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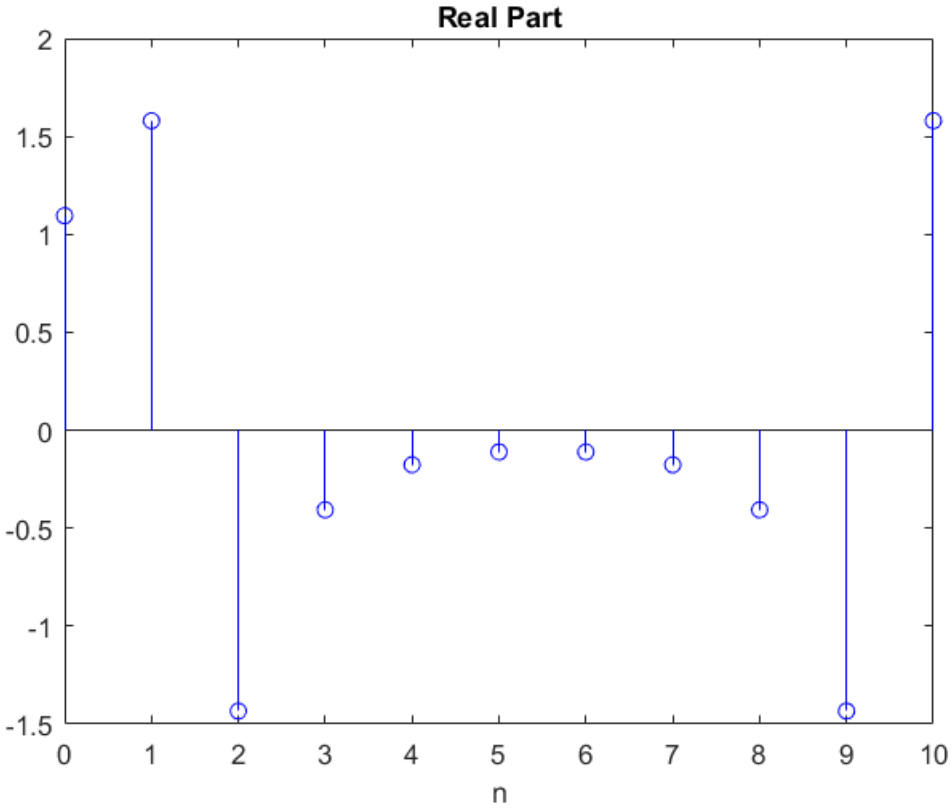
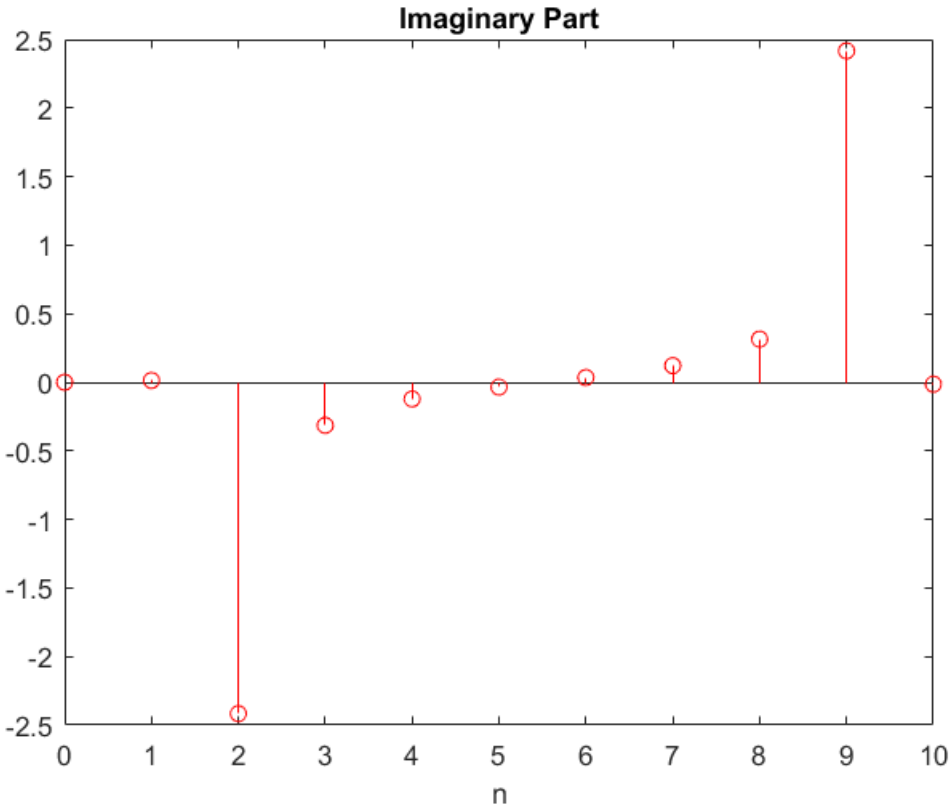
LSS Lab 9 - Section C2 7/3/2017

