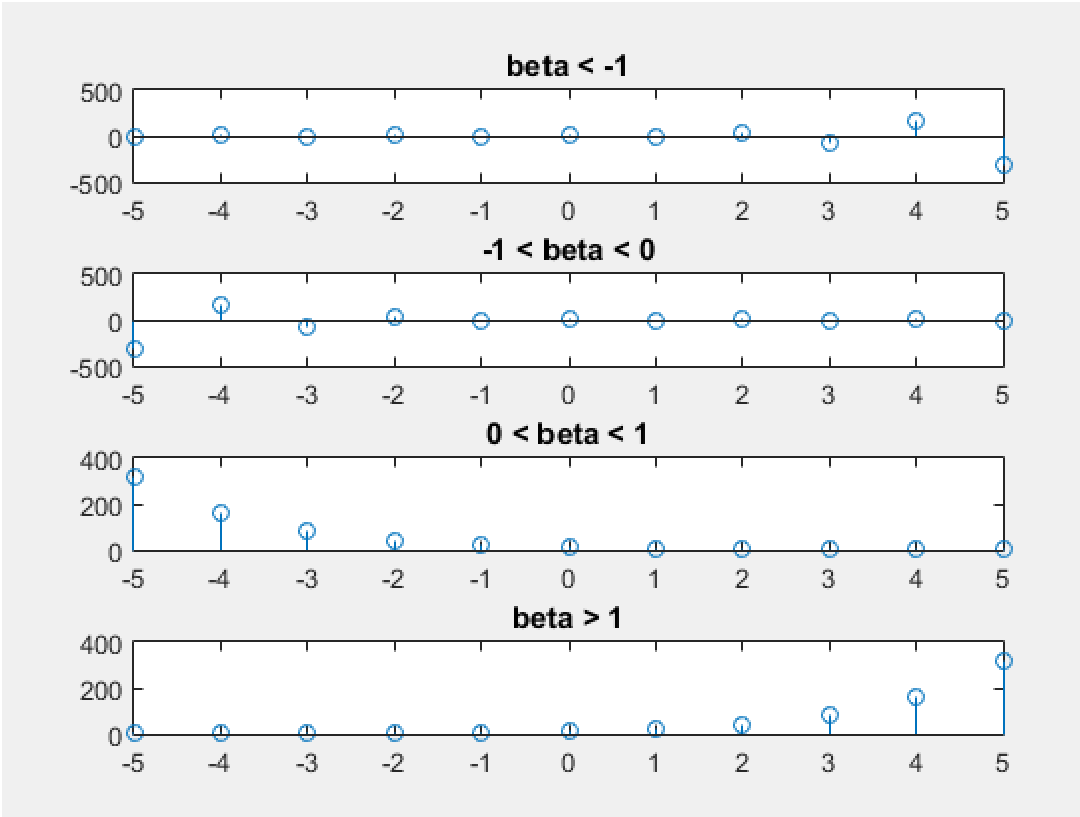
S.THINESH
E/15/366

EE387 – Signals Processing
Lab – 02

Laboratory on Discrete Time Signals

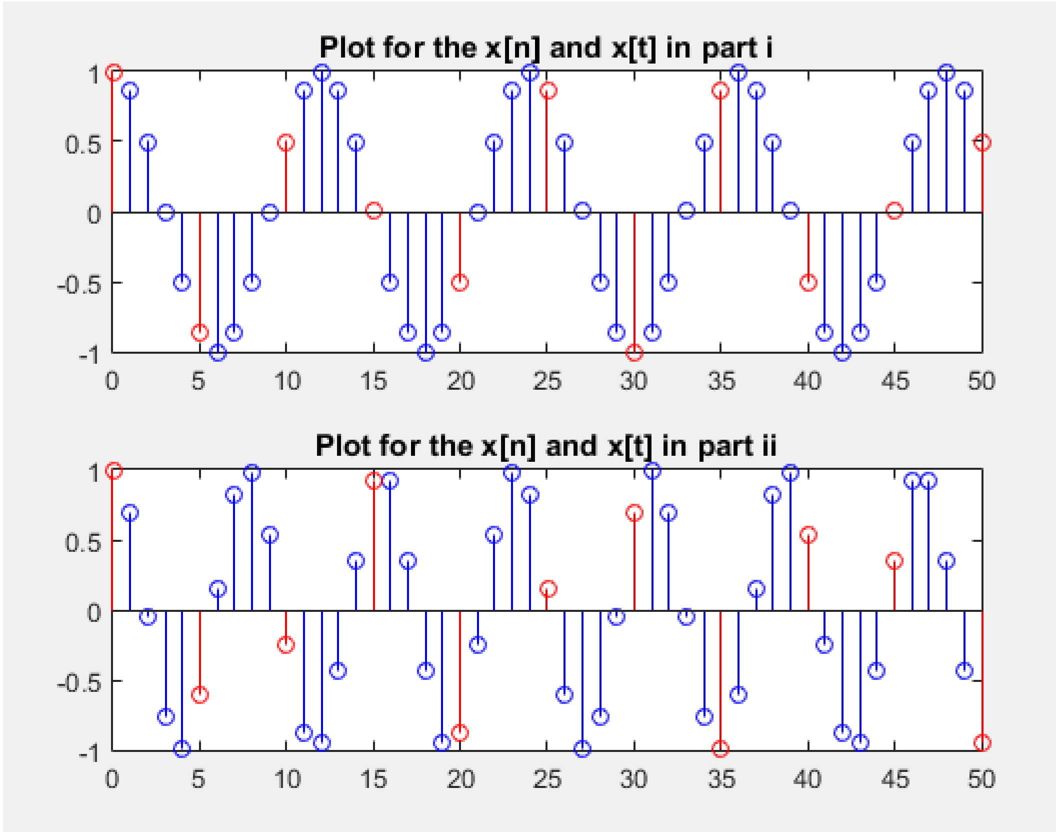
Part 01
a)

```
%range of n
n=-5:5;

% beta < -1
beta = -2;
x = 10* (beta.^n);
subplot(4,1,1);
stem(n,x);
title('beta < -1');

% -1 < beta < 0
beta = -0.5;
x = 10* (beta.^n);
subplot(4,1,2);
stem(n,x);
title('-1 < beta < 0');

% 0 < beta < 1
beta = 0.5;
x = 10* (beta.^n);
subplot(4,1,3);
stem(n,x);
title('0 < beta < 1');

% beta > 1
