## Matlab Program

```
clear;clc;close;
b0 = 1;
b1 = -3/2;
b2 = 7/4;
b3 = -9/8;
b4 = -3/4;
a0 = 1;
n = 1:100;
xn=zeros(1,100);
wn= zeros(1,100);
yn=zeros(1,100);
A = 5;
%xn input is summation of sine wave from frequency 0.05Hz to 0.5 in step of
0.05
freq =0;
for i= 0:10
    freq = freq+0.05;
    W = 2*pi*freq;
    xn = xn+A*sin(W*n);
    freq= freq+0.01;
end
subplot(2,1,1);
stem(n,xn);
xlabel('n sampled at 1 sec');
ylabel('xn');
title("xn input is summation of sine wave from frequency 0.05Hz to 0.5 in
step of 0.05");
for n =3:100
    wn(n) = a0*xn(n);
end
for n=5:100
    yn(n) = b0*wn(n)+b1*wn(n-1)+b2*wn(n-2)+b3*wn(n-3)+b4*wn(n-4);
end
n = 1:100;
subplot(2,1,2);
stem(n,yn);
xlabel('n sampled at 1 sec');
ylabel('yn');
title('yn filtered with given IIR in direct form 2');
```

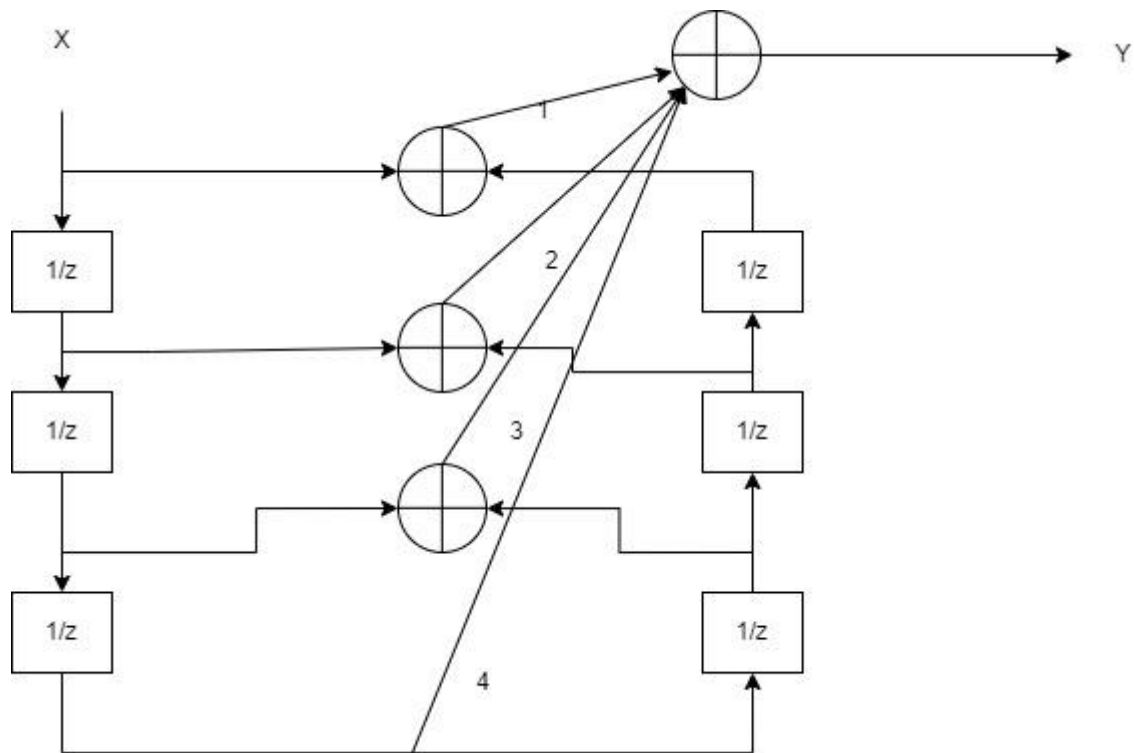
## Output





Determine a direct-form realization for the following linear phase filters in Matlab.