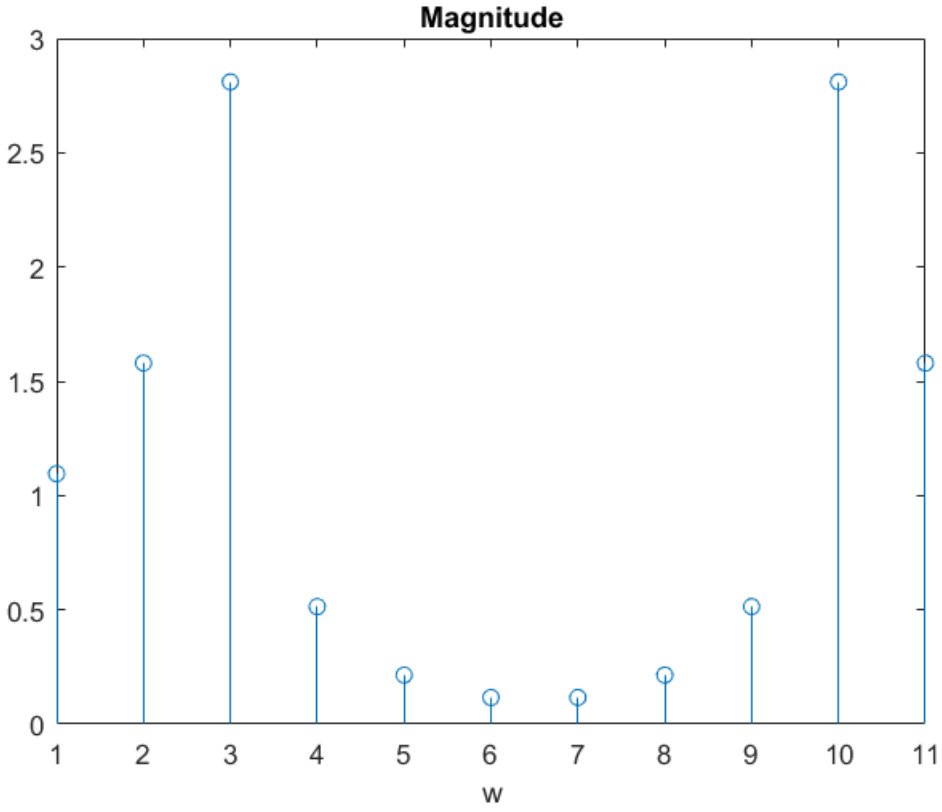
```
close all; clc; clear;
```

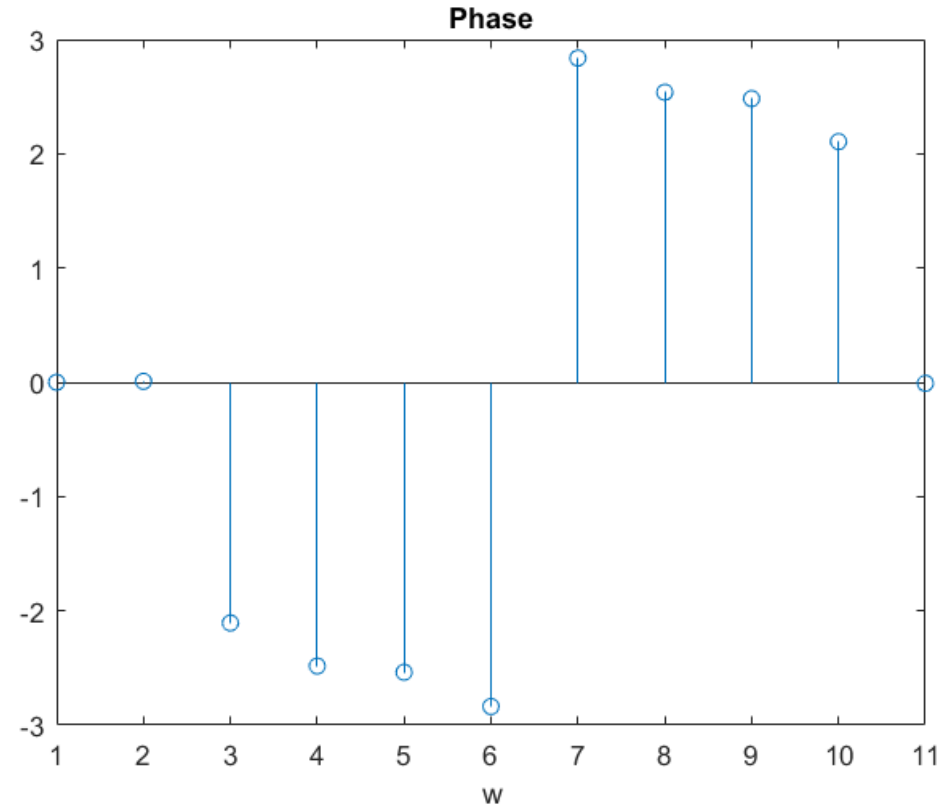
Problem 1

```
n = 0:10;
x = 0.9.^n.*sin(n);
xdft = fft(x);

% Real
figure;
stem(n,real(xdft),'b'); title('Real Part');
xlabel('n');

% Imaginary
figure;
stem(n,imag(xdft),'r'); title('Imaginary Part');
xlim([0 10])
xlabel('n');

% Magnitude
m = abs(xdft);
figure;
stem(m);
title('Magnitude');
xlabel('w');

% Phase
p = angle(xdft);
figure;
stem(p)
title('Phase');
xlabel('w');
```