beta = 2;
x = 10* (beta.^n);
subplot(4,1,4);
stem(n,x);
title('beta > 1');
```



b)

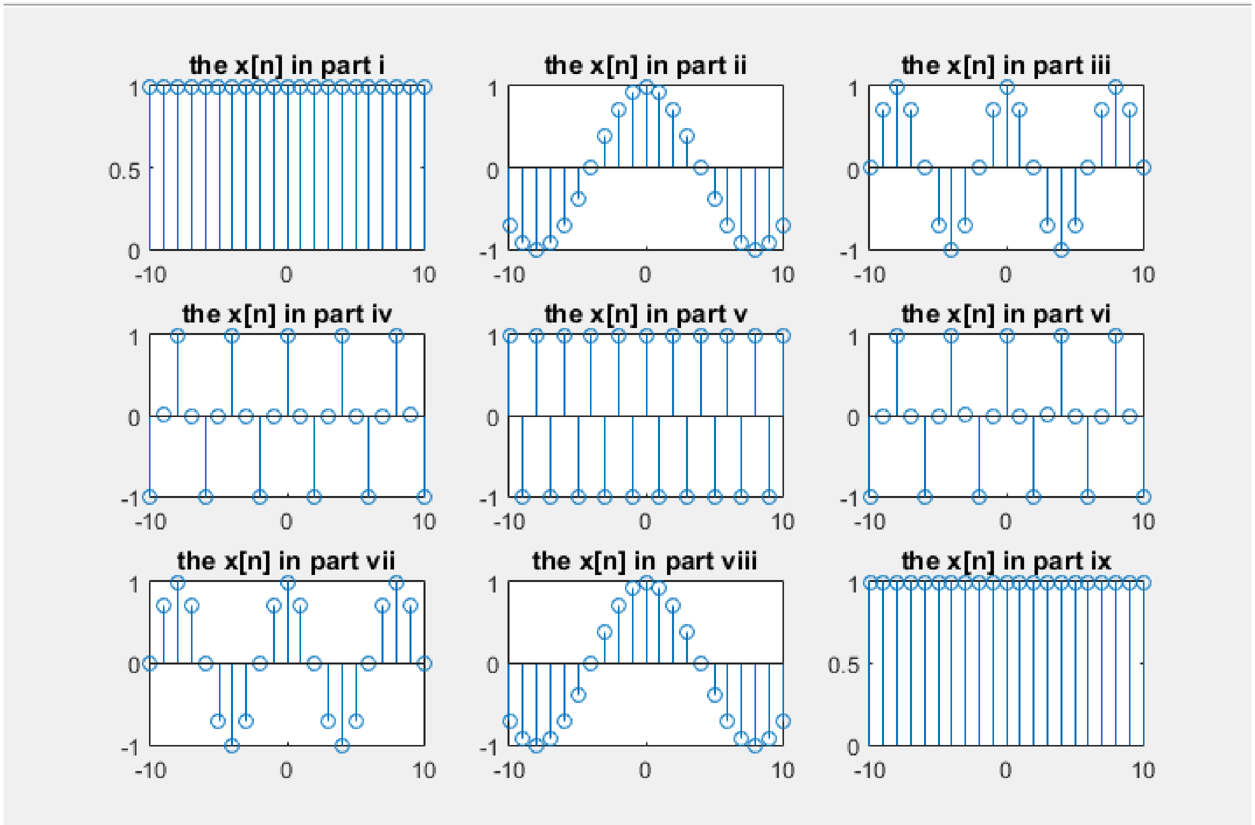
```
t = 0:50; % range of t
n = 0:5:50;  % n=t*k , t = 5s

% part i
x_t = cos(2*pi*t/12);
x_n = cos(2*pi*n/12);
subplot(2,1,1);
stem(t,x_t ,'b');
hold on
stem(n,x_n,'r');
title('Plot for the x[n] and x[t] in part i');

% part ii
x_t = cos(8*pi*t/31);
x_n = cos(8*pi*n/31);
subplot(2,1,2);
stem(t,x_t ,'b');
hold on
stem(n,x_n,'r');
title('Plot for the x[n] and x[t] in part ii');
```