(a)  $h(n) = \{1, 2, 3, 4, 3, 2, 1\}$



### Matlab Program

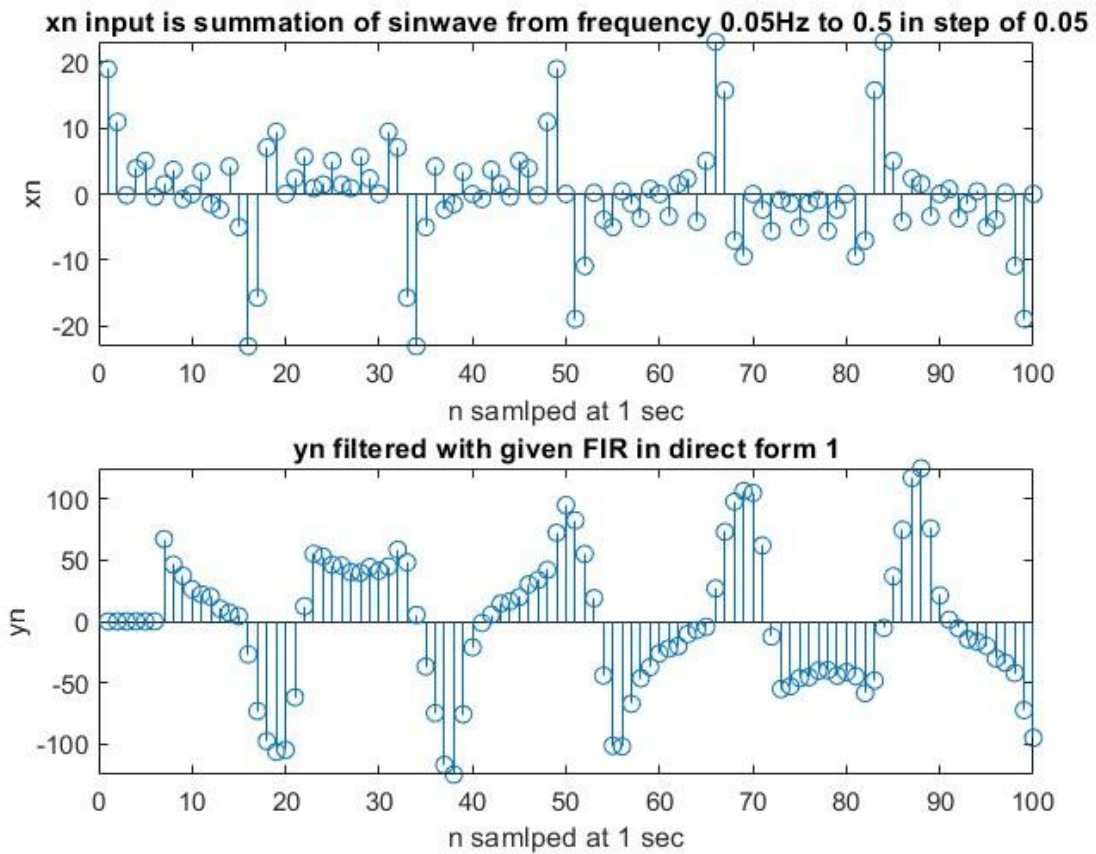
```
clear;clc;close;
hn = [1,2,3,4,3,2,1];
n = 1:100;
xn=zeros(1,100);
wn= zeros(1,100);
yn=zeros(1,100);
A = 5;
%xn input is summation of sine wave from frequency 0.05Hz to 0.5 in step of
0.05
freq =0;
for i= 0:10
    freq = freq+0.05;
    W = 2*pi*freq;
    xn = xn+A*sin(W*n);
    freq= freq+0.01;
end
subplot(2,1,1);
stem(n,xn);