Real Part
2
1.5
1
0.5
0
-0.5
-1
-1.5
0
1
2
3
4
5
6
7
8
9
10
n

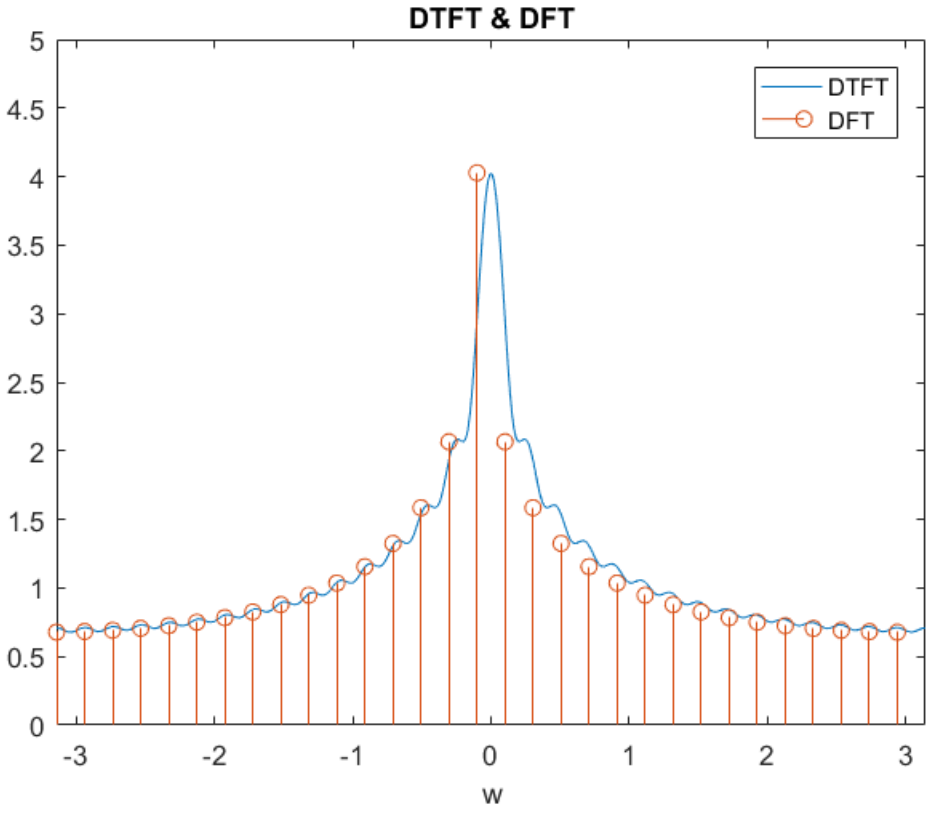

Imaginary Part
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
0
1
2
3
4
5
6
7
8
9
10
n