c)

```
%range of n
n = -10:1:10;

%Figure 1
x = cos(0*n);
subplot(3,3,1);
stem(n,x);
title('the x[n] in part i');

%Figure 2
x = cos(pi*n/8);
subplot(3,3,2);
stem(n,x);
title('the x[n] in part ii');


%Figure 3
x = cos(pi*n/4);
subplot(3,3,3);
stem(n,x);
title('the x[n] in part iii');
```

```
%Figure 4
x = cos(pi*n/2);
subplot(3,3,4);
stem(n,x);
title('the x[n] in part iv');

%Figure 5
x = cos(pi*n);
subplot(3,3,5);
stem(n,x);
title('the x[n] in part v');

%Figure 6
x = cos(3*pi*n/2);
subplot(3,3,6);
stem(n,x);
title('the x[n] in part vi');

%Figure 7
x = cos(7*pi*n/4);
subplot(3,3,7);
stem(n,x);
title('the x[n] in part vii');

%Figure 8
x = cos(15*pi*n/8);
subplot(3,3,8);
stem(n,x);
title('the x[n] in part viii');

%Figure 9
x = cos(pi*n*2);
subplot(3,3,9);
stem(n,x);
title('the x[n] in part ix');
```



d)
When we increase the frequency the shape is becoming into rectangular fashion.

Discrete convolution

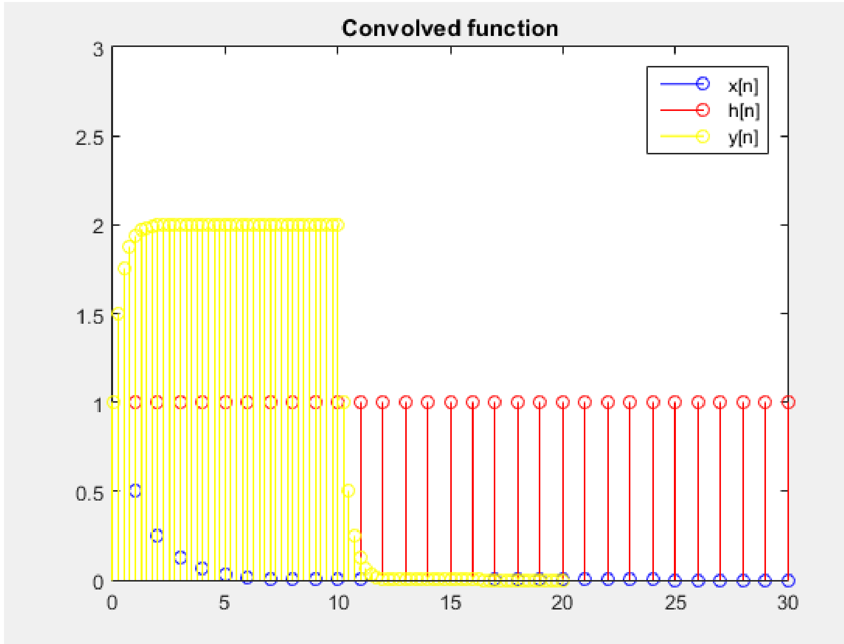
2)

```
function y = discrete_convolution(x,h)
    x2=h;
    lx=length(x);
    lh=length(h);

    if lx>lh
        x2=[x2 zeros(1,lx-lh)];
    else
        x=[x zeros(1,lh-lx)];
    end

    y=zeros(1,lx+lh-1);
    x=fliplr(x);
```