xlabel('n sampled at 1 sec');
ylabel('xn');
title("xn input is summation of sine wave from frequency 0.05Hz to 0.5 in
step of 0.05");
for n =7:100
    yn(n)=
hn(1) * (xn(n)+xn(n-6)) +hn(2) * (xn(n-1)+xn(n-5)) +hn(3) * (xn(n-2)+xn(n-3)) +hn(4) *x
n(n-4);
```

```

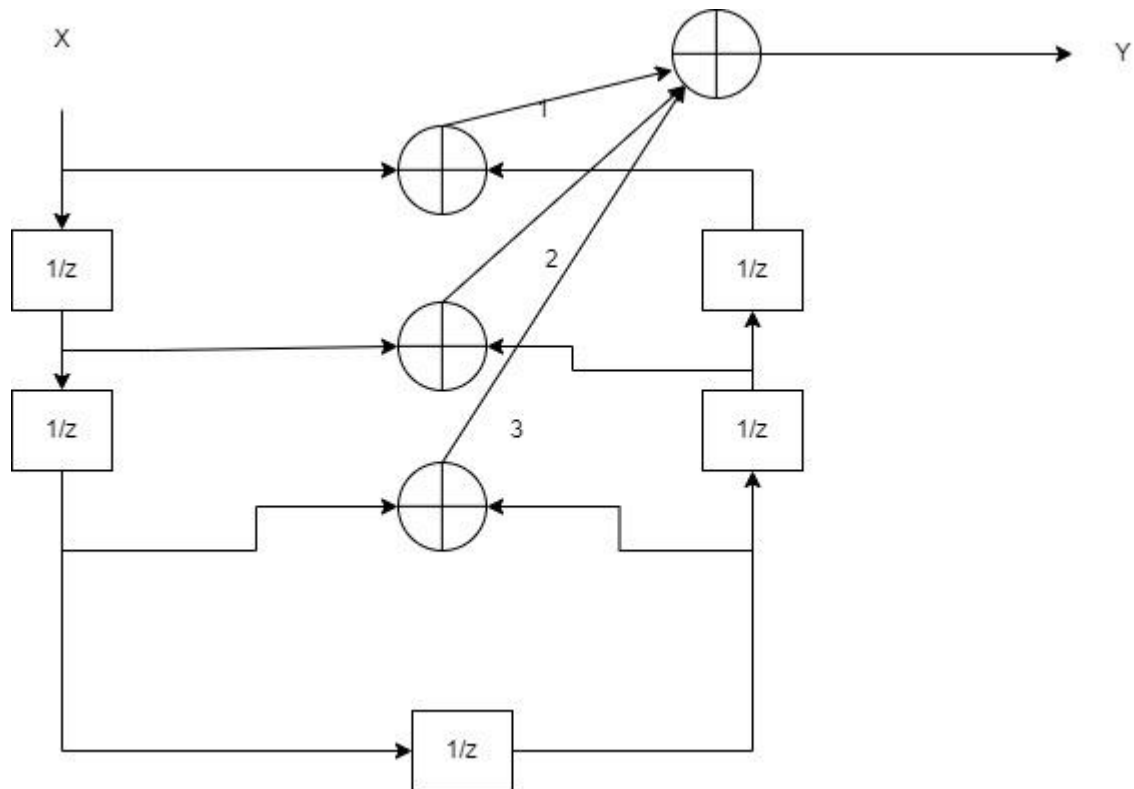
end
n = 1:100;
subplot(2,1,2);
stem(n,yn);
xlabel('n sampled at 1 sec');
ylabel('yn');
title('yn filtered with given FIR in direct form 1');