Magnitude
3
2.5
2
1.5
1
0.5
0
1
2
3
4
5
6
7
8
9
10
11
w


Phase
3
2
1
0
-1
-2
-3
1
2
3
4
5
6
7
8
9
10
11
w

Problem 2

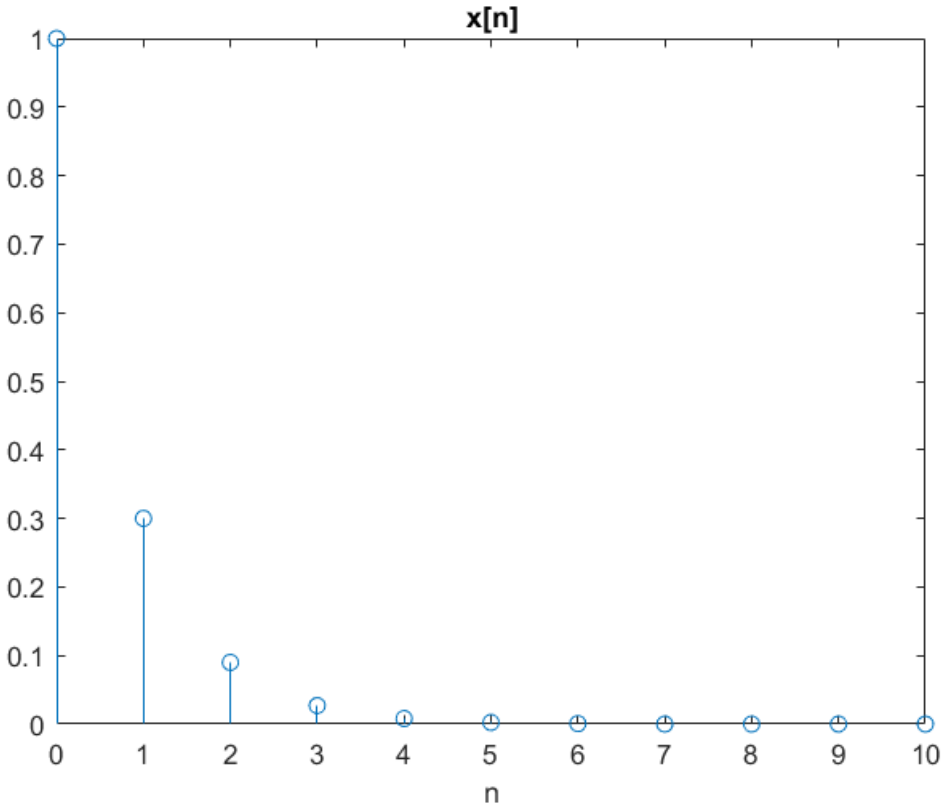
```
syms w

n = 0:30;
x = 1./(n+1);
xdtft=sum(x.*exp(-j*w*n));
xdft = fft(x);

N = 31; k=-N/2:N/2-1;
wk = 2*pi*k/N;
xshift = fftshift(xdft);

figure;
ezplot(abs(xdtft),[-pi,pi]);
hold on;
stem(wk,abs(xshift))
title('DTFT & DFT'); legend('DTFT','DFT');
xlabel('w');
ylim([0 5])
hold off;
```