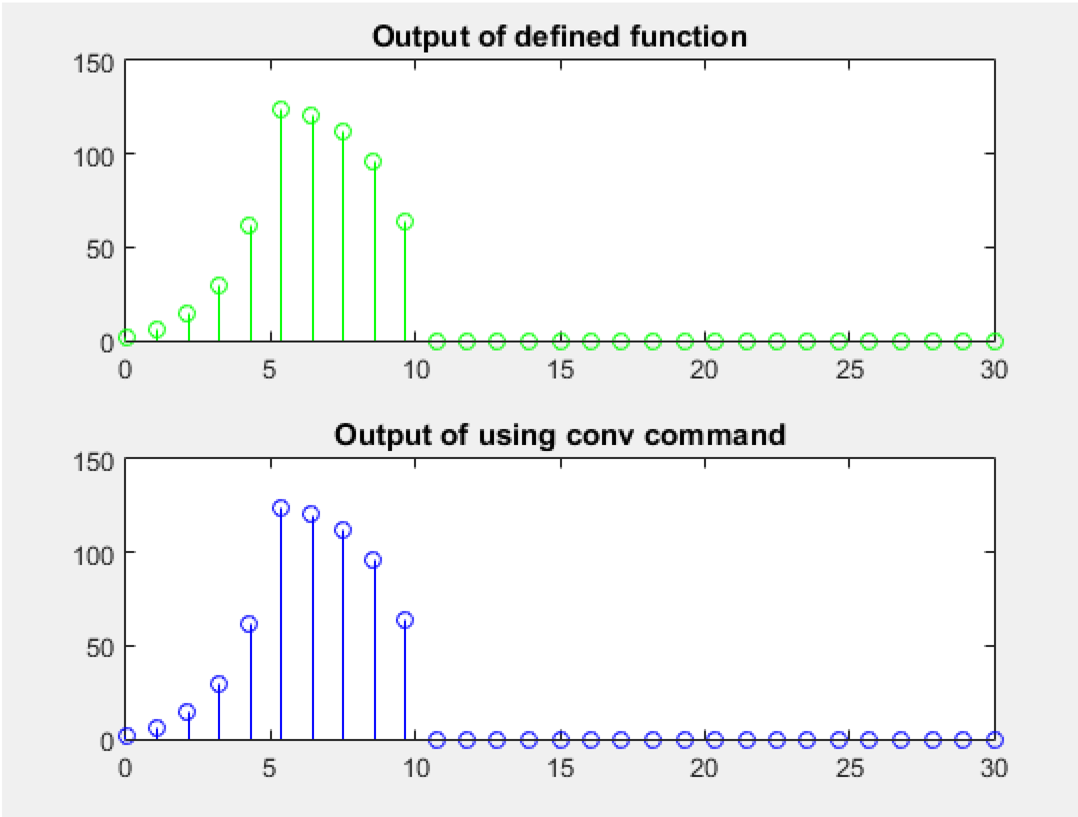
```
    for i=1:length(y)
        if i<=length(x)
            y(i)=sum(x(1,length(x)-i+1:length(x)).*x2(1,1:i));
        else
            j=i-length(x);
            y(i)=sum(x(1,1:length(x)-j).*x2(1,j+1:length(x2)));
        end

    end
```

b)

```
x1 = 0:40;
x2 = linspace(0,20,81);

x_n = 0.5.^x1.*ustep(x1,0);
h_n = ustep(x1,0);
y_n = discrete_convolution(x_n,h_n);

stem(x1,x_n,'b')
hold on
stem(x1,h_n,'r')
hold on
stem(x2,y_n,'y')

axis([0 30 0 3])

legend('x[n]','h[n]','y[n]');
title('Convolved function')


%Function for unit step function
function y = ustep(t, ad)

n = length(t);
y = zeros(1, n);

for i = 1:n

    if t(i) >= -ad

       y(i) = 1;

    end
end
end
```