```

## Output



(b)  $h(n) = \{1, 2, 3, 3, 2, 1\}$



### Matlab Program

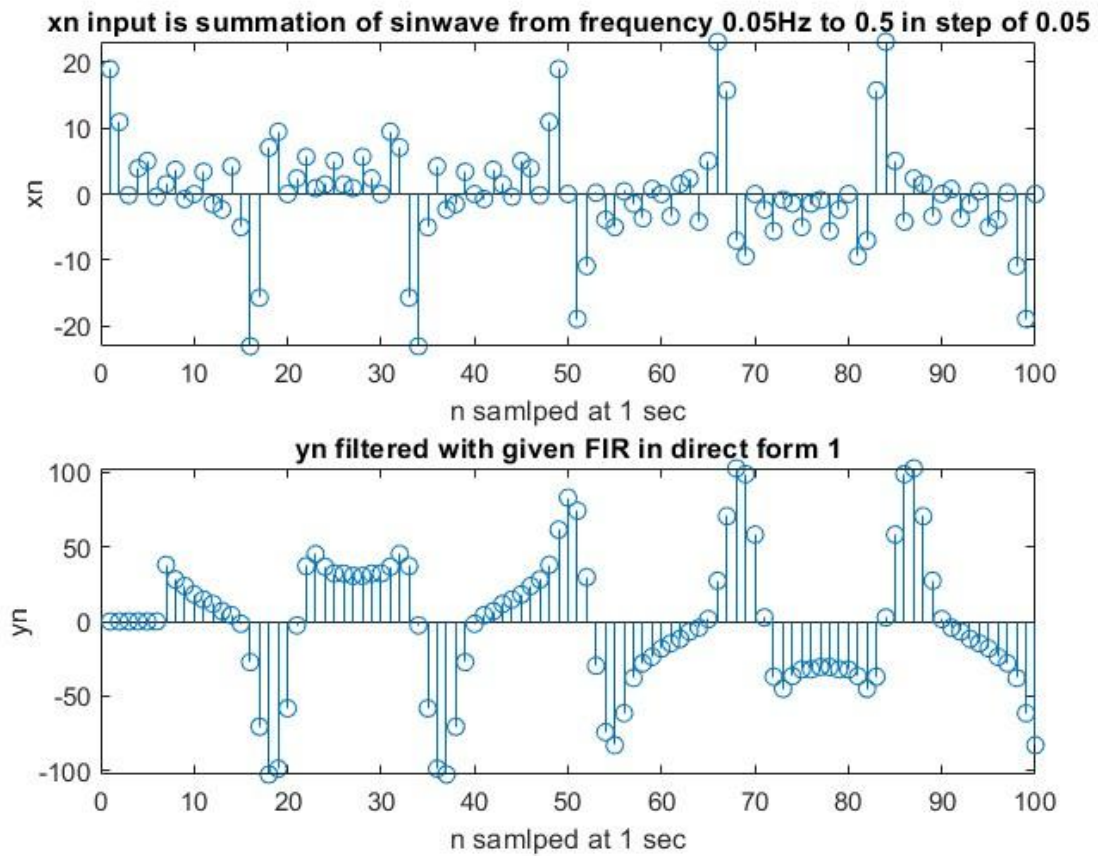
```
clear;clc;close;
hn = [1,2,3,3,2,1];
n = 1:100;
xn=zeros(1,100);
wn= zeros(1,100);
yn=zeros(1,100);
%xn input is summation of sine wave from frequency 0.05Hz to 0.5 in step of
0.05
A = 5;
freq =0;
for i= 0:10
    freq = freq+0.05;
    W = 2*pi*freq;
    xn = xn+A*sin(W*n);
    freq= freq+0.01;
end
subplot(2,1,1);
stem(n,xn);
xlabel('n sampled at 1 sec');
ylabel('xn');
title("xn input is summation of sine wave from frequency 0.05Hz to 0.5 in
step of 0.05");
for n =7:100
    yn(n)=
hn(1) * (xn(n)+xn(n-5)) +hn(2) * (xn(n-1)+xn(n-4)) +hn(3) * (xn(n-2)+xn(n-3));
end
```

```

n = 1:100;
subplot(2,1,2);
stem(n,yn);
xlabel('n sampled at 1 sec');
ylabel('yn');
title('yn filtered with given FIR in direct form 1');

```

## Output



**Result : FIR and IIR Filter are realized for given transfer function.**