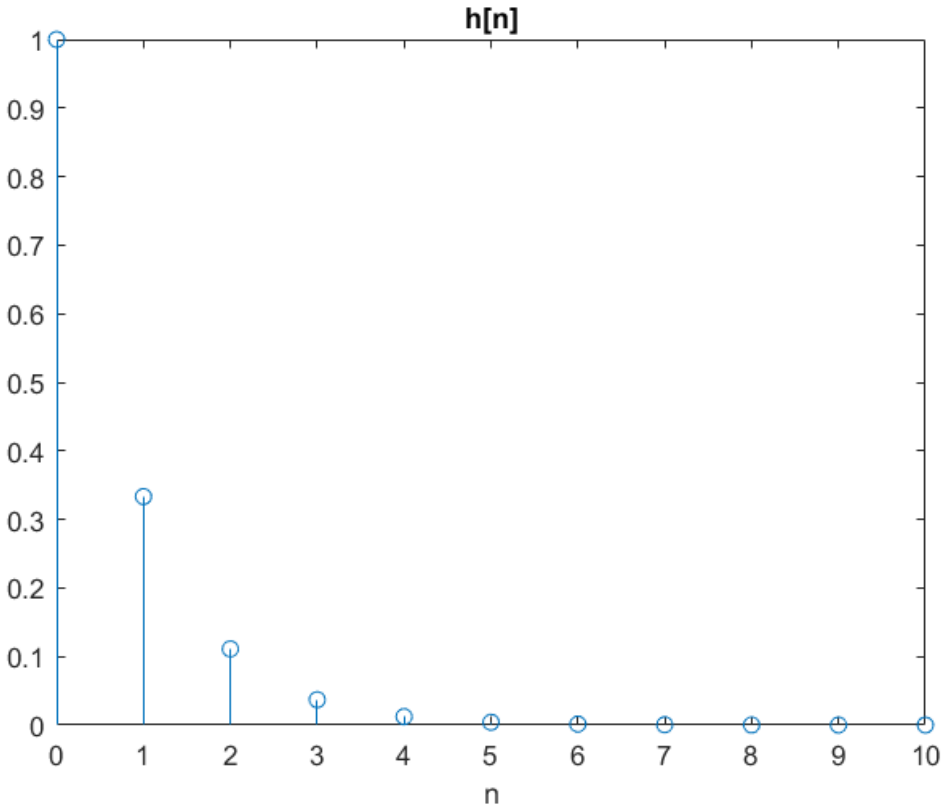


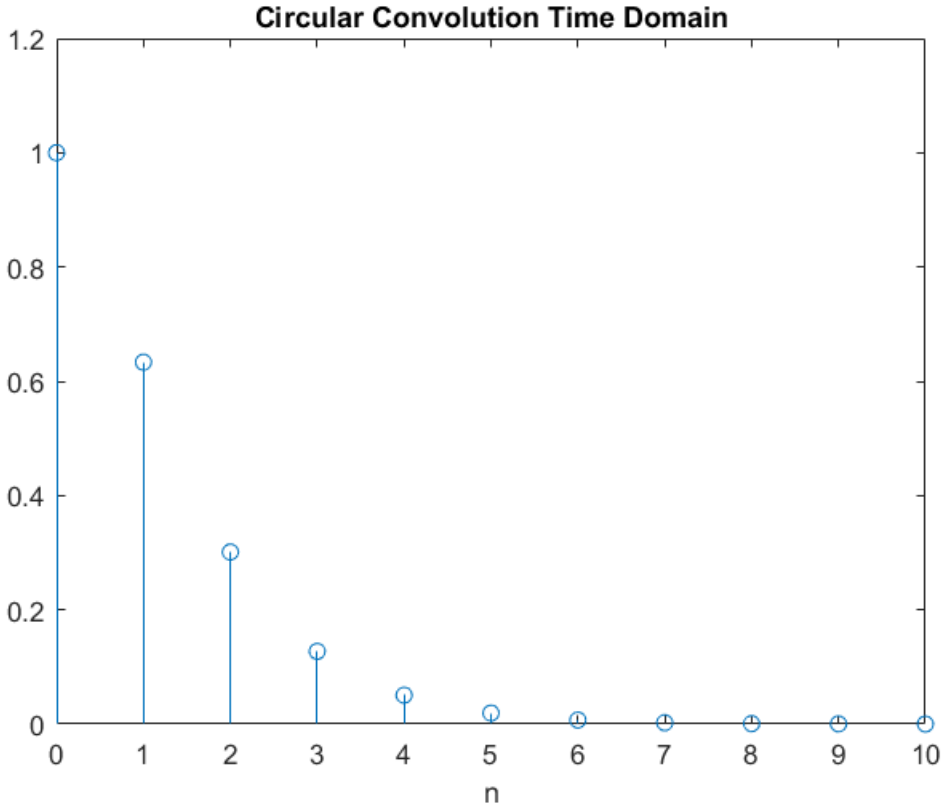
Problem 3

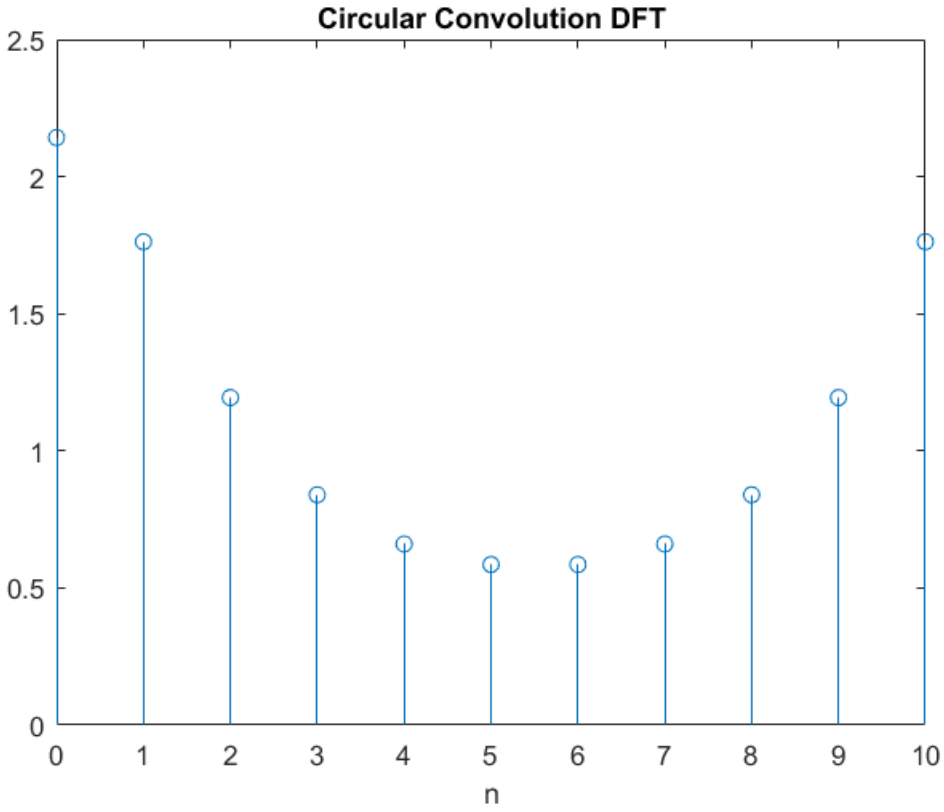
```
n1 = 0:6; n2 = 0:10;
```

```
N1 = length(n1); N2 = length(n2); N = N2;

x = 0.3.^n1;
x = [x 0 0 0 0];
% Pad with zeros to equate N length
h = 3.^(-n2);

figure;
stem(n2,x)
title('x[n]')
xlabel('n');

figure;
stem(n2,h)
title('h[n]')
xlabel('n');

clear hs
for m = 0:N-1
    hs(m+1)=h(1+mod(-m,N));
end