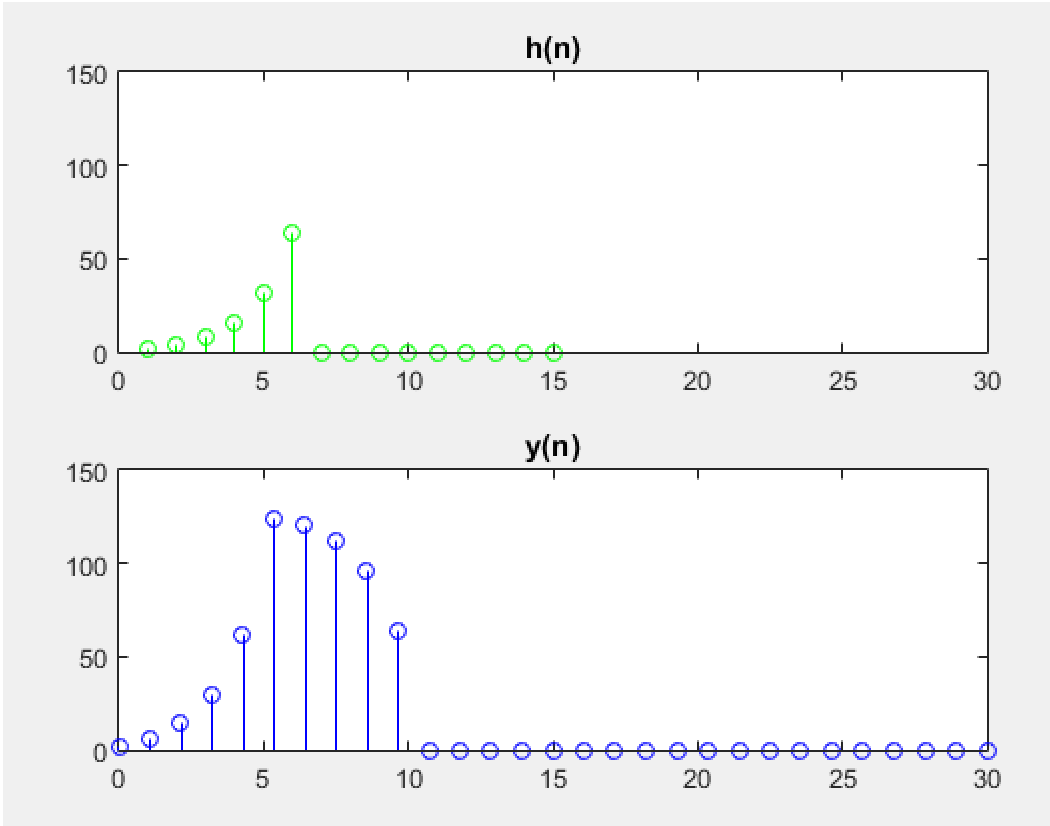


c)
```
x1 = linspace(0,30,29);

x_n = [1,1,1,1,1,0,0,0,0,0,0,0,0,0,0];
h_n = [2,4,8,16,32,64,0,0,0,0,0,0,0,0,0];

y_n = discrete_convolution(x_n,h_n);
subplot(2,1,1);
plot(x1,y_n,'g');
stem(x1,y_n,'g');
title('Output of defined function');


y_n = conv(x_n,h_n);
subplot(2,1,2);
plot(x1,y_n,'b');
stem(x1,y_n,'b');
title('Output of using conv command');
```



iv)

```
x1 = linspace(0,30,29);

x_n = [1,1,1,1,1,0,0,0,0,0,0,0,0,0,0];
h_n = [2,4,8,16,32,64,0,0,0,0,0,0,0,0,0];

subplot(2,1,1);
plot(h_n,'g');
stem(h_n,'g');
title('h(n)');
axis([0 30 0 150]);

% using MATLAB conv function
y_n = conv(x_n,h_n);
subplot(2,1,2);
plot(x1,y_n,'b');
stem(x1,y_n,'b');
title('y(n)');
```



h(n) is increasing exponentially up to n = 6 and remain zero.
y(n) is increasing and decreasing exponentially and then remain zero.