for n = 0:N-1
    hsn=circshift(hs',n);
    y(n+1)=x*hsn;
end
figure;
stem(n2,y)
title('Circular Convolution Time Domain');
xlabel('n');

% DFT
ydft = fft(y);
figure;
stem(n2,abs(ydft));
title('Circular Convolution DFT');
xlabel('n');
```


x[n]
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0 1 2 3 4 5 6 7 8 9 10
n

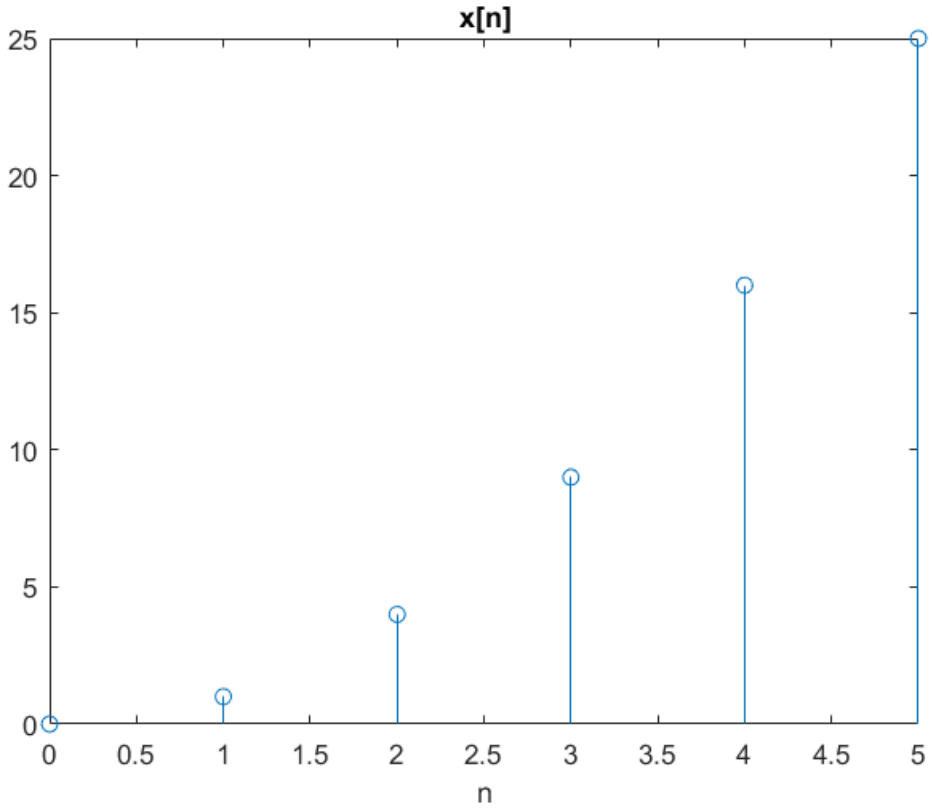

h[n]
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0 1 2 3 4 5 6 7 8 9 10
n

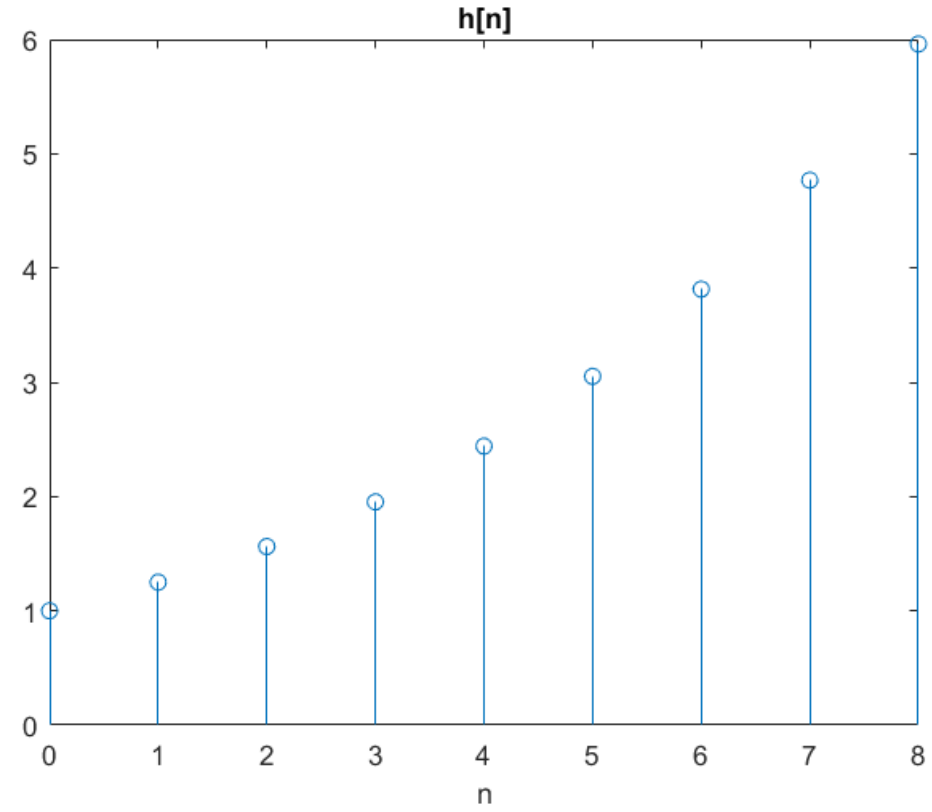

Circular Convolution Time Domain
1.2
1
0.8
0.6
0.4
0.2
0
0
1
2
3
4
5
6
7
8
9
10
n