<u>LTI Systems</u>

3) a)
i)

```
% function for calculating current bank balance
% m = number of month
% p = net savings
function b = current_balance(m, P)

i = 0.01;      % monthly interest of 1%

    for j = 1:m

        if j == 1      % initial month
            y(j) = P;
```

```
        else
            y(j) = y(j-1) + i*y(j-1);
        end


    end

    b = y;

end
```

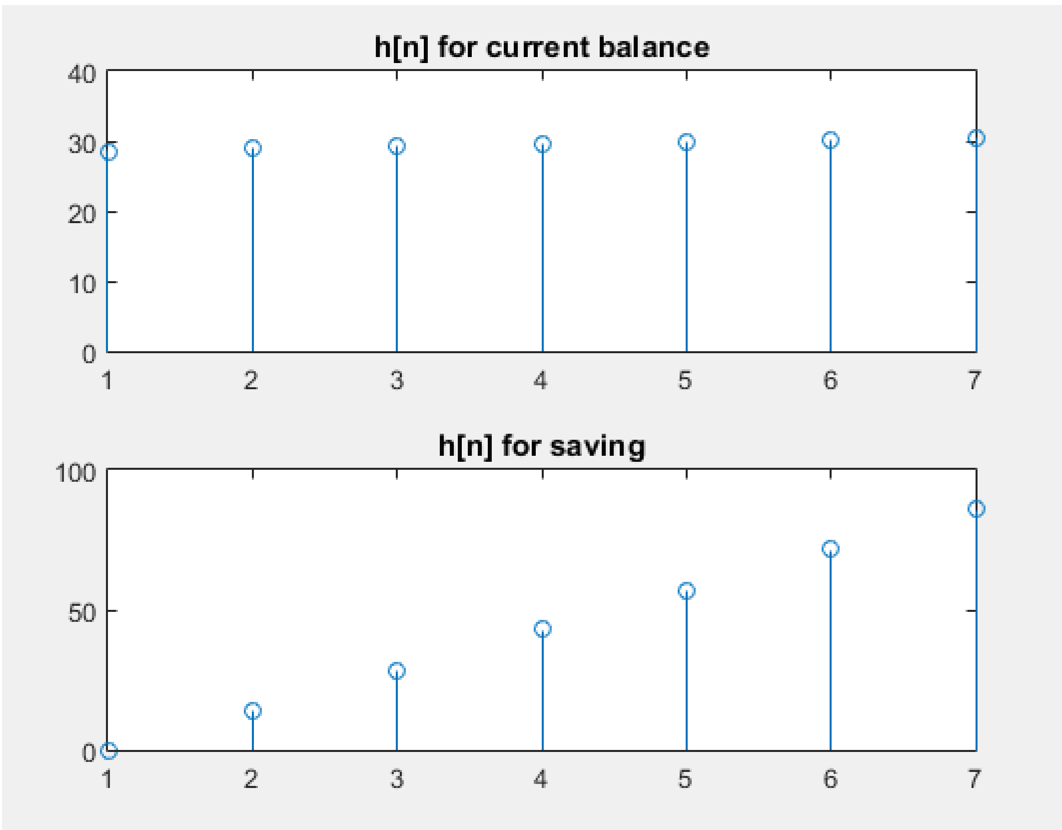
ii)

```
% function for calculating current saving
% n = number  of month
% M = amount
function s = saving(n, M)

    for i = 1:n

        if i == 1
            s(i) = 0;
        else
            s(i) = s(i-1) + M/2;
        end

    end

end
```

b)

```
% impulse response for current balance
% month = 7
% initial amount = 200
x1 = 7;
y1_n = current_balance(x1, 200);
h1_n = deconv(y1_n,x1);
subplot(2,1,1);
stem(h1_n);
title('h[n] for current balance');
```

```
% impulse response for saving
% month = 7
% initial amount = 200
x2 = 7;
y2_n = saving(x2, 200);
h2_n = deconv(y2_n,x2);
subplot(2,1,2);
stem(h2_n);
title('h[n] for saving');
```



c)

Both are Infinite impulse response systems hence the output of the above systems depend on the previous input.