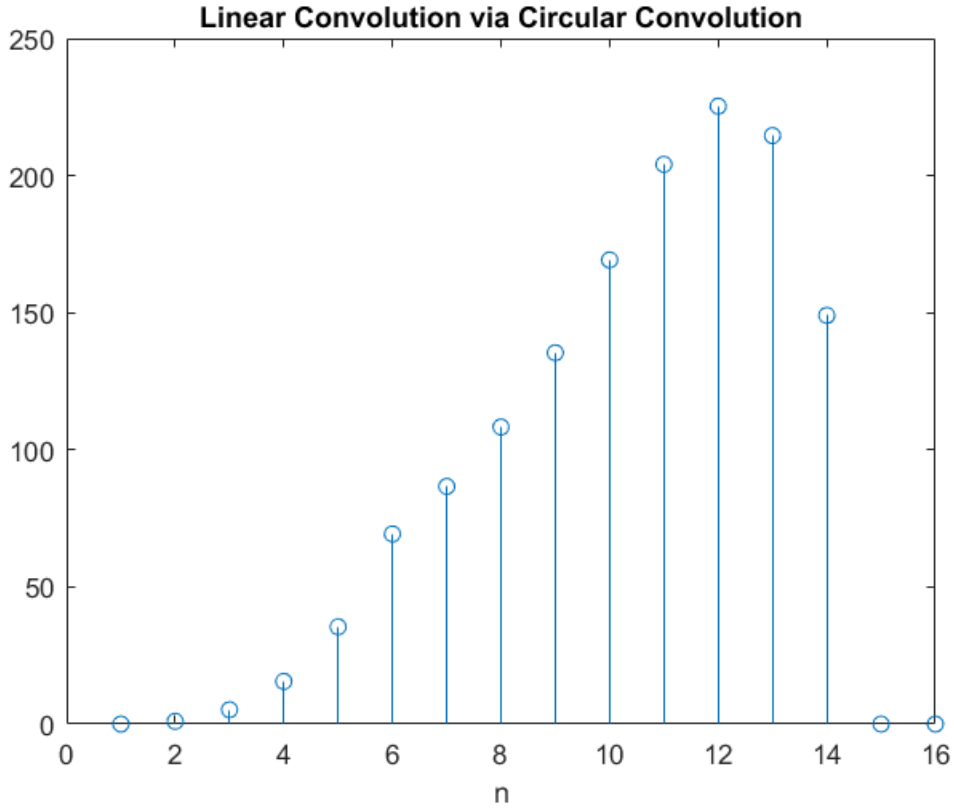

Circular Convolution DFT
2.5
2
1.5
1
0.5
0
0
1
2
3
4
5
6
7
8
9
10
n

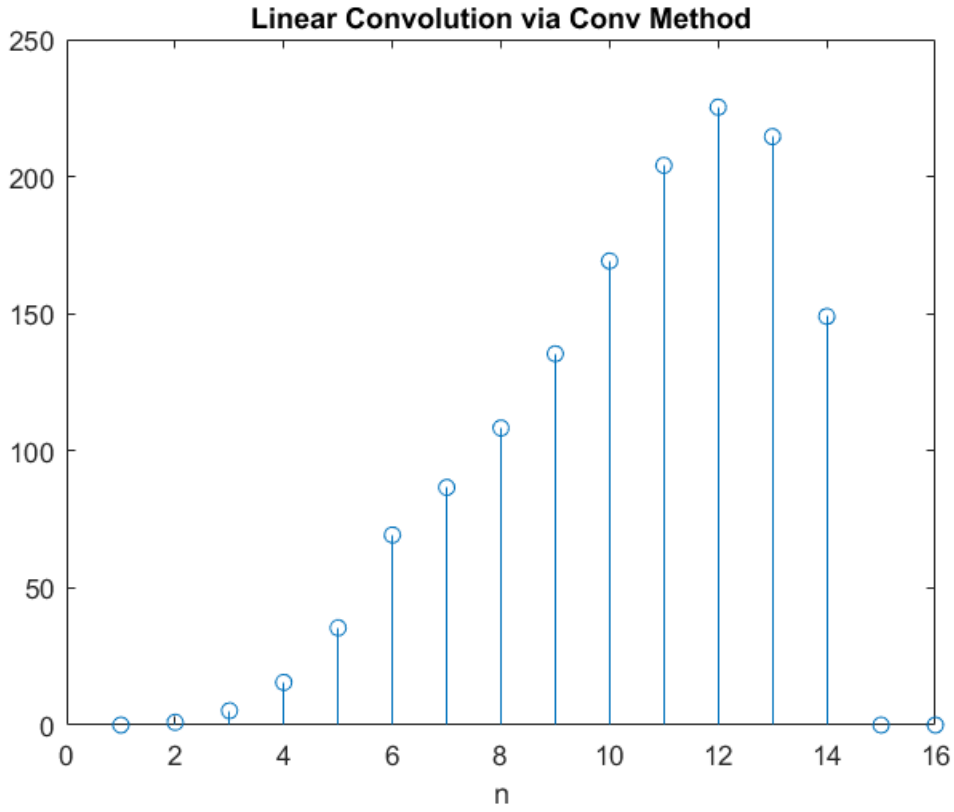
Problem 4

```
n1 = 0:5; n2 = 0:8;
N1 = length(n1); N2 = length(n2);

x1 = n1.^2;
h1 = .8.^(-n2);

figure;
stem(n1,x1)
title('x[n]')
xlabel('n');
figure;
stem(n2,h1)
title('h[n]')
xlabel('n');

z = [0 0 0 0 0 0 0];
% Pad zeros for 2N-1 length
x = [x1 0 0 0 z];
% Pad to equate x with h length
h = [h1 z];
N = length(x);

clear hs
for m = 0:N-1
    hs(m+1)=h(1+mod(-m,N));
end
for n = 0:N-1
    hsn=circshift(hs',n);
    y(n+1)=x*hsn;
end

figure;
stem(y)
title('Linear Convolution via Circular Convolution');
xlabel('n');

% conv method
y1 = conv(x1,h1);
y1 = [y1 0 0];
% add padding for better graph comparison
figure;
stem(y1)
title('Linear Convolution via Conv Method');
xlabel('n');
```


x[n]
25
20
15
10
5
0
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
n


h[n]
6
5
4
3
2
1
0
0
1
2
3
4
5
6
7
8
n


Linear Convolution via Circular Convolution
250
200
150
100
50
0
0
2
4
6
8
10
12
14
16
n


Linear Convolution via Conv Method
250
200
150
100
50
0
0
2
4
6
8
10
12
14
16
n

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